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GOVERNOR

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DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
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OFC. OF ENVIRONMENTAL QUALITY CONTROL

February 6, 1995

Mr. Gary Gill, Director
Office of Environmental Quality
Control
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Mr. Gill:

Subject: LUC Docket No. A94-703/The Lihue Plantation Co, Ltd.: Final Environmental Impact Statement (FEIS)

At its meeting on February 2, 1995, the Land Use Commission accepted the FEIS prepared for the subject docket. The Commission's Decision and Order on this matter will be sent to you at a later date under separate cover.

Should you have any questions, please feel free to call me or Bert Saruwatari of our office at 587-3822.

Sincerely,

Esther Ueda

ESTHER UEDA
Executive Officer

EU:th

cc: Ben Kudo, Esq.
Amfac/JMB Hawaii
Attn: Timothy Johns
PBR Hawaii
Attn: Yukie Ohashi

1995 FEIS KAUAI
LIHUE-HANAMAULU MASTER PLAN

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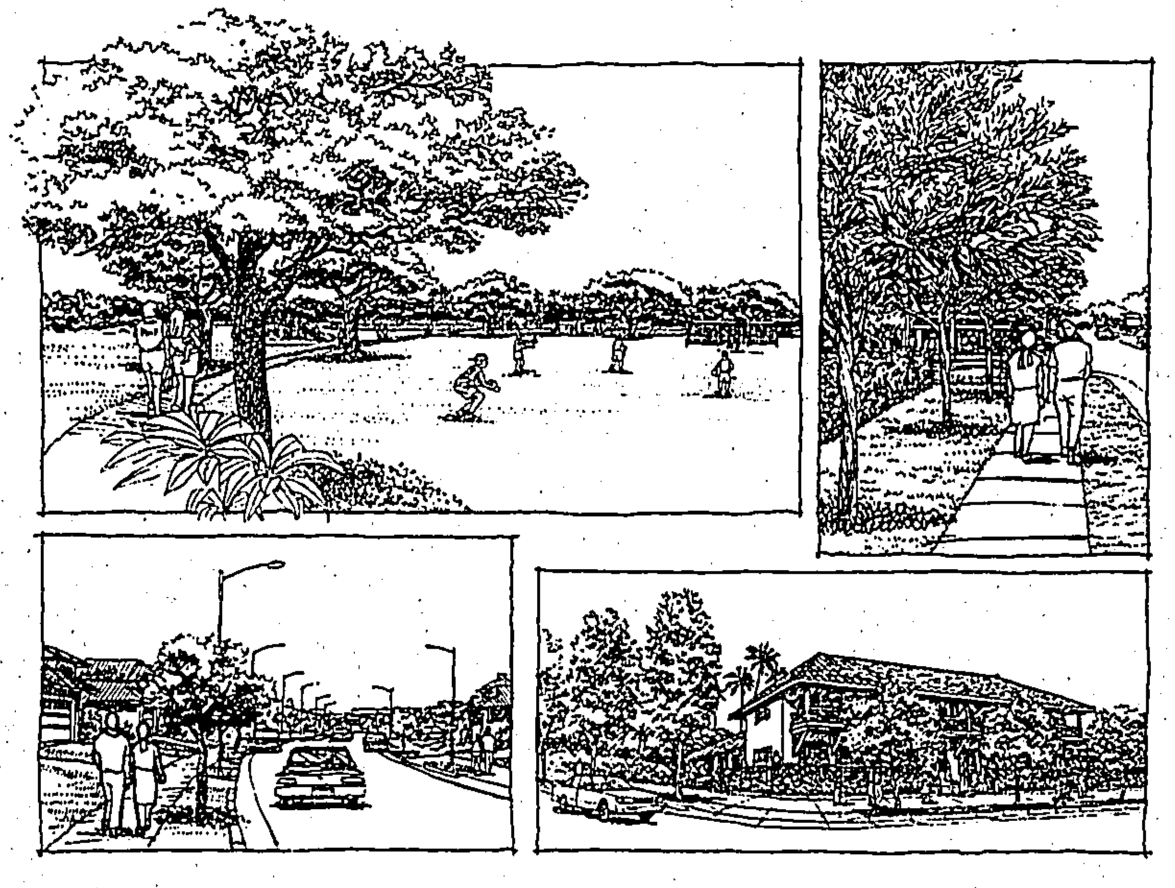
FINAL
ENVIRONMENTAL IMPACT STATEMENT

LIHUE-HANAMAULU MASTER PLAN



Amfac/JMB Hawaii, Inc. and The Lihue Plantation Company, Limited

JANUARY 1995

FINAL
ENVIRONMENTAL IMPACT STATEMENT

LIHUE-HANAMAULU MASTER PLAN

This Environmental Document Is Submitted
Pursuant to Chapter 343, HRS

PREPARED FOR:
THE LIHUE PLANTATION COMPANY, LIMITED
AND
AMFAC/JMB HAWAII, INC.

FOR SUBMISSION TO:
STATE OF HAWAII
LAND USE COMMISSION

SUBMITTED BY:

W. Frank Brandt

WM. FRANK BRANDT, PRESIDENT
PBR HAWAII
HONOLULU, HAWAII

January 1995

FINAL
ENVIRONMENTAL IMPACT STATEMENT

LIHUE-HANAMAULU MASTER PLAN

Applicant:

THE LIHUE PLANTATION COMPANY, LIMITED
AND
AMFAC/JMB HAWAII, INC.

EIS Preparer:

PBR HAWAII

January 1995

TABLE OF CONTENTS

PAGE

Table of Contents i
List of Figures v
List of Appendices vi
Executive Summary viii

1.0 INTRODUCTION 1-1
1.1 Project Summary 1-1
1.2 Status of the Chapter 343 Process, State Land Use Petition Review and County General Plan Amendment Process 1-3
1.3 Location 1-4
1.4 Ownership and Present Uses of the Property 1-4
1.5 Description of the Property 1-4
1.6 Surrounding Land Uses 1-5
1.7 Purpose and Content of the Draft EIS 1-11

2.0 DESCRIPTION OF THE PROJECT 2-1
2.1 Introduction and Background 2-1
2.2 Goals and Objectives of the Lihue-Hanamaulu Master Plan 2-2
2.3 Key Elements of the Master Plan 2-5
2.3.1 Public Facilities and Services 2-6
2.3.1.1 Veterans Center 2-6
2.3.1.2 State Judiciary Complex 2-6
2.3.1.3 Police Station 2-7
2.3.1.4 YMCA/Teen Center 2-7
2.3.1.5 Elementary School 2-7
2.3.1.6 Parks 2-7
2.3.2 Village Mixed Uses - Commercial Development 2-8
2.3.2.1 Retail 2-8
2.3.2.2 Office 2-8
2.3.3 Residential Development 2-8
2.3.4 Industrial Development 2-9
2.3.4.1 Industrial Uses 2-9
2.3.4.2 Lihue Debris Recycling Station 2-9
2.3.4.3 Kauai Tropical Fruit Disinfestation Facility 2-10
2.3.5 Kauai Gateway 2-10
2.3.6 Infrastructure Development 2-10
2.3.6.1 Wastewater Treatment System 2-10
2.3.6.2 Water Source Development 2-11
2.3.6.3 Drainage Facilities 2-12
2.3.6.4 Traffic and Roadways 2-12

PAGE

2.3.6.5 Solid Waste 2-13
2.3.6.6 Other Utilities 2-14
2.4 Construction Activities 2-14
2.5 Market Demand 2-14
2.5.1 Residential 2-14
2.5.1.1 Single Family Residential 2-15
2.5.1.2 Multi-Family 2-15
2.5.2 Commercial 2-16
2.5.2.1 Retail 2-16
2.5.2.2 Office 2-16
2.5.3 Industrial 2-16
2.6 Development Timetable 2-17
2.7 Approximate Infrastructure Costs 2-18

3.0 REQUIRED APPROVALS AND PERMITS FOR THE LIHUE-HANAMAULU MASTER PLAN 3-1
3.1 State of Hawaii 3-1
3.1.1 State Land Use District Boundary Amendment 3-1
3.2 County of Kauai 3-4
3.2.1 General Plan Amendment 3-4
3.2.2 Change of Zone 3-4
3.2.3 Special Management Area Use Permit (SMP) 3-8
3.2.4 Use Permits 3-8
3.3 Other Required Permits 3-8

4.0 ASSESSMENT OF THE EXISTING NATURAL ENVIRONMENT, POTENTIAL IMPACTS AND MITIGATIVE MEASURES 4-1
4.1 Climate 4-1
4.2 Physical Characteristics 4-2
4.3 Soils 4-3
4.4 Agricultural Impact 4-9
4.5 Groundwater Resources 4-11
4.6 Marine Resources 4-12
4.7 Hanamaulu Stream Resources 4-19
4.8 Natural Hazards 4-22
4.9 Vegetation 4-24
4.10 Wildlife 4-27

5.0 ASSESSMENT OF EXISTING HUMAN ENVIRONMENT, POTENTIAL IMPACTS AND MITIGATIVE MEASURES 5-1
5.1 Archaeological and Historic Resources 5-1
5.2 Roadways and Traffic 5-3

			PAGE
	5.3	Noise	5-8
	5.4	Air Quality	5-16
	5.5	Visual Resources	5-18
	5.6	Social Characteristics	5-24
		5.6.1 Population	5-24
		5.6.2 Housing	5-26
		5.6.3 Lifestyle/Character of the Community	5-28
	5.7	Economic Characteristics	5-29
		5.7.1 Employment, Personal Income and Consumer Expenditures	5-29
		5.7.2 Economic Factors/Government Revenues	5-31
	5.8	Infrastructure	5-33
		5.8.1 Water Supply Facilities	5-33
		5.8.2 Water Source Development	5-35
		5.8.3 Wastewater Facilities	5-38
		5.8.4 Solid Waste Disposal Facilities	5-43
		5.8.5 Drainage Facilities	5-44
		5.8.6 Electrical Supply	5-48
	5.9	Public Services	5-49
		5.9.1 Schools	5-49
		5.9.2 Police Protection	5-52
		5.9.3 Fire Protection	5-53
		5.9.4 Health Care/Hospitals	5-54
		5.9.5 Recreational Facilities	5-54
6.0	CONTEXTUAL ISSUES		6-1
	6.1	Cumulative and Secondary Environmental Impacts	6-1
	6.2	Cumulative and Secondary Impacts on Public Services and Facilities	6-1
	6.3	Relationship Between Short Term Issues and Maintenance of Long Term Productivity	6-3
	6.4	Irreversible and Irretrievable Commitments of Resources	6-4
	6.5	Probable Adverse Environmental Effects Which Cannot Be Avoided and Unresolved Issues	6-4
7.0	CONFORMANCE WITH APPLICABLE STATE AND COUNTY POLICIES AND PLANS		7-1
	7.1	OSP Five Year Boundary Review	7-1
	7.2	Hawaii State Plan	7-1
	7.3	State Functional Plans	7-9
	7.4	State Model Energy Code	7-13
	7.5	Chapter 205, HRS - Land Use Commission	7-14
	7.6	Environmental Impact Statements (Chapter 343, HRS)	7-17
	7.7	General Plan for County of Kauai	7-17
	7.8	Lihue Development Plan	7-19

		PAGE
7.9	Comprehensive Zoning Ordinance	7-19
7.10	Hawaii Coastal Zone Management Program	7-19
7.11	Conclusions	7-22
8.0	ALTERNATIVES TO THE PROPOSED ACTION	8-1
8.1	The Preferred Alternative	8-1
8.2	"No-Action Alternative"	8-2
8.3	Residential Land Use/Golf Course	8-2
8.4	Agricultural Subdivision	8-3
8.5	Summary of Major Impacts	8-3
9.0	SUMMARY OF UNRESOLVED ISSUES	9-1
9.1	Overview	9-1
9.2	Conclusion	9-3
10.0	REFERENCES AND LIST OF PREPARERS	10-1
10.1	References	10-1
10.2	List of Preparers of the EIS	10-2
11.0	CONSULTED PARTIES AND PARTICIPANTS IN THE DRAFT EIS PROCESS	11-1
11.1	List of Agencies/Individuals Contacted in Preparation of the EIS	11-1
11.2	Consulted Parties	11-2
12.0	COMMENTS AND RESPONSES	
12.1	Comments Received on the Environmental Assessment/Notice of Preparation of Draft EIS	
12.2	Comments Received on the Draft EIS	
12.2	Comment Letters and the Applicants Responses	

LIST OF FIGURES

		PAGE
1-1	Location/Project Boundary Map	1-5
1-2	Tax Map Key - Key Map	1-6
1-2A	Tax Map Key - Ahukini Makai/Ahukini Mauka (Portion)	1-7
1-2B	Tax Map Key - Molokoa	1-8
1-2C	Tax Map Key - Ahukini Mauka	1-9
1-2D	Tax Map Key - Hanamaulu	1-10
2-1	Conceptual Master Plan	2-3
3-1	Existing State Land Use District Boundaries	3-2
3-2	State Land Use District Boundary Petition Areas	3-3
3-3	Existing Lihue General Plan Map (Portion)	3-5
3-4	General Plan Application Area	3-6
3-5	Proposed General Plan Amendment	3-7
4-1	Detailed Land Classification	4-4
4-2	SCS Soil Survey	4-6
4-3	Agricultural Lands of Importance to the State of Hawaii	4-7
4-4	Hanamaulu Bay Marine Survey/Water Quality Sampling Stations	4-14
4-5	North Drains/Water Quality Sampling Stations	4-16
4-6	Nawiliwili Stream/Water Quality Sampling Stations	4-17
4-7	Flood Insurance Rate Map	4-23
4-8	Civil Defense Siren Locations	4-25
5-1	Roadways in the Traffic Study Area	5-4
5-2	Noise Measurement Locations	5-9
5-3	1994 Aircraft Noise Contours	5-12
5-4	2010 Aircraft Noise Contours	5-13
5-5	Site Photographs Key Map	5-19
5-5A	Site Photographs	5-20
5-5B	Site Photographs	5-21
5-5C	Site Photographs	5-22
5-5D	Site Photographs	5-23
5-7	Character Sketches	5-30
5-8	Proposed Water Source and Storage Facilities	5-34
5-9	UIC Line	5-37
5-10	Alternative WWTP Site and Collection System (Conceptual)	5-40
5-11	Conceptual Storm Drainage Plan	5-47
5-12	Existing and Planned Schools	5-50
7-1	Development Plan - Project District 1	7-20

LIST OF APPENDICES

A Lihue-Hanamaulu Infrastructure Report - Wastewater System
Austin, Tsutsumi & Associates, Inc., January 1995

B Lihue-Hanamaulu Master Planned Community
Preliminary Engineering Report for Water Requirements
Kodani and Associates, Inc., September 1994

C Molokoa Hydrologic Study, Lihue, Kauai
Water Resource Associates, September 1994

D Lihue-Hanamaulu Master Planned Community
Preliminary Engineering Report for Drainage Requirements
Kodani and Associates, Inc., January 1995

E Traffic Impact Report for the Proposed Lihue-Hanamaulu Master Plan Development
Austin, Tsutsumi & Associates, Inc., January 1995

E-1 Lihue-Hanamaulu Infrastructure Report
Interior Roadway Network
Austin, Tsutsumi & Associates, Inc., January 1995

F Market Analysis of the Lihue-Hanamaulu Master Plan at Molokoa, Ahukini and Hanamaulu, Kauai, September, 1994
Arthur Andersen & Co., October 1994

G Agricultural Assessment of the Lands in the Proposed Lihue-Hanamaulu Master Plan
Evaluation Research Consultants, August 1994

H A Quantitative Assessment of the Marine Communities and Water Quality in Hanamaulu Bay, Kauai
Richard E. Brock, Environmental Assessment Co., December 1994

H-1 Report Addendum 1: Marine Communities and Water Quality in the Vicinity of Three Existing Ocean Discharges
Richard E. Brock, Environmental Assessment Co., December 1994

I Hanamaulu Stream Biological Survey, Kauai, Hawaii
BHP Environmental Technologies International, July 1994

I-1 Letter Report Regarding Stormwater Discharges to Hanamaulu Stream
Pacific Aquatic Environmental, December 29, 1994

J Botanical Survey Lihu'e-Hanama'ulu Master Plan
Char & Associates, June 1994

K Avifaunal and Feral Mammal Survey of Molokoa Lands for Amfac's Lihue - Hanamaulu Master Plan, Kauai
Phillip L. Bruner, August 1994

L Recommended Mitigative Measures to Reduce Bird Attractants Associated with the Proposed Lihue Debris Recycling Station and the Tropical Fruit Disinfestation Facility
Pacific Aquatic Environmental, September 1994

M Additional Archaeological Inventory Survey Molokoa Lands Project Area
Paul H. Rosendahl, Ph.D, Inc., June 1994

N Acoustic Study for the Lihue-Hanamaulu Master Plan, Lihue, Kauai, Hawaii
Y. Ebisu & Associates, September 1994

O Air Quality Impact Analysis
Ogden Environmental and Energy Services, September 1994

P Lihue-Hanamaulu Master Plan Social Impact Assessment
Earthplan, September 1994

Q Economic & Fiscal Analysis of the Lihue-Hanamaulu Master Plan at Molokoa, Ahukini and Hanamaulu, Kauai
Arthur Andersen & Co., October 1994

EXECUTIVE SUMMARY

PURPOSE

This Final Environmental Impact Statement ("EIS") has been prepared in support of the proposed Lihue-Hanamaulu Master Plan, a 555-acre master planned community at Lihue, Kauai. The project area includes lands owned by The Lihue Plantation Company ("LPCo") and Amfac Property Development Corporation. A small portion of lands owned by Okada Trucking Co, Ltd. is also included. Amfac/JMB Hawaii, Inc. is the Master Developer.

This document presents the Lihue-Hanamaulu Master Plan and describes the improvements proposed by the urban mixed use development at Lihue, Kauai. It also describes the existing natural and human environment of the project site and surrounding area; the potential impacts that might result from the proposed project and mitigation measures to minimize potential adverse impacts.

The geographic areas of the project Master Plan are referred to as Molokoa, Ahukini Mauka, and Ahukini Makai which are adjacent to Lihue Town, Lihue Airport and Hanamaulu Stream gulch; and Hanamaulu which is adjacent to the existing town of Hanamaulu. A village mixed use concept that will "in-fill" a major portion of the existing Lihue Town, includes a mix of commercial retail and office uses, public service facilities, open spaces for park/plaza/village green, all within walking distance of one another and from residential areas adjoining the village core.

In support of the development, infrastructure facilities that will be constructed include access and circulation roadways; bike routes and pedestrian paths, a wastewater treatment and disposal system; a drainage system, a potable water supply system, including fire protection and other utilities systems.

PROPOSED ACTION

The developer requests a State Land Use District Boundary Amendment ("LUDBA") to reclassify 554.642 acres ("555 acres") to the State Urban District (from Agricultural - 541.769 acres and Conservation - 12.873 acres) and a General Plan ("GP") Amendment to designate 441 acres to Urban Mixed Use (UMU) (from Agricultural (A) - 409 acres - and Public Facility (PF) - 32 acres).

SIGNIFICANT BENEFICIAL AND ADVERSE IMPACTS

With the establishment of the proposed Lihue-Hanamaulu Master Plan, it is anticipated that the proposed improvements will impact the physical resources of the Project Area and adjoining areas in a more beneficial manner. Many of the environmental impacts presently associated with agricultural use of the property will be largely mitigated by the proposed improvements. Proposed facility improvements call for installation of new water, wastewater, drainage, transportation, and electrical/communication infrastructure. New public facility areas may include, but are not limited to a Veterans Center, State Judiciary complex, police headquarters, YMCA/teen center, elementary school, debris recycling station, fruit disinfestation facility and parks.

The need for development of the Lihue-Hanamaulu Master Plan is evidenced by the projected population growth for Kauai and the present overcrowded condition of existing housing. New development of approximately 1,400 to 1,800 residential units, commercial retail and office development, industrial development, and public/quasi-public facilities land uses are envisioned by the Master Plan.

Potential environmental impacts may occur primarily during construction related to noise, soil erosion, increased construction machinery exhaust emissions, and temporary disruption of traffic.

No significant impacts are anticipated regarding the water quality and drainage, flora and fauna, and archaeological resources. For example, there will be long-term beneficial effects to water quality with a reduction by 80 percent of current sediment loss. However, there may be impacts associated with traffic but these will be mitigated with the project related improvements and the base improvements which are planned by the governmental agencies.

Visual changes will occur as a result of the project by replacing the existing agricultural landscape by urban landforms.

PROPOSED MITIGATIVE MEASURES

If implemented with appropriate mitigative measures, project development will maintain existing environmental resources. The design of all major infrastructure and public facility improvements will incorporate methods to ensure that the environmental resources of the region will not be damaged.

Drainage/Flood Control/Water Quality/Soil Erosion - Flood control is addressed through improvements which will utilize a combination park/detention basin concept. To protect water quality and mitigate potential soil erosion, measures will be implemented, such as the grassing of graded areas, watering to reduce fugitive dust emissions, and use of on-site retention basins during and after construction. Implementation of the recommended soil erosion control measures and grading plan will require careful attention to establish new plant materials and ground cover.

Flora and Fauna - No endangered flora and fauna exist on the project area and no mitigative measures are planned. However, the proposed urban landscaping will increase the diversity of both plant and animal communities. Adjacent to the Project Area is the Hanamaulu Stream gulch which provides habitat for native waterbirds. Conservation measures are planned to be implemented to promote stewardship of the resources.

Archaeological Resources - No known archaeological resources requiring preservation exist on the subject property.

Noise - The project is not expected to generate any significant long-term noise that cannot be mitigated. During construction, equipment will be used in accordance with accepted standards and during daylight hours to mitigate potential noise impacts. Aircraft noise from Lihue Airport will be mitigated by locating noise compatible land uses within contours of 60 Ldn or higher.

Air Quality - The primary air quality impact(s) will result from use of construction equipment, fugitive dust, and emissions from vehicular traffic. However, since development is planned over a 15 - 20 year period, impacts from construction equipment and fugitive dust will occur only on a short-term basis within development areas which will average 27 to 36 acres. Because the length of the development period limits the land area exposed to wind erosion during any one year, fugitive dust emissions should be reduced. Watering during construction will largely mitigate dust emissions. Emissions from vehicular traffic may be mitigated by the development of transportation improvements at busy intersections.

Traffic - Roadway improvements are proposed throughout the project area. State and County off-site improvements are also planned to mitigate traffic on a regional basis. With implementation of the proposed transportation improvements, all of the major intersections planned for the project will operate under capacity.

Agriculture - Sugar cane acreage currently under active cultivation in the Project Area will be moved to replacement lands at Kealia, thereby maintaining overall levels of sugar cane production. New opportunities for diversified agriculture will also be enhanced with development of the University of Hawaii's proposed Tropical Fruit Disinfestation Facility which will open up new markets for Kauai's agricultural products.

Visual - Design guidelines will be implemented prior to development to ensure that architectural and landscape design features are compatible and integrated in a cohesive manner. The Kauai Gateway will make a distinctive entry statement at the first major cross-roads into Lihue and the Lihue-Hanamaulu Master Plan area.

Public Services and Utilities - All new infrastructure will be developed in accordance with project requirements. Treated wastewater effluent disposal will be integrated as irrigation water for mauka sugar cane lands and other appropriate landscaped areas. Electrical and communications improvements necessary to support the requirements of this project will be served from existing and proposed utility systems. Existing overhead utility distribution lines will be placed underground within the Project Area.

ALTERNATIVES CONSIDERED

In compliance with the provisions of Title 11, Department of Health, Chapter 200, Environmental Impact Statement Rules, Section 11-200-17(f), the "known feasible" alternatives to the proposed project are limited to those that would allow the objectives of the project to be met, while minimizing potential adverse environmental impacts.

COMPATIBILITY WITH LAND USE PLANS AND POLICIES

Implementation of the proposed master plan, would be generally consistent with applicable provisions of the Office of State Planning 5-year Boundary Review, Hawaii State Plan and various functional plans, policies of the County of Kauai General Plan (a land use map amendment is required), and the Lihue Development Plan. A Change of Zone will be required. The site is currently designated by the State Land Use Commission as both "Agriculture" and "Conservation", and classified by the County of Kauai as Agricultural and Open. Only a small portion of the Conservation District area is located within the County of Kauai's Special Management Area.

1.0

INTRODUCTION

1.0 INTRODUCTION

The Lihue Plantation Company, Limited, ("LPCo" or "Lihue Plantation"), through its parent company, Amfac/JMB Hawaii, Inc. ("Amfac/JMB"), has applied to the State Land Use Commission (the "Accepting Agency") for a reclassification of Agricultural and Conservation District lands to the State Urban District and to the Kauai County Planning Department for a General Plan Amendment to permit the development of the land uses proposed in the Lihue-Hanamaulu Master Plan. The Master Plan provides for a range of residential and village mixed uses on 555 acres of land located at Lihue and Hanamaulu, Kauai.

According to the Office of State Planning Urban Land Requirements Study (Wilson Okamoto and Associates, 1991) prepared in support of the five-year boundary review, Kauai will have a deficit of approximately 1,100 acres of urban land in the year 2000. The proposed Lihue-Hanamaulu Master Plan addresses this need, by providing for single-family and multi-family residential uses, public and quasi-public facilities, village mixed-use, industrial development, parks, infrastructure and open space.

The village concept envisions the employment center, shopping areas, cultural and recreational facilities and public service centers within short distances from nearby residential areas forming the core of the town. Supporting infrastructure development includes a wastewater treatment system, access and internal roadways, drainage improvements, water source development and water and utility transmission lines. The State Land Use and General Plan applications are requesting the reclassification of land designations to allow this development.

1.1 PROJECT SUMMARY

Applicant/Landowner:

The Lihue Plantation Company, Limited
2970 Kele Street
Lihue, Kauai, Hawaii 96766

Amfac Property Development Corp.
700 Bishop Street, 21st Floor
Honolulu, Hawaii 96813

Landowner:

Okada Trucking Co., Ltd.
2065 South King Street, Rm. 105
Honolulu, Hawaii 96826-2286

Master Developer:	Amfac/JMB Hawaii, Inc. 700 Bishop Street, 21st Floor Honolulu, Hawaii 96813 Timothy E. Johns, Vice President Telephone: (808) 543-8900
Planning Consultant and EIS Preparer:	PBR Hawaii Pacific Tower, Suite 650 1001 Bishop Street Honolulu, Hawaii 96813 Thomas S. Witten, Executive Vice President Yukie Y. Ohashi, Project Planner Telephone: (808) 521-5631
EIS Accepting Authority:	State Land Use Commission 335 Merchant Street, Room 104 Honolulu, Hawaii 96813 Esther Ueda, Executive Officer Telephone: (808) 587-3822
Proposed Action:	Applicant requests a State Land Use District Boundary Amendment ("LUDBA") to reclassify 554.642 acres ("555 acres") to the State Urban District (from Agricultural - 541.769 acres and Conservation - 12.873 acres) and a General Plan ("GP") Amendment to designate 441 acres to Urban Mixed Use (UMU) (from Agricultural (A) - 409 acres - and Public Facility (PF) - 32 acres) to allow the development of 1,400 to 1,800 residential units, commercial retail and office development, industrial development, and public/quasi-public facilities (which may include, but are not limited to a Veterans Center, judiciary complex, police headquarters, YMCA/teen center, elementary school, debris recycling station, fruit disinfestation center and parks). The LUDBA area and GP area are not coterminous.
Project Name:	Lihue-Hanamaulu Master Plan
Project Location:	The property is located in Kalapaki and Hanamaulu, in the Lihue Judicial District, Kauai, Hawaii

Tax Map Keys:	Tax Map Key designations for the total 555-acre Master Plan area (LUDBA and GP areas) include the following parcels: TMK 3-6-2: 01, 4 & 20 (portions) TMK 3-6-2: 17 TMK 3-7-1: 01 (portion) TMK 3-7-2: 01 & 12 (portions) TMK 3-7-3: 20 (portion)
Total Project Area:	554.642 acres ("555 acres")
Existing Use:	Current use includes sugar cane cultivation by LPCo; other uses include a tour helicopter office; a transformer site for Kauai Electric Company; and a Veteran's Center.
State Land Use District:	Agricultural District (541.769 acres) Conservation District (12.873 acres)
General Plan:	Agricultural (409 acres) Public Facility (32 acres)
Zoning:	Agriculture

1.2 STATUS OF THE CHAPTER 343 PROCESS, STATE LUC PETITION REVIEW AND COUNTY GENERAL PLAN AMENDMENT PROCESS

The Environmental Assessment and a Notice of Preparation ("NOP") for an EIS for the project was published in the June 23, 1994 issue of the OEQC Bulletin. A Draft EIS was subsequently prepared, filed and published on October 23, 1994.

Two hearings before the County of Kauai Planning Commission have been held on July 28, 1994 and October 27, 1994 to review the project and the Draft EIS. Pending is a decision on the General Plan Amendment request which will follow the acceptance of the Final EIS.

Since the filing of the NOP, a boundary interpretation was completed by the Land Use Commission which resulted in a project area change from 555.026 to 551.692 acres with the reduction occurring in the Agricultural District from 539.153 acres to 538.819 acres. Subsequently, a review and revision to the survey map and metes and bounds description has resulted in a further revision of the project area. Although the area has increased the project boundaries remain unchanged. The revised acreage for the total project area is 554.642 acres (541.769 acres - Agricultural District and 12.873 acres - Conservation District). In addition, the Conceptual Master Plan has been revised to reflect the revised acreage and to accommodate the constraints identified in the technical studies performed for the preparation of the EIS.

1.3 LOCATION

The property encompassed by this project consists of approximately 555 acres of sugar cane fields located at Kalapaki and Hanamaulu, in the Lihue Judicial District, Kauai (Figure 1-1). The geographic areas of the project Master Plan are referred to as Molokoa, Ahukini Mauka, and Ahukini Makai which are adjacent to Lihue Town, Lihue Airport and Hanamaulu Stream gulch; and Hanamaulu which is adjacent to the existing town of Hanamaulu. The Tax Map Key designations for the property are TMK 3-6-2: 01, 4, and 20 (portions), TMK 3-6-2: 17, TMK 3-7-1: 01(portion), TMK 3-7-2: 01 & 12 (portions), and TMK 3-7-3: 20 (portion). Major roadways adjacent to the property include Ahukini Road, Kapule Highway, and Kuhio Highway.

1.4 OWNERSHIP AND PRESENT USES OF THE PROPERTY

The subject land is owned in fee in part by LPCo, in part by Amfac Property Development Corp., a Hawaii corporation ("APDC") and in part by Okada Trucking co., Ltd. ("Okada"). LPCo owns TMK Nos. 3-6-2:01 (portion), 3-6-2:17, 3-7-1:01 (portion), 3-7-2:12 (portion), and 3-7-3:20 (portion) and APDC owns TMK No. 3-6-2:4 (portion). Okada owns TMK: 3-6-2:20 (portion). Copies of the TMK maps are shown in Figures 1-2, 1-2A, 1-2B, 1-2C and 1-2D. All owners of the Master Plan area, consent to the submission of the LUDBA and the GP amendment applications.

Amfac/JMB, as the parent company to LPCo, will serve as the Master Developer ("Developer") for the project. This role is similar to its role as Master Developer in the successful Waikele Planned Community in central Oahu. Amfac/JMB will similarly contract with third party builders and sub-developers to construct residential and commercial/industrial developments and will be responsible for full development of the Master Plan area. Design controls to preserve land values and to maintain integrity of the project will be instituted. All major infrastructure will be constructed, contracted or arranged for by Amfac/JMB.

A majority of the Master Plan area is under cultivation for sugar cane production. Other portions are being used for an office site for a helicopter tour operation, a Veterans Center and a transformer site for Kauai Electric Company.

1.5 DESCRIPTION OF THE PROPERTY

The project site consists of sugar cane fields with the majority of the land having gentle slopes from 1 to 8 percent. The property has been under cultivation since the early 1900's. The first cane harvest occurred in 1919. The range in elevation is approximately 60 feet above mean sea level (msl) at the eastern or makai location of the property and 200 feet above msl at the western or mauka location of the property. The project lands are in four distinct geographic locations separated by major roadways; these include Molokoa (159.5 acres), Ahukini Mauka (221.7 acres), Ahukini Makai (143.8 acres) and Hanamaulu (30 acres) as shown in Figure 1-2. Molokoa, Ahukini Mauka and Ahukini Makai are separated by Kapule Highway and Ahukini Road. The Hanamaulu parcel is bounded by the Kapule

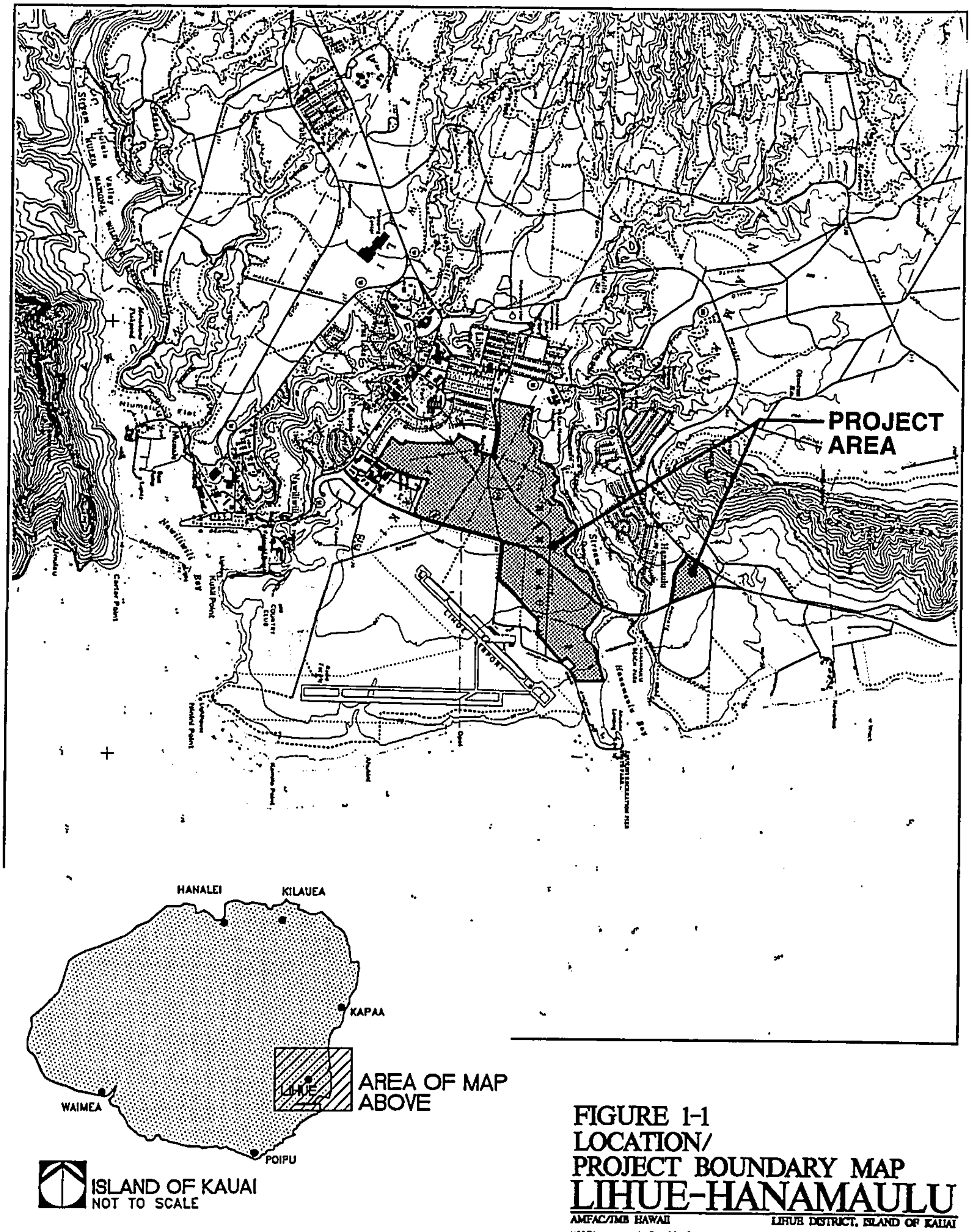
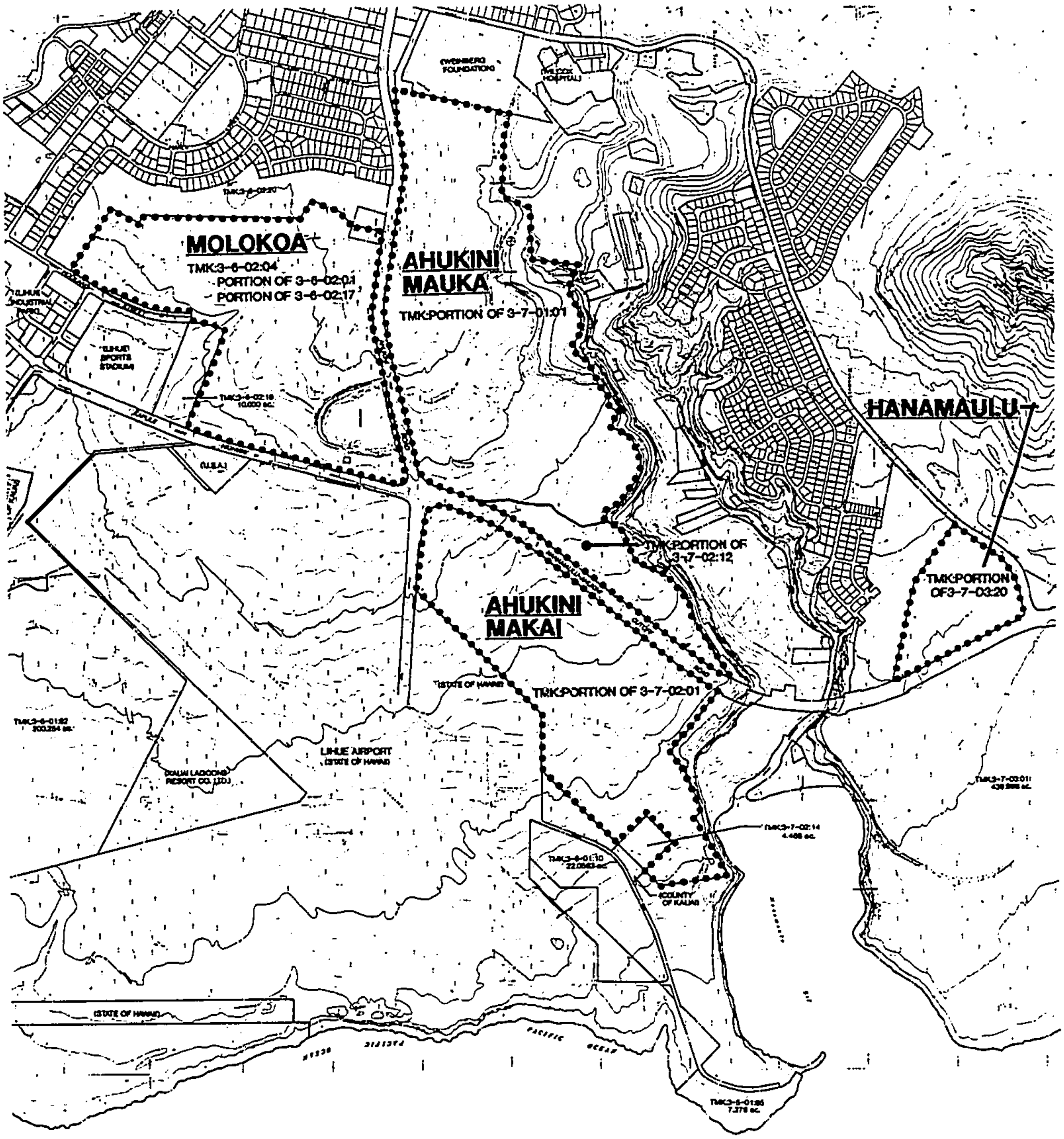


FIGURE 1-1
LOCATION/
PROJECT BOUNDARY MAP
LIHUE-HANAMAULU
AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI
NORTH
LINEAL SCALE
1000 0 1000 2000 4000
FEET
DATE: 5/94
PBR HAWAII



LEGEND

PROJECT AREA BOUNDARY

FIGURE 1-2
TMK-KEY MAP
LIHUE-HANAMAULU
AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI
NORTH
LINEAL SCALE
375 0 375 750 1500
FEET
PBR HAWAII

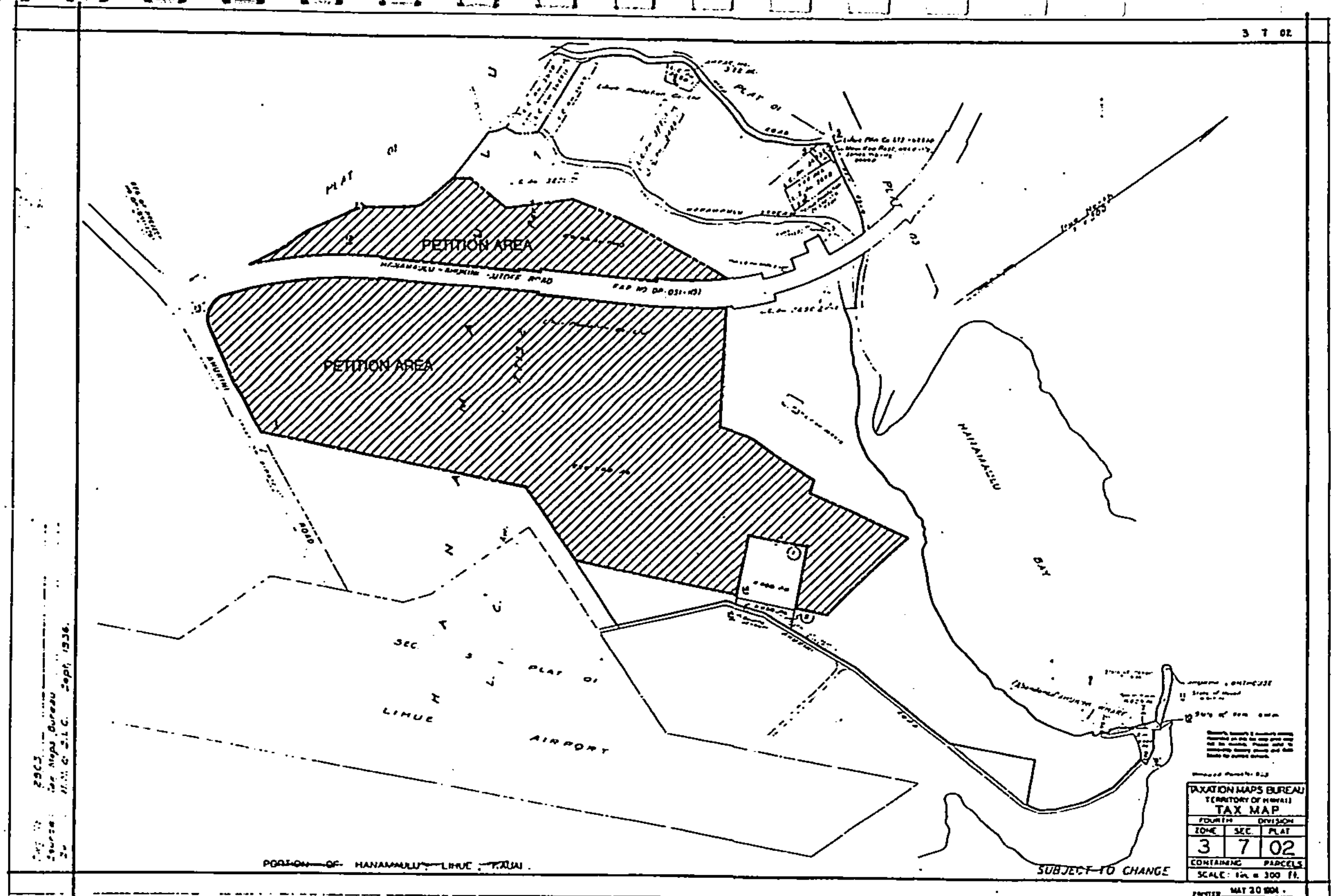


FIGURE 1-2A
TMK-AHUKINI MAKAI/
AHUKINI MAUKA (POR.)
LIHUE-HANAMAULU
AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI
NORTH
NOT TO SCALE

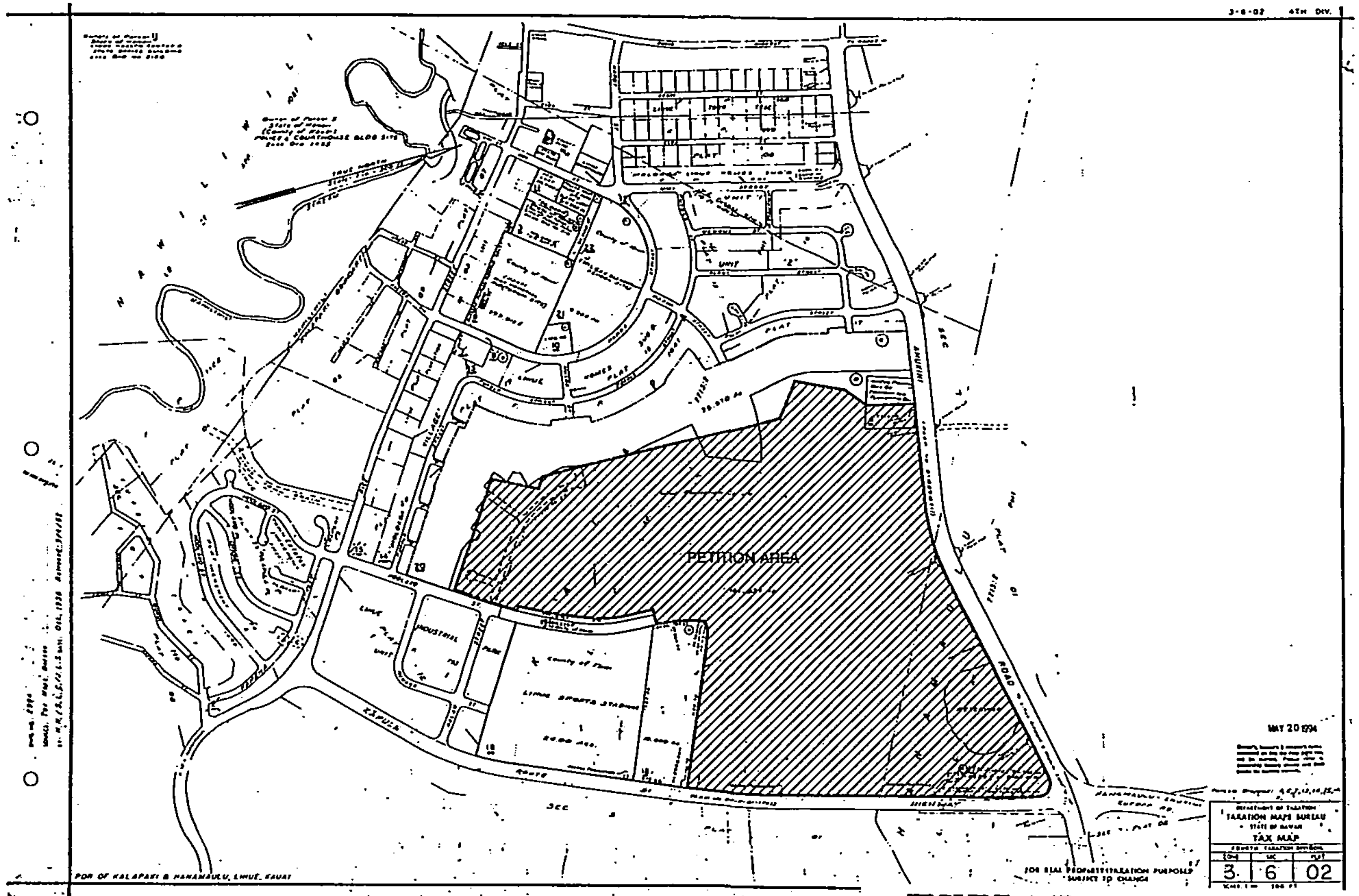


FIGURE 1-2B
TMK-MOLOKOA
LIHUE-HANAMAULU
AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI

NORTH

NOT TO SCALE

PBR HAWAII

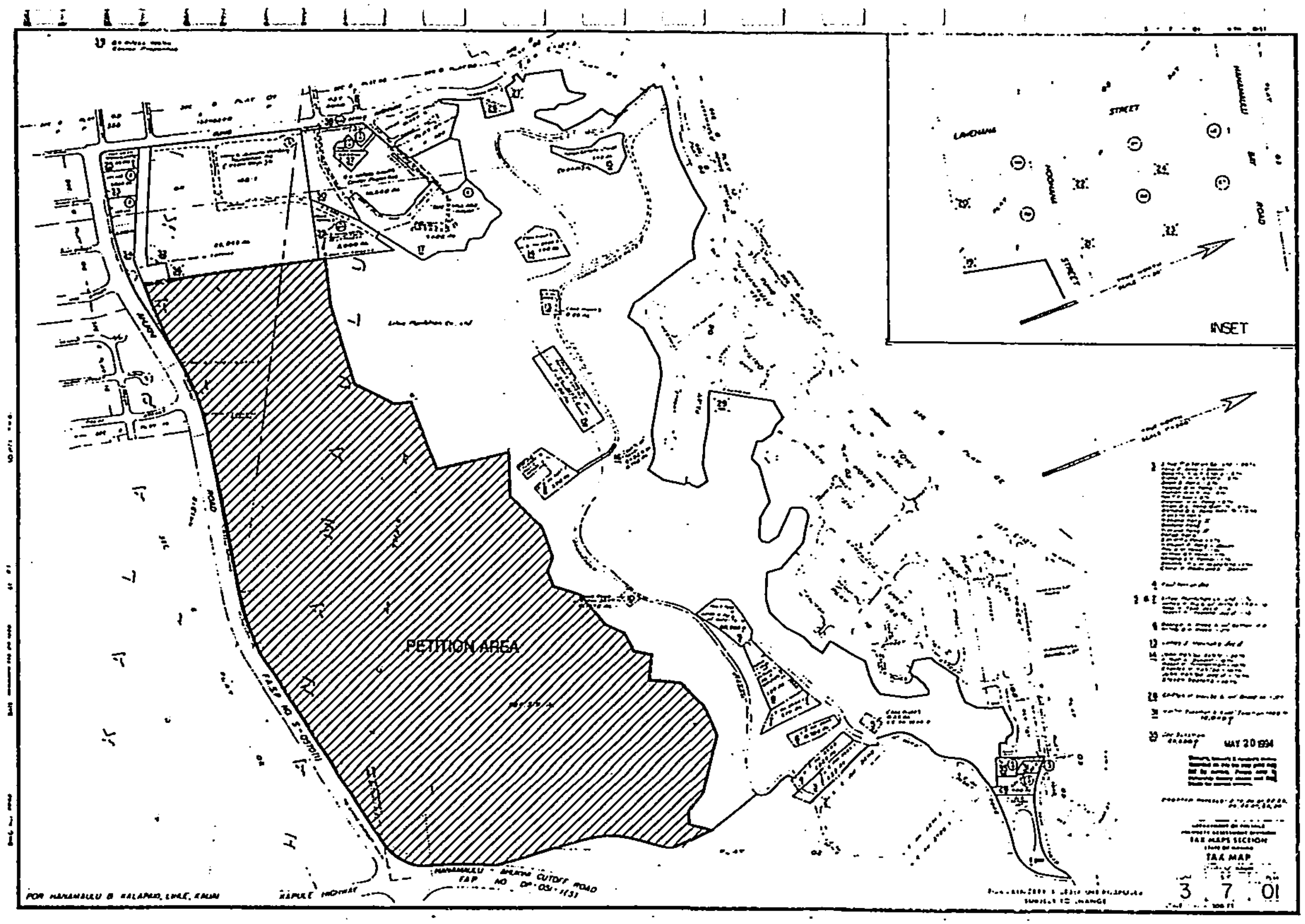


FIGURE 1-2C
TMK-AHUKINI MAUKA
LIHUE-HANAMAULU
AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI
NORTH
NOT TO SCALE

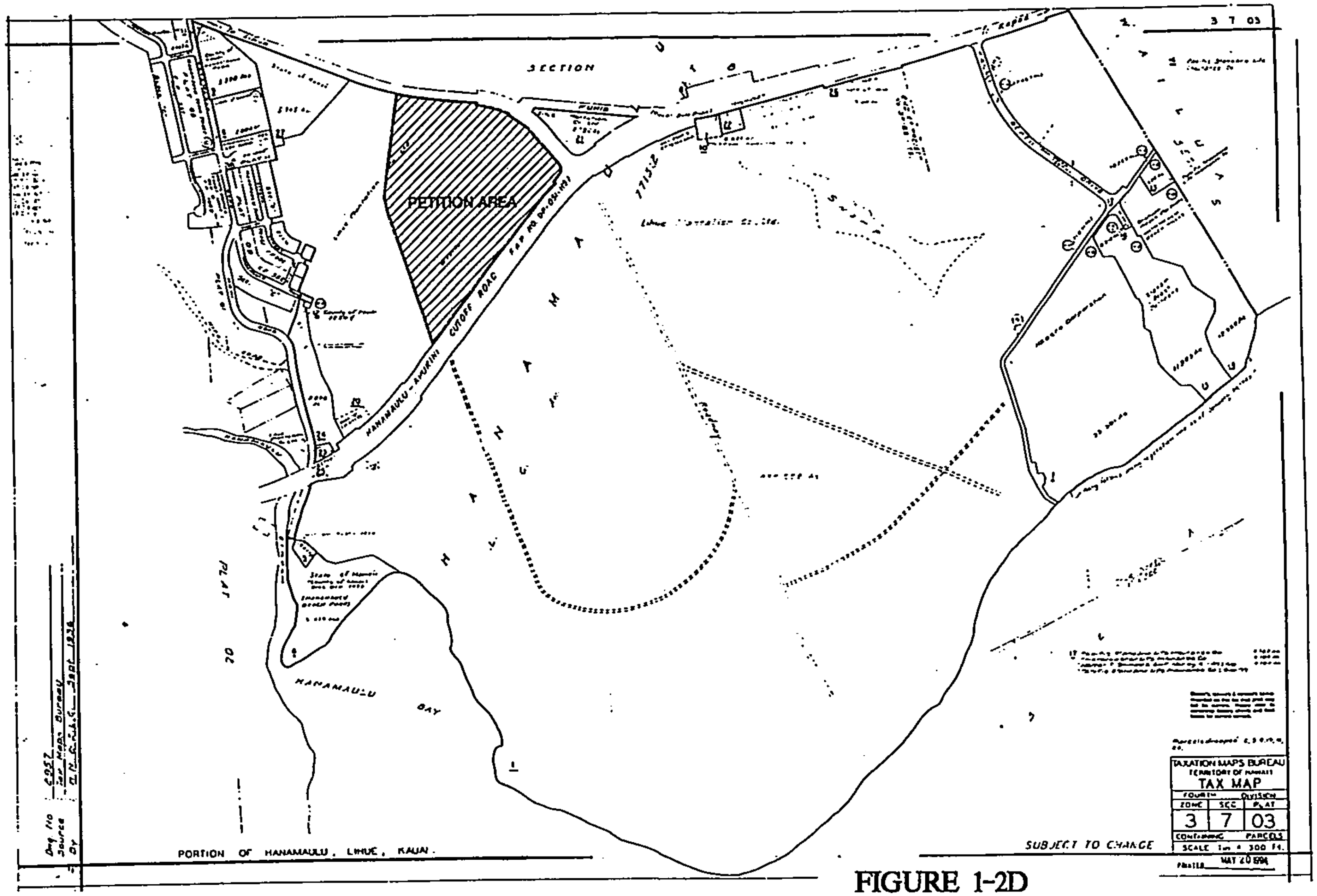


FIGURE 1-2D
TMK-HANAMAULU
LIHUE-HANAMAULU
AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI
NORTH
NOT TO SCALE
PBR

Highway and Kuhio Highway. Dirt roadways for cane haul trucks and other plantation vehicles traverse the property and a Kauai Electric easement runs through a portion of Molokoa.

1.6 SURROUNDING LAND USES

The Master Plan area is surrounded by existing land uses which include commercial. residential, public facility, industrial land uses and open space. Natural and structural landmarks in the vicinity include Hanamaulu Gulch, Hanamaulu Bay, Lihue Airport, the Antone K. Vidinha Memorial Stadium, the Lihue Post Office Airport Annex, and Wilcox Hospital. Several small tracts of undeveloped land which are planned for residential development also surround the property.

1.7 PURPOSE AND CONTENT OF THE FINAL EIS

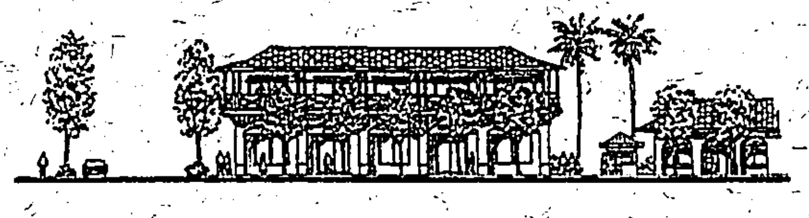
This Final EIS integrates the comments and issues identified during the Draft EIS review period which identified and evaluated the potential impacts which could result from the implementation of the Lihue-Hanamaulu Master Plan. The Chapter 343 process is undertaken as part of an application for a State Land Use District Boundary Amendment and a County General Plan Amendment. The public review and comment process is incorporated by addressing comments in the formulation of this Final EIS.

The content of this report includes an Executive Summary which summarizes the major issues of the report. The Final EIS is presented in 10 sections. Section 1 is the Introduction which identifies the Landowner and Applicant and provides a background of the project. Section 2 is a detailed description of the Master Plan and its components. Section 3 includes a discussion of the existing land use and zoning designations applicable to the property and approvals required to implement the Master Plan. Section 4 includes the description of existing physical and natural environmental conditions, potential impacts of the project and recommended mitigative measures. The existing human and socio-economic environment, potential impacts of the project and mitigative measures are presented in Section 5. Section 6 identifies the contextual impacts of the Master Plan and unavoidable impacts of the project. Section 7 includes a discussion of the relationship of the project to existing plans and policies for the area. Alternative uses to the proposed action, including no-action, an agricultural alternative, and a residential/golf course subdivision are presented in Section 8; unresolved issues in Section 9; and Section 10 includes a list of preparers, governmental agencies and community organizations which were contacted in the planning process. And finally, Sections 11 and 12 include the Consulted parties and written comments received and the applicant's corresponding responses.

Several appendices are attached which include the technical studies and reports which have been prepared for the Master Plan. A number of the technical appendices are not affected by the approximately 3 acre change in the project area; therefore references to a project area of 555 acres remain in some reports. The engineering studies, however, incorporates the new acreage and addresses the change in impacts. In addition to this EIS document, application reports for the State Land Use District Boundary Amendment and the General Plan Amendment have been prepared and submitted to the respective agencies.

2.0

DESCRIPTION OF THE PROJECT



2.0 DESCRIPTION OF THE PROJECT

Provided in this section is a summary of the proposed Lihue-Hanamaulu Master Plan, including a description of the overall theme and the goals and objectives for the master planned development. The components of the plan, including infrastructure development, are also summarized. Also discussed in this section are market demand, anticipated construction activities, the preliminary development timetable, and estimated infrastructure costs.

2.1 INTRODUCTION AND BACKGROUND

The Lihue-Hanamaulu Master Plan proposes a conceptual land use plan to meet the urban expansion needs of Lihue. As a logical urban in-fill project consistent with the Office of State Planning recommendation of urban use for the project area, the Master Plan maintains and supports Lihue as the governmental, commerce, and transportation center of Kauai.

The Setting. Forested mountain peaks at the island's center support unique and valuable natural resources and cascade into valleys giving Kauai its nickname, the Garden Island. Lihue Town is centrally located within the perimeter coastal plain and is suitable topographically and geographically for the island's major transportation infrastructure. Kauai's major airport and harbor facilities are at Lihue, as are the head offices of banking institutions and corporations. Lihue serves as the professional center of the island with offices of attorneys, engineers, architects, land development and realty professionals, as well as social service and health care providers.

Lihue Town Center. Concentrated at the Lihue town center are the Civic Center Complex, the County and State office buildings and the Kauai Museum, a major repository for the cultural and historical record of the island. The street patterns reinforce and strengthen this sense of the town's core. Over time, however, the vitality of Lihue as the urban core has shifted. Other communities, particularly those that contain visitor destinations and resort complexes, have experienced significant growth in recent times and areas such as Kapaa and Wailua are transforming from primarily residential neighborhoods to full-service and self-contained communities. Settlement patterns and the ability to grow have had a direct effect on Lihue town's position as the island's major urban center.

Town Planning Principles and Guidelines. In A Pattern Language, Christopher Alexander aptly describes city planning principles that are applicable to what the proposed Lihue-Hanamaulu Master Plan will address and how it plans to achieve it.

> "A city becomes good for life when it contains a great density of interactions among people and work, and different ways of life. For the sake of this interaction, the city must be continuous, not broken up. Give it the wherewithal it needs to build a base of local industry and commerce, so that those towns are not dormitories for people who work in other places, but real towns - able to sustain a way of life."

The Lihue-Hanamaulu Master Plan provides this opportunity. As a master planned in-fill development of Lihue, it will allow growth to form the needed resident population and business activity which will invigorate and reinforce the stature of being Kauai's main town.

Recent writings by Andres Duany, Elizabeth Plater-Zyberk, Peter Calthorpe and others have refocused the planning of communities, neighborhoods, towns and cities, as places conducive for their viability and vitality. Calthorpe in The Next American Metropolis provides the following guidelines:

- Organize growth on a regional level to be compact and transit-supportive;
- Place commercial, housing, jobs, parks, and civic uses within walking distance of transit stops;
- Create pedestrian-friendly street networks which directly connect local destinations;
- Provide a mix of housing types, densities, and costs;
- Preserve sensitive habitat, riparian zones, and high quality open space;
- Make public spaces the focus of building orientation and neighborhood activity; and
- Encourage in-fill and redevelopment along transit corridors within existing neighborhoods.

These guidelines have directed the preparation of the master plan which is described in the following section. Calthorpe further states "...more walkable, integrated communities can help relieve dependence on the auto and provides greater opportunities for a broad spectrum of residents." These principles have been integrated into the Lihue-Hanamaulu Master Plan.

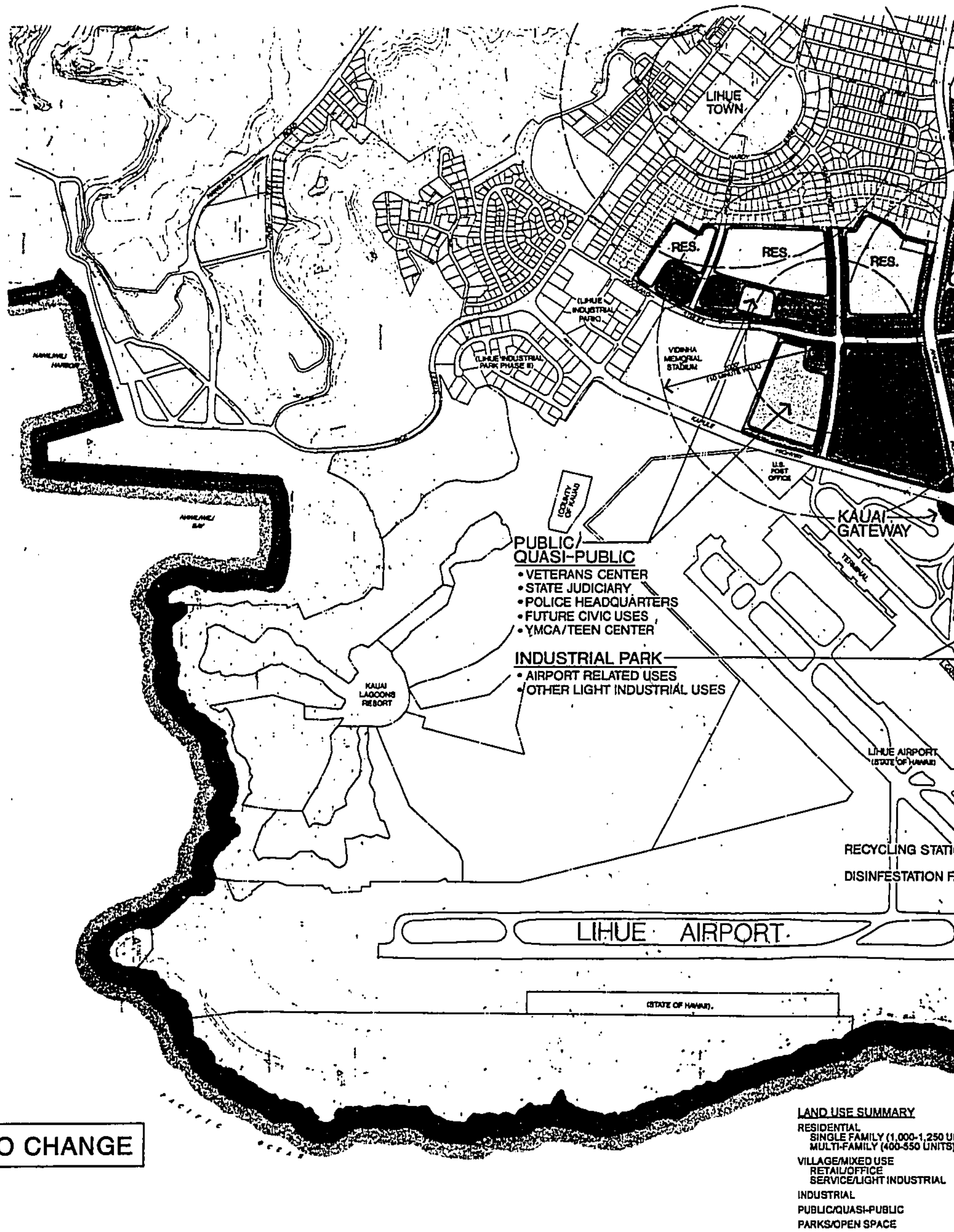
2.2 GOALS AND OBJECTIVES OF THE LIHUE-HANAMAULU MASTER PLAN

The overall goal of the Lihue-Hanamaulu Master Plan is to develop a range of residential and village mixed-uses on 555 acres of land located at Lihue and Hanamaulu (Figure 2-1). Four geographic areas of the Master Plan include Molokoa, Ahukini Mauka, Ahukini Makai and Hanamaulu. Development is projected to be over a 15 to 20 year period and is planned to be flexible in responding to future community needs. The project will provide opportunities for residential construction, public and quasi-public facilities, commercial retail and office employment, and industrial development. The requested land use approvals for urban classification at the State Land Use and County General Plan levels will allow this broad range of urban land uses.

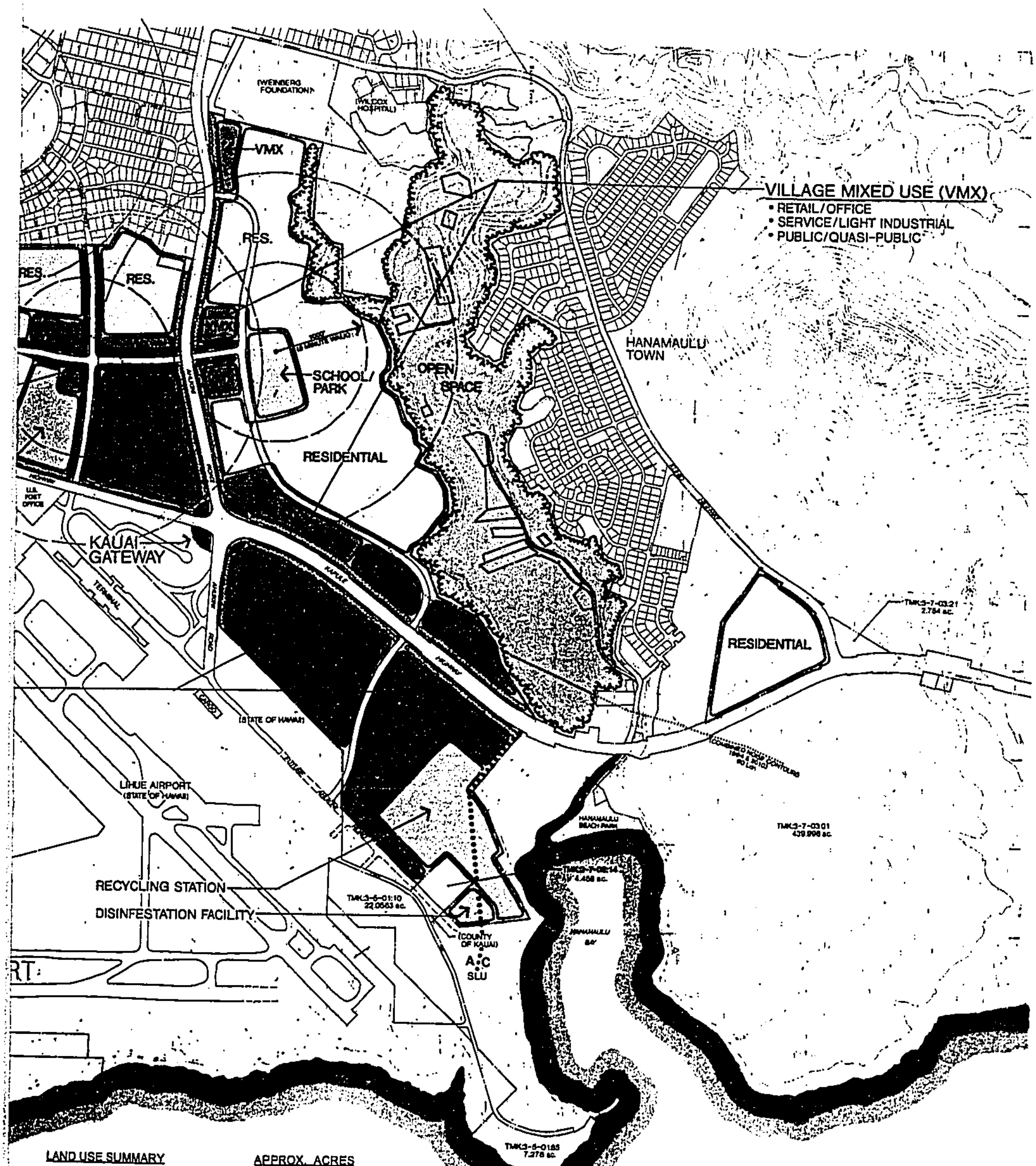
In formulating the overall master plan concept, the following goals and objectives have been established to serve as achievable planning milestones that will accomplish the project in an environmentally sensitive and desirable manner.

□ PUBLIC FACILITIES AND SERVICES

- Maintain and support Lihue Town as the governmental and commerce center of Kauai



SUBJECT TO CHANGE



LAND USE SUMMARY	APPROX. ACRES
RESIDENTIAL	
SINGLE FAMILY (1,000-1,250 UNITS)	180
MULTI-FAMILY (400-550 UNITS)	35
VILLAGE/MIXED USE	
RETAIL/OFFICE	70
SERVICE/LIGHT INDUSTRIAL	26
INDUSTRIAL	102
PUBLIC/QUASI-PUBLIC	70
PARKS/OPEN SPACE	48
MAJOR ROADWAYS	24
TOTAL	555

FIGURE 2-1
CONCEPTUAL MASTER PLAN
LIHUE-HANAMAULU

AMFAC/JMB HAWAII — LIHUE DISTRICT, ISLAND OF KAUAI

NORTH — LINEAL SCALE 350 0 350 700 1400 FEET

PBR

- Provide opportunities for public/quasi-public facilities for island-wide and local community needs (i.e., Veteran's Center, judiciary complex, police headquarters, YMCA-type/teen center, elementary school site, Lihue Debris Recycling Station, Tropical Fruit Disinfestation Facility, parks)

- INFRASTRUCTURE DEVELOPMENT
  - Upgrade existing and provide new infrastructure concurrent with community development
  - Improve traffic circulation between Lihue and Lihue Airport

- HOUSING
  - Provide housing opportunities that will be affordable to Kauai's growing population in all market sectors - affordable, gap group, and market
  - Provide a range of residential product types: single family and multi-family

- ECONOMIC DEVELOPMENT
  - Provide service, commercial office and retail development to support existing and future sectors and create additional employment opportunities
  - Support island-wide needs for industrial and airport related uses on land adjacent to Lihue Airport
  - Provide a mixture of land uses traditionally found in small towns

- PEDESTRIAN AND TRANSIT ORIENTED
  - Provide an integrated system of pedestrian and bike routes with linkages to existing and future neighborhoods
  - Provide for future transit opportunities that could serve the Lihue-Hanamaulu areas

- KAUAI GATEWAY
  - Provide for the planning and implementation of a "Gateway" entry to Kauai that is distinctive and creates a positive image of Kauai..."the Garden Island"
  - Establish generous landscape buffers along major vehicular corridors

The village mixed use concept (shown as "VMX" on the Master Plan) is applied to the project. It includes a mix of commercial retail and office uses, public service facilities, open spaces for park/plaza/village green, all within walking distance of one another and from residential areas adjoining the village core.

In support of the development, infrastructure facilities that will be constructed include access and circulation roadways; bike routes and pedestrian paths, a wastewater treatment and disposal system; a drainage system, a potable water supply system, including fire protection and other utilities systems. A brief description of each geographic area of the Master Plan is presented below.

Molokoa. The heart of the village core will be at Molokoa. Sharing common boundaries with Lihue Town, Molokoa will provide the transition for the expansion. It provides vitality to the project and creates viability and serves as a magnet for social and cultural life. Molokoa is planned as a mixed-use neighborhood with a central town core of services, employment, retail, dining, social and cultural opportunities, with residential and public uses within a comfortable 10 minute walking distance of a core commercial area and civic uses. Together with Lihue Town, Molokoa will strengthen and complement the existing economic and governmental sectors of the County.

Ahukini Mauka. Ahukini Mauka is characterized by the broad open views over the riparian Hanamaulu Gulch. The neighborhoods at this location will include single-family and multi-family residential uses, a cluster of village mixed-uses and a proposed elementary school. At the corner of Ahukini Road and Kapule Highway a Kauai Gateway concept is planned to provide a strong sense of arrival to the Garden Island of Kauai. In addition, a village mixed-use area along Kapule Highway could include visitor oriented Kauai products commercial retail and craft shops that would be developed within design guidelines which would achieve building profiles compatible with the Gateway concept. A ten-acre multi-purpose park and service and related light industrial uses are also planned.

Ahukini Makai. Industrial uses at Ahukini Makai are well positioned relative to the major transportation centers including major roadways, Lihue Airport and Nawiliwili Harbor. Potential types of business include service facilities for airport related activities; warehousing for wholesalers serving retail, restaurant and hotel operators; motor vehicle oriented activities servicing transportation companies, state and county governments such as car rental yards and commercial passenger vehicle staging areas; food processing and packaging businesses; construction related businesses and local consumer-oriented businesses.

Hanamaulu. As an extension of the existing Hanamaulu Town, the Hanamaulu area will provide additional residential opportunities. A range of single and multi-family residences will be provided.

2.3 KEY ELEMENTS OF THE MASTER PLAN

The village mixed-use concept includes an integration of public facilities, residential development, commercial office and retail space, and industrial development. Supporting infrastructure include roads, water, sewer and drainage facilities to allow the village to function efficiently. As shown on the Conceptual Master Plan in Figure 2-1, the general land use allocation is summarized as follows:

LAND USE	APPROX. ACRES
Residential	
Single-Family (1,000 - 1,250 units)	180
Multi-Family (400 - 550 units)	35
Village Mixed-Use	
Retail/Office	70
Service/Light Industrial	26
Industrial	102
Public/Quasi-Public Facilities	70
Parks/Open Spaces	48
Major Roadways	24
Total Acreage:	555

2.3.1 PUBLIC FACILITIES AND SERVICES

Several public facilities planned to be located within the town core at Molokoa will serve Lihue and islandwide residents. These include a Veterans Center, and potentially a State Judiciary complex, Police Headquarters, and a YMCA-type Teen Center. Other similar public facilities may be located in the project area. At Ahukini Mauka, a new elementary school is proposed and a County park will serve the residents in the surrounding neighborhoods. Additional mini-parks may be included within residential neighborhoods when planned. Other parks are planned to meet the communities recreation needs and also function partially as detention basins for drainage control during storm events. Within the Ahukini Makai industrial area will be the County's Debris Recycling Station and a State Tropical Fruit Disinfestation Facility.

2.3.1.1 Veterans Center

The 2.3 acre site for the Kauai Veterans Center at Molokoa has been donated by LPCo/Amfac/JMB with the planning and construction funded by the State of Hawaii. Recently completed, the center will include a museum honoring veterans and a meeting hall for conventions and social gatherings. The Center will serve 1,500 men and women who make up the Veteran's Council. Organizations represented include the 442nd Club, the Kauai 100 Club, Merchant Marine Service, The Military Order of the Purple Heart - Chapter 489, Disabled American Veterans - Chapter 5, Veterans of Foreign Wars Post 3855, Kauai Vietnam Veterans Club, The Kauai Veterans Club, Military Intelligence Service, American Legion Posts #2 and #51, and the American Legion Auxiliary Unit #2.

2.3.1.2 State Judiciary Complex

The present Lihue Courthouse facility for the Kauai Judiciary is congested, overcrowded, and unsuitable for present and future judiciary needs. To address this present need, the Master Plan has incorporated a proposed 6.5 acre Judiciary complex site at Molokoa. This facility will be built by the State of Hawaii and will provide space for judicial proceedings, courtrooms for hearings and trials, judges chambers for conferences, hearings, and space for legal research, offices, driver education, traffic violations bureau, law library, and administrative departments. Records and exhibit storage space will also be available.

2.3.1.3 Police Station

To ensure continued levels of protective services, a new County police headquarters building is being planned to serve the Sector 5 area and the County. The current station, built in 1953, is outdated and overcrowded with no room for further expansion for a crime laboratory and accompanying equipment and staffing requirements change in the future. Presently, the Kauai force consists of 139 officers and 28 civilian employees.

To address the anticipated need, the project Master Plan has identified a new police headquarters site adjacent to the planned Judiciary complex at Molokoa. Tentative plans include civil defense facilities, a crime fighting equipment room and a crime lab which are lacking at the present facility. As a project of the County of Kauai, detailed planning and design for the station will be completed by the County as future needs are better defined.

2.3.1.4 YMCA/Teen Center

In addition to the planned parks, a site for a multi-purpose YMCA-type facility/teen center is identified adjacent to a planned park in Molokoa. To serve as a social and recreational center for the community, this facility could include a multi-purpose meeting rooms, gymnasium, and swimming pool. The teen center could provide a place for Lihue youth to gather and fraternize in a safe supervised environment. Programs at the YMCA could include a full range of classes, counseling services, parent-infant care classes, and other programs to serve the community.

2.3.1.5 Elementary School

To address future educational requirements of the proposed Master Plan development, the State Department of Education ("DOE") was contacted to ascertain facility and personnel needs. Based on the DOE recommendations, the Master Plan provides a 12-acre site for an elementary school of which approximately four acres could serve as a community park. As the need for new school facilities increases in the future, the overcrowding at Wilcox and Kaumualii Elementary Schools will be mitigated. As an alternative to providing a school site within the project, the DOE may also consider an elementary school site located elsewhere within the Lihue district.

2.3.1.6 Parks

Several parks are planned within the master plan area. These include parks adjoining the village core and neighborhood parks for passive and active recreation. These include a park of approximately four acres at Molokoa, a four-acre playground at Ahukini Mauka to serve as a community park and playground for the elementary school, and an approximately ten-acre park in Ahukini Mauka adjacent to Kapule Highway. An approximately four-acre site for a YMCA-type facility is also planned adjacent to the park in Molokoa. In total, approximately 22 acres are planned to meet the communities park and recreation needs.

In compliance with the County's park dedication requirements, this project would be required to dedicate approximately 7.6 to 9.7 acres for park use. Generally, portions of the parks will be designed to serve as shallow drainage detention basins to improve the quality of surface water runoff and control the quantity of runoff flowing off-site. Inasmuch as the parks will serve drainage control functions, the entire park will be landscaped and usable for recreational uses. Functioning of the park/detention basin is first, as park space and will be designed to County's Departments of Public Works and Parks criteria. The details of this new concept is further discussed in Section 5.8.5.

In addition to the 22 acres of park land described, private neighborhood mini-parks and recreational facilities may be planned within the single-family and multi-family residential areas. Based on the projected population which will be generated by the project, the new parks planned exceed the park dedication requirement of the County of Kauai as noted above.

2.3.2 VILLAGE MIXED USES - COMMERCIAL DEVELOPMENT

Integral to the village concept is the proximate location of employment centers for residents living nearby the village core and within the surrounding area. In addition to the employment at public/quasi public facilities, several commercial clusters will provide retail and office space. Approximately 70 acres are provided within the master plan to meet the retail and office needs.

2.3.2.1 Retail

Ideally situated at Kauai's major crossroads for commercial retail development, it is estimated that the project has the potential to capture 30 to 40 percent of the increase in demand for retail space in the Lihue District. Opportunities for several types of retail centers within the Molokoa village core and the neighborhood VMX clusters will be available. These include a community/ neighborhood center offering a major drugstore and supermarket as anchor tenants, visitor-oriented Kauai products specialty retail center, a convenience center, and a commercial center.

2.3.2.2 Office

Similar to the positive locational attributes for retail commercial uses, the project is ideally situated to provide for the future office space needs of the region. Adjacent to Lihue Town's existing central business district, Nawiliwili Harbor, Lihue Airport and the Kauai Lagoons Resort, and situated within the village core, the project can support a wide-range of office needs including professional medical services. Within the Lihue District, the project could capture approximately 60 percent of the increase in demand for office space.

2.3.3 RESIDENTIAL DEVELOPMENT

A total of 1,400 to 1,800 single and multi-family homes in a range of product type and densities will be available for purchase and rent. Approximately 215 acres will be allocated for residential use.

Within approximately 180 acres, single-family residential homes would be developed at densities of 3.5 to 9.0 dwelling units per acre. Multi-family residences would be developed at densities of 10 to 20 dwelling units per acre and encompass approximately 35 acres. The primary market buyer for homes is the Kauai resident first time home buyer wishing to purchase or upgrade accommodations. The secondary market buyer is the Kauai resident wishing to relocate to reduce travel time to the employment center.

Affordable Housing. As a fully integrated mixed-use community, the proposed Master Plan is intended to provide for the residential housing needs of local residents. No "resort-type" or second home land uses are proposed. Consequently, the residential real estate products must be economically feasible, yet priced at affordable rates to address the needs of Kauai residents. As such, a significant planning component of the project will be the production of affordably priced for-sale housing. As the master developer, Amfac/JMB is committed to working with both the State and County governments to assure that the affordable housing component is produced at prices in accordance with applicable governmental policy and regulatory requirements.

2.3.4 INDUSTRIAL

Due to its central location in terms of population distribution and transportation corridors, it is anticipated that Lihue District will likely continue as the primary location for industrial activities on Kauai. As such, the Master Plan area has a number of locational advantages (as discussed in Section 2.5.3) which make it a desirable site for industrial activities. In addition, industrial related public facilities are also planned at Ahukini Makai; these include the County Debris Recycling Station and a State Fruit Disinfestation Facility.

2.3.4.1 Industrial Uses

Businesses which would require industrial land in the future include: motor vehicle-oriented activities servicing transportation companies, state and county governments and local residents such as car rental yards, commercial passenger vehicle staging areas, repair and servicing centers, and used rental vehicle sales centers; service facilities for airport-related activities such as aircraft maintenance, catering and cleaning services; wholesalers serving retail, restaurant and hotel operators who need warehousing facilities; food processing and packaging firms; construction industry related businesses; and local consumer-oriented businesses. To provide for these industrial uses approximately 128 acres are planned for general industrial, light industrial/service related uses in Ahukini Makai and Ahukini Mauka along the Kapule Highway corridor. These lands would meet approximately 40 percent of the projected industrial land needs for the Lihue District.

2.3.4.2 Lihue Debris Recycling Station ("LDRS")

The Recycling Station is a proposed project of the County of Kauai, Department of Public Works, which will enable the County to continue diversion and segregation of Hurricane Iniki debris and to meet solid waste diversion goals as stipulated by the State Legislature. The recycling station will collect, segregate, and process for transport green waste, construction and demolition debris, metals and recyclables. These materials will then be transported off-site for final processing, such as composting and biofuel production and incineration or shipped off island. The location of the 35-acre site for the facility is adjacent to the existing Lihue refuse transfer station.

This facility is one of four being planned by the County to divert as much Hurricane Iniki debris as possible from Kekaha landfill. The development of the project is funded by the Federal Emergency Management Agency ("FEMA"). Recycling stations are planned at three other locations: Koloa, on Phase I of Kekaha Landfill, and on the north shore of Kauai. A separate Environmental Assessment is being processed by the County of Kauai for the LDRS.

2.3.4.3 Kauai Tropical Fruit Disinfestation Facility

The proposed fruit disinfestation facility within the project is being proposed by the University of Hawaii Office of Technology Transfer and Economic Development ("UH/OTTED"). The fruit facility will provide hot air or dip treatment and a packing facility for exporting fruit to new mainland and Japan markets. The new quarantine treatment and packing facility will allow Kauai papaya farmers to export fruits, thereby opening up an enormous market for Kauai produce. University of Hawaii studies indicate the facility will gross approximately $4 million by its fourth year of operation and $7 million by the sixth year of operation. The facility will be located moments from the air freight terminals which will minimize transportation costs for more profitability. The 4.7-acre site is adjacent to the existing Lihue transfer station. A separate Environmental Assessment has been processed by the University of Hawaii for the Disinfestation Facility.

2.3.5 KAUAI GATEWAY

The proposed Kauai Gateway is intended to create a positive visual impression of Kauai as the Garden Island at the first major crossroads formed by the Ahukini/Kapule Highway intersection. Visitors and returning residents arriving at the Lihue Airport and traveling to their destinations all pass through this crossroads. Appropriate landscaping and signage at the four corners will be coordinated with the State Department of Transportation's and the "Aloha Plumeria Project" Kauai Gateway beautification efforts.

2.3.6 INFRASTRUCTURE DEVELOPMENT

The project will require infrastructure development on-site as well as off-site, including roads, water, sewer and drainage improvements as part of the overall development of the Lihue-Hanamaulu Master Plan. The project is planned to be phased over a 15 to 20 year time period; therefore, infrastructure will be developed to coincide with project requirements. The improvements will tie into the existing County water, sewer, roadway and drainage systems and will be upgraded as required, to accommodate the project's growth.

2.3.6.1 Wastewater Treatment System

Wastewater will be generated by the proposed residential units, public-quasi public facilities, industrial land uses, a school site, and park areas. An infrastructure report for the wastewater system was prepared by Austin, Tsutsumi & Associates ("ATA") for the Draft EIS and has been revised to address the comments received in the EIS review process. The revised report is attached as Appendix A. More discussion on the wastewater treatment system, including a Figure, is described in Section 5.8.3.

The proposed Lihue-Hanamaulu Master Plan will require the collection, treatment, and disposal of wastewater. Consequently, using the County of Kauai design flow rates to calculate the average daily wastewater flows generated by the project, approximately 1.6 million gallons per day ("mgd") is projected. However, because only 95,600 gpd of this demand is already accounted for in the current expansion program for the Lihue Wastewater Treatment Plant ("WWTP"), the full implementation of the proposed development will require additional treatment capacity of approximately 1.51 mgd average daily flow ("ADF").

The proposed treatment options consist of; 1) phased expansion of the existing Lihue WWTP, 2) development of a new WWTP adjacent to the proposed Ahukini Road in Ahukini Makai a combination of expansion of the existing Lihue WWTP and construction of a new, smaller WWTP facility within Ahukini Makai, and 4) expansion of the liquid processing facilities of the existing Lihue WWTP to accept the project's wastewater with the construction of a new facility at Ahukini Makai to process solids removed at the Lihue WWTP for both the existing flow and the project's wastewater. All options can accommodate the projected 1.51 mgd ADF of additional treatment capacity that will be generated by the project.

For effluent disposal, the near-term and long-term solution involves pumping treated effluent to the existing Lihue Plantation Company hydro-separator and pump station located just mauka of the Kuhio Highway/Ahukini Road intersection. Here the effluent would be blended with mill wash water and reused to irrigate LPCo sugar cane fields. LPCo would control and be responsible for the effluent after it is pumped to the hydro-separator. Should the sugar industry become a non-viable alternative, other land application areas include pasture land, irrigation of landscape along roadways, public areas and Lihue Airport will be utilized. Additional details for effluent disposal are included in Section 5.8.3.

2.3.6.2 Water Source Development

The water requirements for the Lihue-Hanamaulu Master Plan have been evaluated by Kodani & Associates (September 1994) in a preliminary engineering report which is attached as Appendix B. Additional discussion on the project's water system is included in Sections 5.8.1 and 5.8.2.

Based on Department of Water standards and the maximum development density of 1,800 residential units, the project will require approximately 1.75 million gallons per day (mgd) of potable water. Consequently, nine new wells (including one standby well) will be required to supply the daily domestic demand and fire protection requirements. Using a maximum demand of 1.5 times the average daily demand, the project area will require 2.68 mgd of storage capacity comprised of three storage reservoirs. These have been tentatively planned for sites mauka of the project area at the 400-foot elevation.

The hydrologic study prepared by Water Resource Associates for the project and provided as Appendix C, concluded that the Hanamaulu Aquifer System has an estimated recharge of 79 mgd and sustainable yield of 40 mgd. Presently, the County's Lihue Water System, which currently serves the area surrounding the proposed development, does not have a sufficient source capacity developed to meet the projected water requirements of the project, even though the 40 mgd sustainable yield of the Hanamaulu Aquifer System far exceeds the estimated 5 mgd current withdrawal rate. The additional withdrawal of 1.75 mgd for the proposed Master Plan development brings the total withdrawal to 17 percent of the sustainable yield.

To transport water from the source location, water transmission lines from the new wells and storage facilities are required. Tentative plans call for development of a large 16-inch transmission main from the well and storage site that will connect to the Lihue Water System at Ahukini Road. Transmission mains (12 inch) will also be required along Ahukini Road and Kuhio Highway and along interior roadways of the project area.

2.3.6.3 Drainage Facilities

Since the Master Plan area has been used for agriculture, all drainage improvements were originally designed for agricultural use. Therefore, a new drainage system will be required to accommodate the proposed urban development. Under sugar cane cultivation, runoff has been transmitted into existing drainageways or the ocean without any significant treatment or control of discharge rates. A Preliminary Engineering Report for Drainage Requirements has been prepared by Kodani & Associates, Inc. (January 1995) and is provided as Appendix D. To control the quantity and quality of surface runoff, portions of planned park areas will also serve as shallow detention basins. This practice will allow settlement of some suspended soil particles, and better control the rate of discharge as a means to limit potential flooding. This is further discussed in Section 5.8.5 and Appendix D.

According to Kodani & Associates, the amount of soil loss will decrease over time as the site becomes more developed due to the reduced amount of exposed soils which occurs under the current agricultural land use. Presently, it is estimated that the 555 acre project area loses approximately 310 tons of soil annually due to rainfall and agricultural activities on the property. Although increased erosion could occur during the first two years of construction, the establishment of urban landscapes and ground cover will dramatically reduce the amount of soil lost to erosion to amounts less than under agricultural land uses. Assuming an average development rate of 36 acres per year over a 15 year development period, it will take only three years to reduce soil loss to below current conditions. At buildout of the project, the sediment loss will be reduced by more than 80 percent compared to current conditions.

2.3.6.4 Traffic and Roadways

A Traffic Impact Report for the project has been prepared by Austin, Tsutsumi and Associates (January 1995) and is attached as Appendix E.

The Lihue-Hanamaulu Master Plan area is presently accessed by several major highways. Kapule Highway serves as the primary north/south arterial which intersects with Rice Street, located approximately one mile south of Ahukini Road. To the north, Kapule Highway intersects with Kuhio Highway at Hanamaulu. The intersection of Ahukini and Hoolako Street (Extension) establishes the midpoint of the Lihue-Hanamaulu Master Plan. Ahukini Road extends in the mauka direction from Lihue Airport, through the central portion of the project area, and finally connecting to Kuhio Highway.

Much of the projected population growth for the Lihue District will occur within the Master Plan area. Existing traffic patterns and the overall traffic congestion will gradually be impacted as islandwide population growth occurs in the future. However, because an employment center will be created within the Master Plan area, many trips will likely be comprised of shorter commutes within the project area.

Implementation of appropriate mitigation measures will be necessary to reduce the potential increase in traffic congestion. These proposed mitigation measures are further described later in the Draft EIS.
Primary access to the proposed project area will be from three major roadways; Kapule Highway, Kuhio Highway and Ahukini Road. Major collector streets within the project area will have a 60 foot right-of-way with a 44-foot curb-to-curb pavement section. This right-of-way width will accommodate additional lanes of traffic if required. Minor collector streets will have a 56 foot right-of-way with a 40-foot curb to curb pavement section. This right-of-way width will accommodate two lanes of traffic and allow on-street parking on both sides. All sidewalks will be 4 feet wide on both sides of the paved roadway.

Proposed improvements consist of the extension of Hoolako Street, Malae and Kaana Streets through Molokoa to serve as a major collector streets. Within Ahukini Mauka, a major collector road will be constructed from the extension at Hoolako Street to Kapule Highway. Ahukini Makai will be accessed by a proposed east-west major collector street from Kapule Highway to Ahukini Road near the heliport. The internal roadway circulation system is described in Appendix E-1. Provisions for bike routes and future transit system facilities are also planned.

To encourage pedestrian linkage between the project's residential areas and employment centers, bike routes, sidewalks, and walking paths will be incorporated into the project design. By making employment centers and residential areas convenient to each other, these pedestrian features will indirectly discourage the use of vehicular transportation.

2.3.6.5 Solid Waste

Solid waste generated during construction, will be trucked to the Lihue Debris Recycling Station. This facility is expected to be completed and in operation by the first year of project construction. The Recycling Station is intended to process debris from Hurricane Iniki and may serve as a permanent recycling facility after the hurricane debris is processed.

Once the project begins to achieve occupancy, solid waste will be collected by the Department of Public Works and disposed of at the existing Lihue Refuse Transfer Facility or the project's Recycling Station. Opportunities to encourage and facilitate solid waste recycling will be explored for both commercial and residential waste.

2.3.6.6 Other Utilities

Although the Master Plan area is presently serviced by electrical and telephone lines, these systems will require on-site and off-site improvements to accommodate project requirements. New lines and distribution facilities will be installed as part of an ongoing process over the 15 to 20 year development period. The landowner/developer will work closely with both Kauai Electric Company and Hawaiian Telephone Company to coordinate the necessary improvements.

2.4 CONSTRUCTION ACTIVITIES

Construction activities at the project will involve grading, construction of roadways, buildings, and landscaping.

Construction will occur in four phases beginning in 1997 with substantial completion of project infrastructure expected within the initial phase of the project. The major infrastructure development, homes, community facilities and retail/office space are anticipated to be completed during the early phase is consistent with market demand.

2.5 MARKET DEMAND

The existing and future projected market demand for this development has been identified through a market analysis prepared by Arthur Andersen & Co. (October 1994); the report is attached as Appendix F. A brief discussion of market demand for the project components is presented in this section.

2.5.1 Residential

According to the Office of State Planning, the number of new residential dwelling units required to support the anticipated population growth in the Lihue District market area between 1995 and 2020 is projected to be 5,733 units. The market analysis assumed the Lihue-Hanamaulu Master Plan project would capture 30 to 40 percent of the single-family and 35 to 45 percent of the multi-family market demand in the Lihue District, or approximately 1,308 to 1,750 residential units. This is consistent with the 1,400 to 1,800 residential units proposed in the master plan.

The primary market for the project's housing units will be Lihue District residents and other Kauai residents. In addition, the mix of product type is intended to include affordable for sale and rental housing, as well as market priced homes to allow residents from a variety of income levels an opportunity to live within the project area. While the project area will be attractive to Kauai residents due to the proximity to commercial centers and public recreational facilities, it is unlikely to be attractive to short-term residents who would rather be near the ocean, in a scenic area and/or a golf course.

To meet this residential housing need, a variety of single and multi-family residential units will need to be planned and developed within the Lihue District. Generally consistent with the Lihue District housing trends, approximately 70 to 75 percent of the homes would be single family residences and approximately 25 to 30 percent would be multi-family residences to meet market demands.

The Lihue-Hanamaulu Master Plan has been planned to provide for a portion of the Lihue District housing need over a 15 to 20 year period (1997 to 2016). Based on these market projections, the Lihue-Hanamaulu Master Plan has provided a development plan that is consistent with the projected residential needs of the Lihue District. Assuming the necessary land use approvals are obtained, the initial phase of residential development could be available as early as 1997.

2.5.1.1 Single Family Residential

Based on the strong locational attributes of the project area, the opportunities for an appealing mix *of product types, and consideration of other planned residential projects within the Lihue District,* the market analysis has projected that 30 to 40 percent of the Lihue District's single-family residential needs could be met by the Lihue-Hanamaulu Master Plan. The market analysis projects that by the year 2016, the project could have provided 1,009 to 1,366 single-family homes.

By providing a variety of product types, from traditional single family detached homes on lots ranging from 5,000 to 10,000 square feet to clustered and zero-lot-line homes on lots of 3,500 to 5,000 square feet, the Project would be able to provide housing at affordable, gap and market prices. With approximately 180 acres planned for single family residential use that would be developed at densities ranging from 3.5 to 9 dwelling units per acre, the project area can provide approximately 1,000 to 1,250 sites for single-family homes.

2.5.1.2 Multi-Family

The multi-family residential uses within the project would provide primarily for the affordable and rental housing market needs. Opportunities to provide market multi-family residences are also available within the Project. With the strong locational attributes of the project area and the relative lack of planned multi-family housing areas within the Lihue District, the market analysis has projected that 35 to 45 percent of the demand for the multi-family residential units within the Lihue District would be met within the project area. By the year 2016, it is projected that approximately 299 to 384 units could be absorbed by the project.

To meet the full spectrum of the market needs, the multi-family residences would be developed at densities ranging from 10 to 20 dwelling units per acre in a variety of single and multi-story configurations. As master planned, approximately 35 acres would be developed as multi-family residences and provide 400 to 550 units.

2.5.2 COMMERCIAL

Approximately 70 gross acres of commercial use are planned within the project. Master planned to meet future district and regional commercial needs and to provide compatible land uses for lands impacted by the noise of the nearby Lihue Airport, the planned retail and office uses are concentrated primarily within the Molokoa area of the project. Served by major collector roadways, the village center within Molokoa would provide village mixed uses with a variety of retail, service and office uses to augment Lihue's role as the island's commercial center.

The market analysis identifies the retail potential of the project to provide a community/neighborhood center offering a major drugstore and supermarkets, a visitor-oriented Kauai products specialty retail center, and a convenience center. Office space demand would be generated by the anticipated growth of the Lihue district and based on Lihue's role as the civic and commercial center of Kauai, the project is ideally located to meet a high proportion of the district's need for office space.

2.5.2.1 Retail

Based on an evaluation of district and island-wide needs, the market analysis projects a need for 755,802 additional square feet of additional gross leasable retail space between 1995 and 2020 for the Lihue District. Assuming the project captures approximately 40 percent of the increased demand for retail space between 1997 and 2016, the project could provide for approximately 328,500 square feet of gross leasable area. Assuming the needed floor area were developed at an average floor area ratio of 23 percent, approximately 45 net acres could be absorbed for retail uses within the project.

2.5.2.2 Office

The demand for office space was determined through an examination of current and future market forces as well as a review of the current office supply in the Lihue area. Located within Lihue and near employment generating areas such as the existing central business district, Nawiliwili Harbor, the Lihue Airport, the Lihue Industrial subdivision, and the Kauai Lagoons resort area, the market analysis has assumed a capture rate of 50 to 60 percent of the Lihue demand for office space.

As such, the project could provide for approximately 189,500 square feet of gross leasable area by the year 2016. Developed at an average floor area ratio of 23 percent, approximately 25 net acres could be absorbed for office uses within the 15 to 20 year development of the project.

2.5.3 INDUSTRIAL

The project has a number of locational advantages which make it a desirable site for industrial activities, including close proximity to the Lihue Airport and Nawiliwili Harbor, good roadway access to all parts of Kauai, the presence of the existing Lihue Industrial subdivision, and convenient access to commercial areas in Lihue. Future industrial land use needs are likely to include service facilities for airport related activities, motor vehicle-oriented service transportation businesses, wholesale operations, food processing and packaging facilities, building industry businesses and local consumer-oriented businesses.

With the noted desirable attributes of the site, and the assessment of other potential industrial areas within the Lihue district, the market analysis has projected a capture rate of 40 percent of the Lihue District industrial space demand. By the year 2016, the project would have the potential to provide for approximately 950,000 square feet of gross leasable area. Assuming an average build-out of the industrial lands at a floor area ratio of 23 percent, approximately 95 net acres of industrial land could be absorbed within the project.

As master planned, the Ahukini Makai area of the project provides approximately 102 gross acres of industrial land that, when improved, would yield approximately 95 acres of developable industrial property. The balance of the demand for industrial and service related uses would be provided in the approximately 26 acres of property within Ahukini Mauka along the Kapule Highway. These lands would be reserved for more community service related uses that are compatible to the planned residential uses.

2.6 DEVELOPMENT TIMETABLE

The current schedule anticipates that all approvals for development will be in place to allow for major infrastructure development to begin in late 1996 or 1997. The first phase of development will focus on the establishment of infrastructure, construction of residential dwelling units, commercial retail/office development, and industrial land uses. The planned quasi-public facilities will be completed at the appropriate time during the development period. The Veterans' Center was completed in 1994. The County's Lihue Debris Recycling Station and the Kauai Fruit Disinfestation Facility are expected to be constructed and in operation by the end of 1995.

The schedule for the development of the Police Station, the State judiciary complex, the YMCA/teen center, the elementary school, and County parks has not been determined. These planned public facilities will be developed by several public and quasi-public entities; as such, the Developer has no control over their time of completion.

LAND USE AND DEVELOPMENT PERMITS	Tentative Schedule
Environmental Impact Statement	4/94 -1/95
General Plan Amendment	4/94 - 8/95
State Land Use Boundary Amendment	5/94 - 11/95
County Zoning Change	11/95 - 8/96
County Subdivision/Construction Permits	8/96 - 7/97

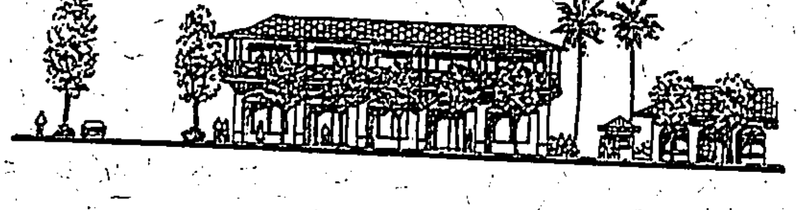
2.7 APPROXIMATE INFRASTRUCTURE COSTS

The total estimated construction cost for on-site and off-site infrastructure improvements is approximately $55 to $65 million. These costs are preliminary and based on the Conceptual Master Plan. Costs will be refined as more detailed development plans are prepared and alternatives are selected. The order of magnitude costs (1994 dollars) are broken down as follows:

INFRASTRUCTURE COST SUMMARY	TOTAL COST
Onsite Roads/Electricity	$10 million to $12 million
Onsite Water	$ 1 million to $ 2 million
Onsite Sewer	$ 2 million to $ 2.5 million
Onsite Drainage	$ 3 million to $ 3.5 million
Offsite Roads/Electricity	$ 8 million to $ 8.5 million
Offsite Water	$ 8 million to $10 million
Offsite Sewer	$22 million to $25 million
Offsite Drainage	$ 1 million to $ 1.5 million
TOTAL:	$55 million to $65 million

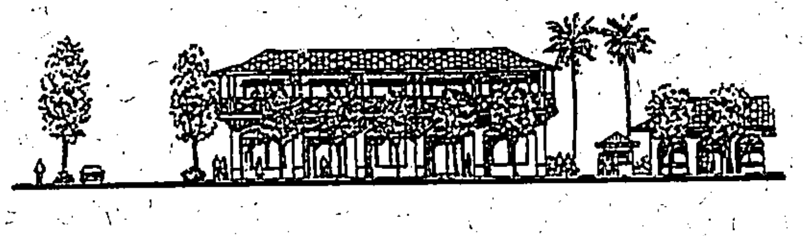
3.0

REQUIRED APPROVALS AND PERMITS FOR THE LIHUE-HANAMAULU MASTER PLAN



3.0

REQUIRED APPROVALS AND PERMITS FOR THE LIHUE-HANAMAULU MASTER PLAN



3.0 REQUIRED APPROVALS AND PERMITS FOR THE LIHUE-HANAMAULU MASTER PLAN

The Lihue-Hanamaulu Master Plan will require several entitlements including a State Land Use District Boundary Amendment and a County General Plan Amendment. This Final EIS is prepared pursuant to Chapter 343, Hawaii Revised Statutes, in conjunction with the State Land Use and General Plan Amendment petitions.

Two facilities in the Master Plan Area, the County's Lihue Debris Recycling Station and the University of Hawaii's Tropical Fruit Disinfestation Facility, proposed within the industrial area at Ahukini Makai, are undergoing independent Chapter 343 review for the respective facilities. A Draft Environmental Assessment ("EA") for the Recycling Station was published in the OEQC Bulletin on August 8, 1994. The Disinfestation Facility Final EA has been completed. Both facilities are planned to be completed and operating by late 1995. Impacts which are identified for the Recycling Station and the Fruit Disinfestation Facility are being addressed by the County and the University of Hawaii, respectively; and are summarized in this Final EIS, where appropriate.

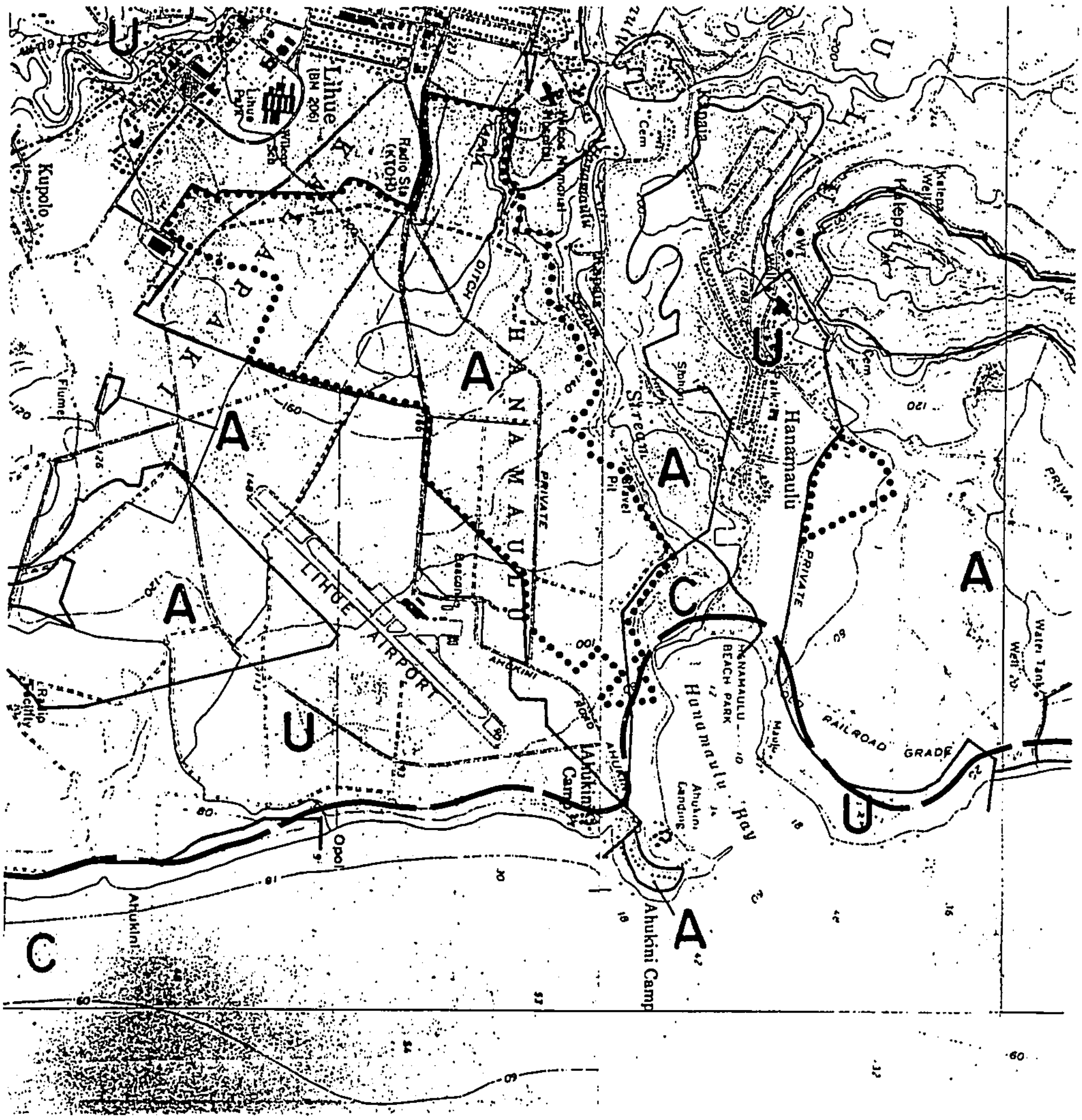
3.1 STATE OF HAWAII

3.1.1 State Land Use District Boundary Amendment

Current Land Use Classification. Most of the project site currently lies in the State Agricultural District and is in active sugarcane cultivation. A small portion is in the State Conservation District, General and Limited subzones, also in sugar cane (Figure 3-1).

Proposed Reclassification. The proposed uses in the Lihue-Hanamaulu Master Plan Area require the reclassification of the lands to the State Urban District. As such, 554.642acres ("555 acres") of land in the Agricultural District (541.769 acres) and Conservation District (12.873 acres) are being requested for reclassification to the State Urban District. The petition area is shown in Figure 3-2).

Responsible Agency. A petition for reclassification and a Notice of Preparation for an EIS were filed with the State Land Use Commission and Office of State Planning in May 1994.



LEGEND

U	URBAN
A	AGRICULTURE
C	CONSERVATION
	PROJECT AREA BOUNDARY
	SMA LINE

Source: State Land Use Commission; Kauai County–Office of Economic Development.

FIGURE 3-1
EXISTING STATE LAND USE DISTRICT BOUNDARIES
LIHUE-HANAMAULU

AMFAC/JMB HAWAII — LIHUE DISTRICT, ISLAND OF KAUAI

NORTH — LINEAL SCALE 300 0 500 1000 2000 FEET

PBR HAWAII

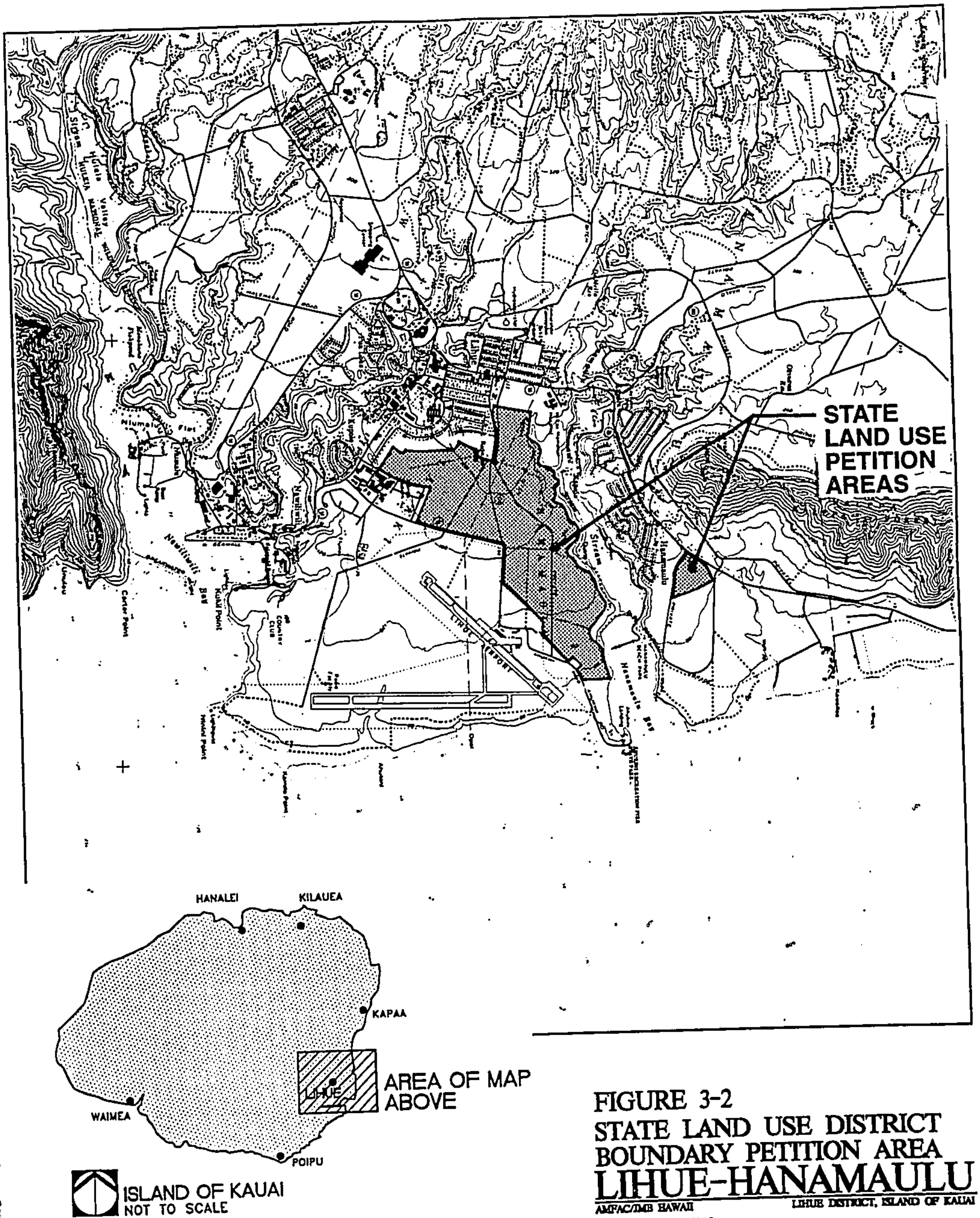


FIGURE 3-2
STATE LAND USE DISTRICT
BOUNDARY PETITION AREA
LIHUE-HANAMAULU

AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI

NORTH
LINEAL SCALE
1000 0 1000 2000 4000
FEET

PBR HAWAII

3.2 COUNTY OF KAUAI

3.2.1 General Plan Amendment

Existing General Plan. The County of Kauai is divided into six General Plan ("GP") areas which are designated on seven maps. The Master Plan area is included on the Lihue Map and is shown in Figure 3-3. The Master Plan area adjacent to Lihue contains several General Plan designations, the most predominant being Agricultural (A), which reflects the current land use (sugar cane cultivation) by LPCo. Portions of the Master Plan area adjacent to Lihue are already designated as Urban Mixed Uses (UMU), a designation similar to the greater Lihue area. As such, some of the Master Plan area (approximately 20 percent) is already appropriately designated and consistent with the General Plan. The land within the Hanamaulu Stream gulch is designated as Open (O) and a small portion of land immediately mauka of Lihue Airport is designated as Public Facility (PF). Within the Hanamaulu portion of the project, the GP designation is Urban Residential (UR) consistent with the existing designation of Hanamaulu town.

Proposed General Plan Amendment. Portions of the Lihue GP map which contain the Master Plan Area, consisting of Agricultural (A) and Public Facility (PF) designations, require a GP amendment to (UMU) to be consistent with the proposed Master Plan, as shown on Figures 3-4 and 3-5. To implement the Master Plan, a request has been made to amend 409 acres from (A) to (UMU), and 32 acres from (PF) to (UMU).

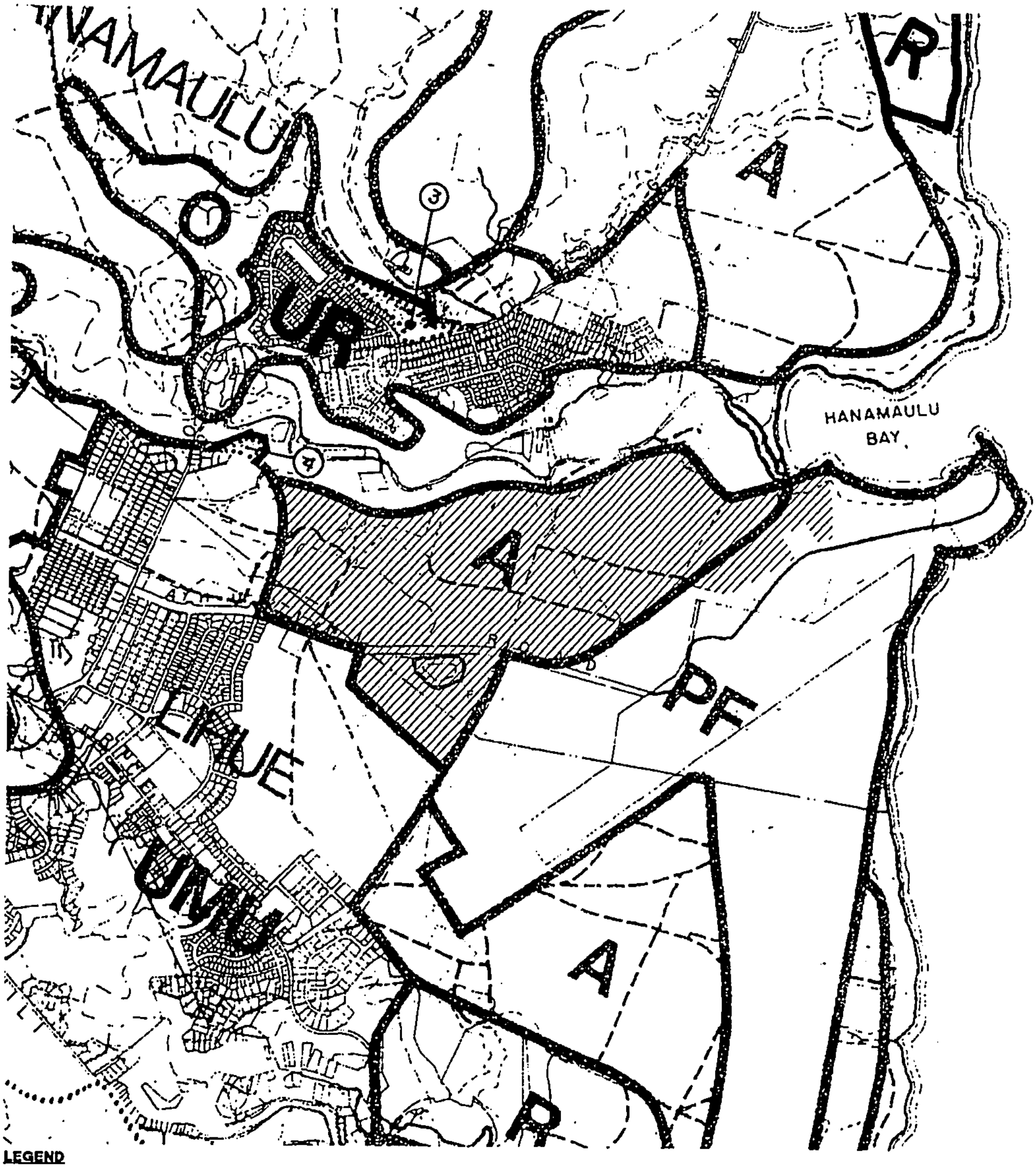
Responsible Agency. An application to amend the GP was submitted to the Planning Commission in May 1994. A public hearing was held in July and October. A recommendation by the Planning Commission will be made to the Kauai County Council upon acceptance of the Final EIS. The proposed GP Amendment is subject to approval by the County Council and the Mayor.

3.2.2 Change of Zone

Existing Zoning. The entire property is in the Agriculture District (A).

Proposed Change of Zone: Detailed site planning for a Change of Zone for the Master Plan Area will follow the SLUDBA and GP amendment decision. The project area will require the appropriate residential, commercial, industrial, and open zone changes to implement the Master Plan.

Responsible Agency. The proposed change of zone to the Kauai Zoning Code is by Ordinance and is subject to approval by the County Council and the Mayor. The review process involves public hearings before both the Planning Commission and the County Council.



LEGEND

PF PUBLIC FACILITIES

A AGRICULTURE

O OPEN

UMU URBAN MIXED USE

UR URBAN RESIDENTIAL

R RESORT

GP APPLICATION AREA

FIGURE 3-3
EXISTING GENERAL PLAN
LIHUE-HANAMAULU

AMFAC/JMB HAWAII

LIHUE DISTRICT, ISLAND OF KAUAI

NORTH

LINEAL SCALE

500 0 500 1000 2000

FEET

PBR HAWAII

Source: Kauai County Planning Commission.

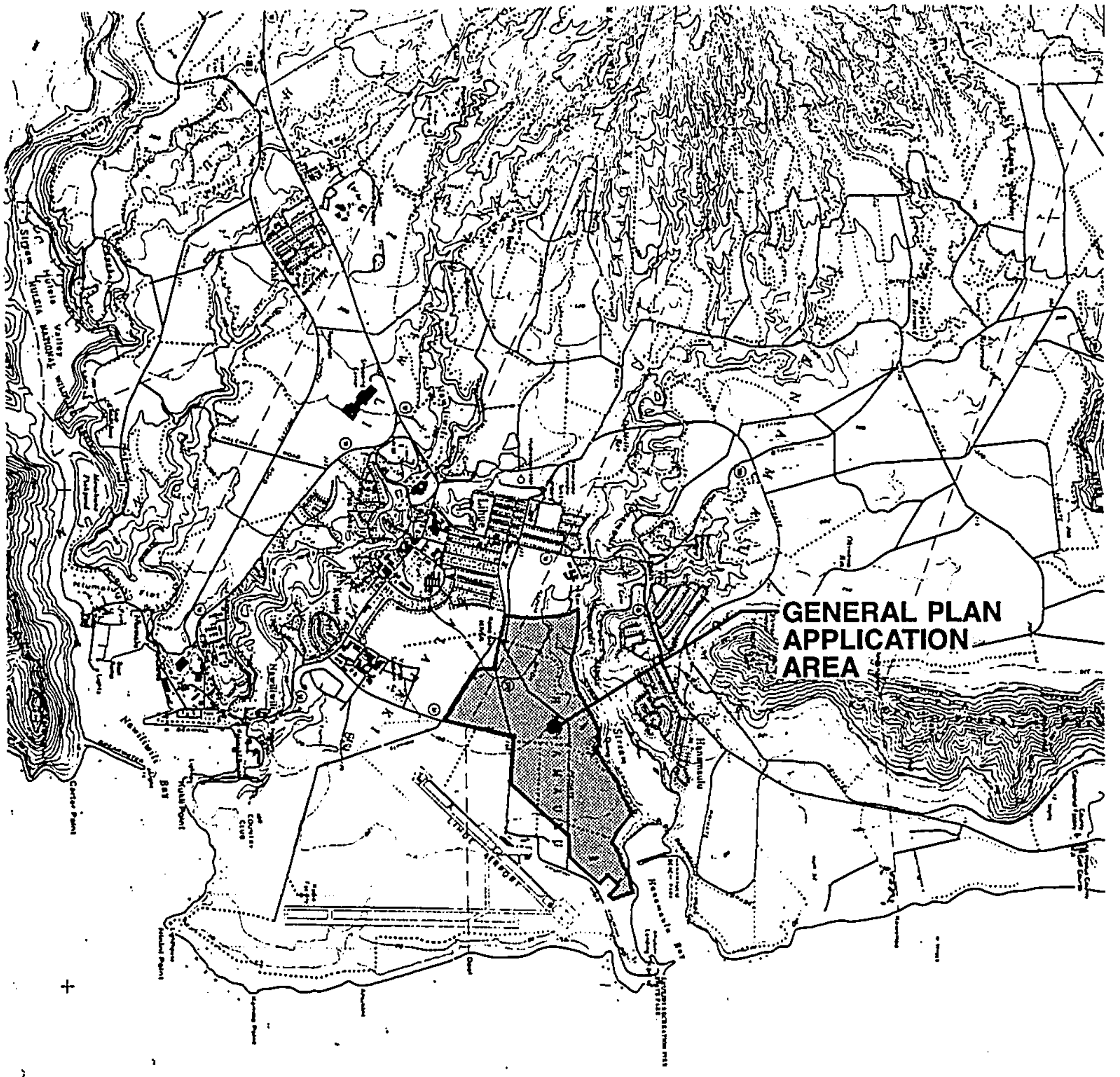
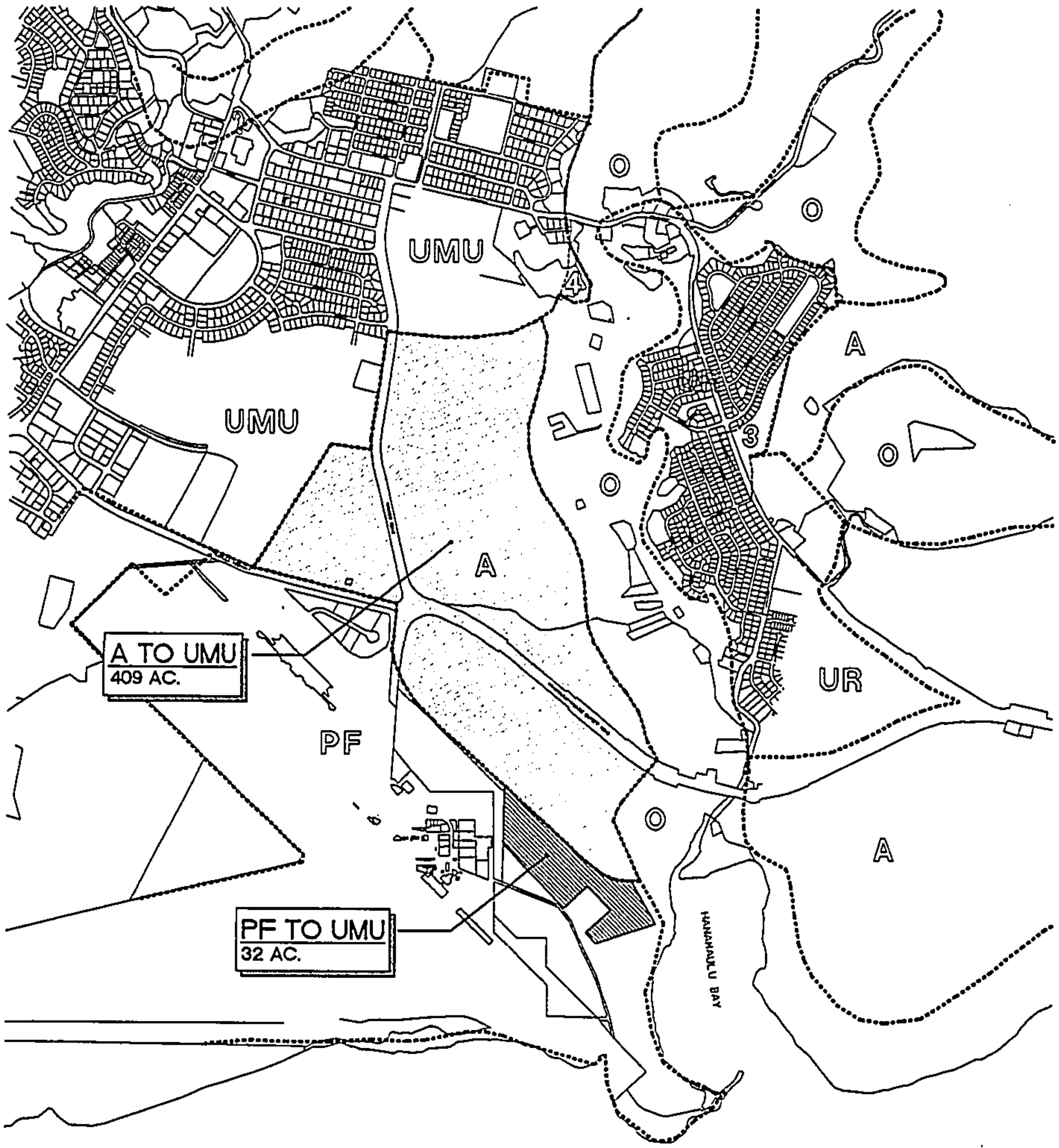


FIGURE 3-4
GENERAL PLAN
APPLICATION AREA
LIHUE-HANAMAULU
AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI
NORTH
LINEAL SCALE
1000 0 1000 2000 4000
FEET
PBR HAWAII



LEGEND

PF	EXISTING PUBLIC FACILITY (PF) DESIGNATION
A	EXISTING AGRICULTURAL (A) DESIGNATION
O	EXISTING OPEN (O) DESIGNATION
UMU	EXISTING URBAN MIXED USE (UMU) DESIGNATION
	EXISTING GENERAL PLAN BOUNDARY
	PROPOSED (A) TO (UMU) DESIGNATION
	PROPOSED (PF) TO (UMU) DESIGNATION

FIGURE 3-5
PROPOSED
GENERAL PLAN AMENDMENT
LIHUE-HANAMAULU

AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI

NORTH
LINEAL SCALE
500 0 500 1000 2000
FEET

PBR HAWAII

3.2.3 Special Management Area Use Permit (SMP)

A small portion of the 35-acre parcel for the County's Recycling Station is in the SMA as shown on Figure 3-1. The County is presently processing a Special Management Area Use Permit Application for the facility. No other area of the Master Plan Area is within the SMA.

3.2.4 Use Permits

Use permits may be required to allow specific uses with the zoning districts. This will be determined during the zoning process through discussions with the County Planning staff.

3.3 OTHER REQUIRED PERMITS

- Well Drilling/Pump Installation/Water Withdrawal Permit (State Water Commission)
- Wastewater Treatment System Approval (State Department of Health, County Department of Public Works
- Roadway Modification Approvals (State Department of Transportation)
- Grading/Building Permits (Department of Public Works)
- National Pollutant Discharge Elimination System (NPDES) (State Department of Health)

4.0

ASSESSMENT OF THE EXISTING NATURAL ENVIRONMENT, POTENTIAL IMPACTS AND MITIGATIVE MEASURES

4.0 ASSESSMENT OF THE EXISTING NATURAL ENVIRONMENT, POTENTIAL IMPACTS AND MITIGATIVE MEASURES

Background information on the existing natural and physical environment is presented in this section to evaluate the project for its potential to generate significant environmental impacts. Impact discussions are classified as short-term construction-related impacts and long-term operational impacts. Mitigative measures to offset the impacts are presented.

4.1 CLIMATE

A. Existing Conditions

The average annual temperatures recorded at the Lihue Plantation range between a high of 77 degrees F and a low of 81 degrees F. The range in normal temperature between the coolest month (February) to the warmest month (August) averages less than 8 degrees F. The daily range in temperature is also small, averaging less than 15 degrees F. From July through September, average daily maximum temperatures are 85 degrees. The average annual rainfall at the airport is 35 inches, and the wind speed varies from 13 to 24 miles per hour from the northeasterly direction. The average relative humidity recorded at Lihue Airport is 67 percent in the middle of the afternoon and 83 percent in the early morning hours.

Trade wind showers are relatively common and although heavy rains occur at times, most of the showers are light and of short duration. Normal annual rainfall is greater than 40 inches, three-fourths of which occurs during the wet season from October through April. Normal precipitation in January, the wettest month, is over 6 inches, and in June, the driest month, averages one and one-half inches.

Surface winds are generally around 13 to 24 miles per hour from the northeast. There are some seasonal changes in prevailing wind direction in winter with southerly Kona winds. Strong winds do occur at times in connection with storm systems moving through the area. Wind velocities and directions are influenced to an important extent by the mountainous terrain to the south and west. Daily variations include diurnal effects of winds from the southwest quadrant during the night and morning hours, shifting to the northeast during the day.

B. Anticipated Impacts and Mitigative Measures

Design of the proposed project will be typical for a tropical climate. The proposed project will have no effect on climatic conditions and no mitigative measures are necessary. Project landscaping will mitigate localized temperature increases from parking areas, roadways, and buildings, and design guidelines will incorporate building orientation recommendations during the design process.

4.2 PHYSICAL CHARACTERISTICS

A. Existing Conditions

The project area is located south of Kalepa Ridge. Kalepa Ridge represents an erosional remnant of lava of the original volcanic dome on Kauai. It also forms (with the Nonou Ridge) the eastern boundary of the Lihue Depression, a collapsed caldera.

The rocks of Kalepa Ridge are part of the Napali formation of the Waimea Canyon volcanic series of the Pliocene age. The Napali formation rocks are gently dipping, thin flows of olivine basalt. Dikes are present in the Napali formation of Kalepa Ridge but their effect on ground water is unknown. In general, these rocks are highly permeable and form an excellent source of ground water.

Overlying the Napali formation and separated by an erosional unconformity are the rocks of the Koloa volcanic series. These volcanic flows and ash deposits floor much of the Lihue Depression. The Project Area is located on the lava flows of the Koloa volcanic series. The Koloa volcanic series consists of materials that are dense to moderately dense. Lava flows are pahoehoe and a'a, the latter being more abundant.

There are no distinctive physical features within the Project Area. Currently under sugar cane cultivation, the Project Area is a plateau which gradually rises from the makai end to the mauka boundary with gentle slopes ranging from 0 to 8 percent over the length of the Project Area. Elevations range from 75 to 220 feet. The northern boundary of the Project Area borders Hanamaulu Stream gulch.

B. Anticipated Impacts

The implementation of the Lihue-Hanamaulu Master Plan will require earthwork and grading of the soils over the 15 to 20 year buildout period, an average of 37 acres annually. As an urban in-fill project, the plan incorporates residential, commercial, industrial, public facility and park uses which will require different levels of site preparation. Development of building sites will require grading to establish level building surfaces with drainage improvements to direct surface flows into the project's drainage system. Due to the relatively minor slopes characteristics of the topography, project development will not require extensive cut and fill for construction.

C. Mitigative Measures

(1) **Utilization of the Natural Topography.** The natural topography of the land will not require any major cut and fill of building areas, therefore impacts to the topography will be minimized.

(2) **Grading Ordinance Compliance.** All grading operations will be conducted in full compliance with dust and erosion control and other requirements of the Kauai County Grading Ordinance. A grading permit is a requirement to modify the topography. In addition, a National

Pollutant Discharge Elimination System (NPDES) permit will also be required prior to construction to address non-point source discharges to bodies of water.

4.3 SOILS

A. Existing Conditions

There have been three soil suitability studies prepared for Hawaii whose principal focus has been on describing the physical attributes of land and the relative productivity of different land types for agricultural production. These are: the Land Study Bureau Detailed Land Classification, the U.S. Department of Agriculture Soil Conservation Service Soil Survey, and the Agricultural Lands of Importance to the State of Hawaii (ALISH).

4.3.1 Land Study Bureau Detailed Land Classification

The Land Study Bureau Detailed Land Classification (1965 through 1972) series was produced by the Land Study Bureau (LSB) of the University of Hawaii for each island. This series of reports were produced with the intention of developing a land inventory and productivity evaluation based on statewide "standards" of crop yields and levels of management.

The LSB land classification is a synthesis of the information found in the 1955 Soil Survey for the Territory of Hawaii as well as several other sources for data on geology, topography, climate, water resources and crops. The LSB classification system groups land into homogeneous units called Land Types, describes their condition and environment, delineates the areas on aerial photo base maps, rates the lands on their overall quality (productivity) in relation to other lands, and appraises their performance under selected alternative agricultural crops. The productivity evaluations were based on statewide standards of crop yields and levels of management at the time the classification was made.

According to Section 205-4.5 of the Hawaii Revised Statues, the LSB studies define the areas in the State Agricultural District wherein specific agricultural uses are permitted and where restrictions relating to the disposition of the land are applicable.

A five-class productivity rating is applied using the letters A, B, C, D and E, with A representing the class of highest productivity and E the lowest. The Project Area soils are rated B (specifically, B41i), which reflects its present and past use for sugar cultivation under irrigated conditions (Figure 4-1). A and B soils represent 40,000 acres on Kauai. Consequently, the use of the Project Area for urban uses represents less than 1.3 percent of the soils on Kauai rated B or better.

LEGEND

B4li	NON-STONY; OVER 30" DEEP; 0–10% SLOPE; WELL DRAINED WITH A MODERATELY FINE TEXTURE
D44 D44i	NON-STONY; OVER 30" DEEP; 21–35% SLOPE; WELL DRAINED WITH A MODERATELY FINE TEXTURE
E87	NON-STONY TO ROCKY; VARIABLE DEPTH; 36–80% SLOPE; WELL DRAINED WITH A MEDIUM TO FINE TEXTURE
•••••	PROJECT AREA BOUNDARY

FIGURE 4-1
DETAILED LAND CLASSIFICATION
LIHUE-HANAMAULU

AMFAC/JMB HAWAII — LIHUE DISTRICT, ISLAND OF KAUAI

NORTH — LINEAL SCALE 500 0 500 1000 2000 FEET

PBR HAWAII

Source: Land Study Bureau, University of Hawaii-State of Hawaii, May 1967.

4.3.2 Soil Conservation Service Soil Survey

The Soil Conservation Service Soil Survey (1972) series for each island was prepared by the U.S. Department of Agriculture Soil Conservation Service (SCS) and the University of Hawaii Agricultural Experiment Station. These reports are somewhat similar to those of the Land Study Bureau, except that they are patterned after a soil classification procedure adapted for nationwide, uniform application. Soil types are ranked according to their suitability for most kinds of crops. Also provided are listings of crops commonly grown on the soil types and their expected productivity under present management.

Except for the former reservoir site located in TMK 3-6-02: 01 (south of Ahukini Road), all of the soils on site are of the Lihue Series (Figure 4-2). Specifically, nearly all the soils are classified Lihue Silty Clay (LhB) except for approximately 20 acres in TMK 3-6-02: 01 that are classified Lihue Gravelly Silty Clay (LIB). Both have 0 to 8 percent slopes. This series consists of well-drained soils on uplands on the island of Kauai developed in material weathered from basic igneous rock. The annual rainfall on this series amounts to 40 to 60 inches. Lihue Silty Clay is found on the tops of the uplands. Permeability is moderately rapid. Runoff is slow, and erosion hazard is no more than slight. The characteristics of Lihue Gravelly Silty Clay are similar to Lihue Silty Clay.

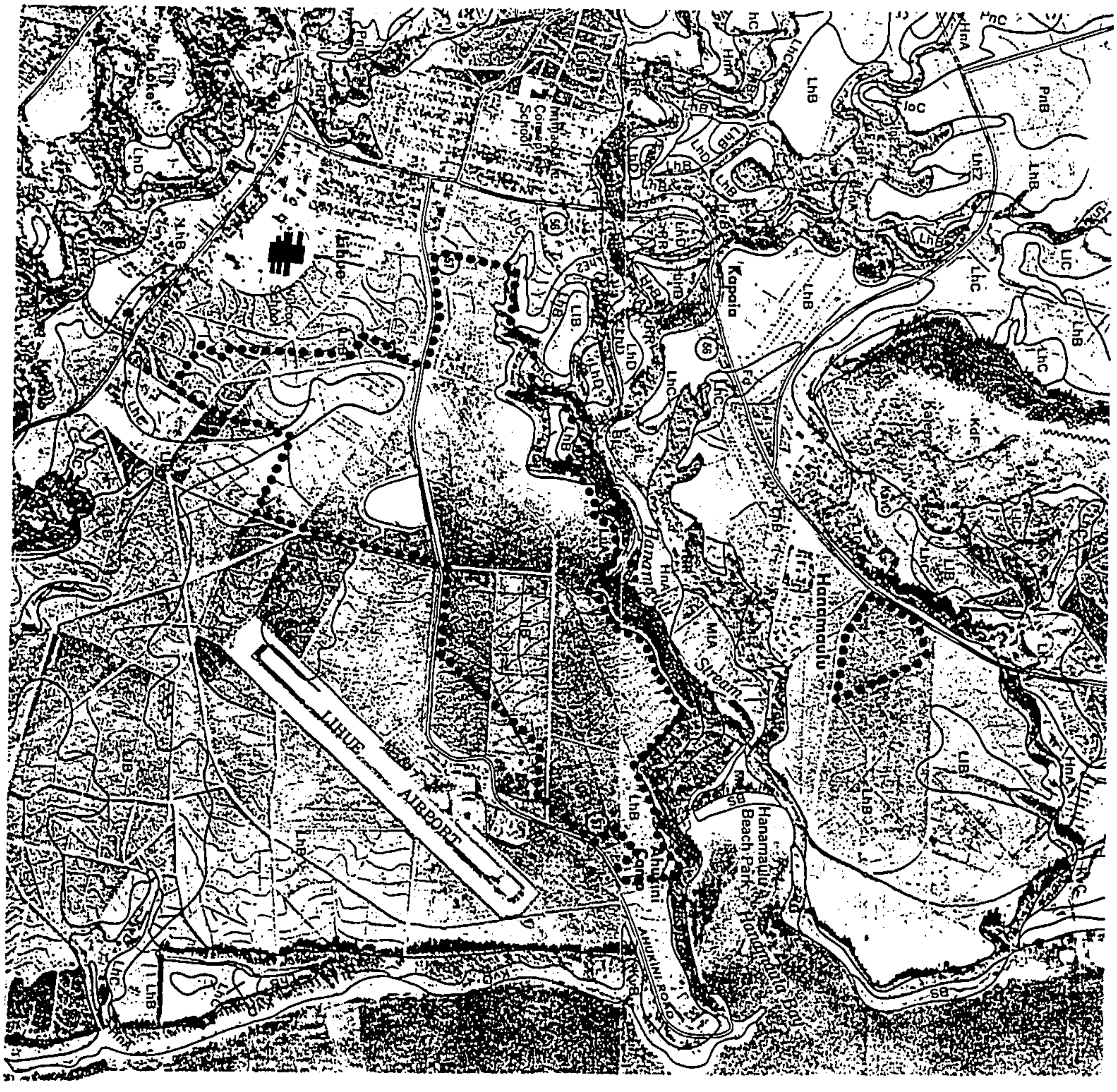
4.3.3 Agricultural Lands of Importance to the State of Hawaii

The Agricultural Lands of Importance to the State of Hawaii (ALISH) (1977) system includes the entire state. The ALISH system consists of the mapped identification of three broad classes of agricultural land based, in part, on the criteria established by the Soil Conservation Service (Figure 8); Prime, Unique, and Other Important Agricultural Land.

Except for the former reservoir site located in TMK 3-6-02: 01, nearly all of the areas of application are located on lands designated as "Prime Agricultural Land" (Figure 4-3). The former reservoir site is unclassified. Although the ALISH system classifies the Project Area as "prime", this definition does not factor in other important criteria such as compatibility with surrounding land uses. According to the project's Agricultural Assessment, the Project Area constitutes less than 1 percent of the prime lands on Kauai.

B. Anticipated Impacts

Clearing and grubbing activities during construction will temporarily disturb portions of the existing sugar fields and expose the soils to erosional forces. However, development of the 555 acres is planned over a 15 to 20 year buildout period, with sugar cane phasing out over a period of time. Therefore, the grading for project development is expected to be substantially less than under the present condition of agricultural use where large areas of soil are exposed in the period between harvesting and planting.



LEGEND

- LhB — LIHUE SILTY CLAY, 0–8% SLOPES
- LhC — LIHUE SILTY CLAY, 8–15% SLOPES
- LhE2 — LIHUE SILTY CLAY, 25–40% SLOPES, ERODED
- rRR — ROUGH BROKEN LAND
- •••• — PROJECT AREA BOUNDARY

FIGURE 4-2
SCS SOIL SURVEY
LIHUE-HANAMAULU

AMFAC/JMB HAWAII — LIHUE DISTRICT, ISLAND OF KAUAI

NORTH — LINEAL SCALE 500 0 500 1000 2000 FEET

Source: U.S. Dept. of Agriculture, Soil Conservation Service & University of Hawaii, Aug. 1972.

LEGEND

PRIME AGRICULTURAL LAND

OTHER IMPORTANT AGRICULTURAL LAND

PROJECT AREA BOUNDARY

Source: Dept. of Agriculture–State of Hawaii, Jan. 1977.

FIGURE 4-3
ALISH
LIHUE-HANAMAULU
AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI
NORTH
LINEAL SCALE
500 0 500 1000 2000
FEET
PBR HAWAII

The soil loss potential during the construction phase of the project development period has been calculated by Kodani & Associates (September 1994) in the project Drainage Study (Appendix D). According to the drainage study, soil erosion during the construction phase will actually decline compared to the current agricultural use and overall soil loss will be reduced significantly after the third year of development. As portions of the Project Area are developed, there will also be beneficial impacts resulting from the project's landscaping plan.

C. Mitigative Measures

Mitigative measures will be implemented to reduce short-term soil erosion during construction.

(1) Construction Erosion Control. Construction activities will follow strict erosion control measures specified by applicable Federal, State and County regulations. Prior to issuance of a grading permit by the County Department of Public Works, an erosion control plan and best management practices required for the NPDES permit will be submitted describing the implementation of appropriate erosion control measures. These generally include use of cut-off ditches, temporary ground cover, and use of detention areas.

(2) Watering and Landscaping. A watering program will be implemented to minimize soil loss through fugitive dust emissions during construction. Other control measures include cleaning of construction equipment on the job-site and establishment of ground cover as quickly as possible after grading.

(3) Landscaping and Long-Term Erosion Control. Permanent landscaping will re-establish the soil retention values throughout the Project Area. This extensive, continuous, and long-term landscape management program for the property will significantly reduce erosion from the present conditions under agricultural use.

(4) Other Mitigation. In addition to those listed above, erosion control measures to further lessen construction impacts include:

a. Early construction of drainage control features.
b. Station water trucks on-site during the construction period to provide immediate sprinkling as needed in construction zones (weekends and holidays included).
c. Plant and establish ground cover immediately after grading work has been completed.
d. Construct temporary sediment basins to trap silt.
e. Use temporary berms, cut-off ditches, and other diversion channels where needed to interrupt and divert flows to the nearest sediment basin.
f. Construct temporary silt fences or straw bale barriers to trap silt.
g. Reduce the amount of exposed soils from agricultural areas during project construction by maintaining ground cover (i.e. sugar cane) during project construction. This will ensure that total net soils erosion does not exceed current levels.

4.4 AGRICULTURAL IMPACT

This section includes a discussion of the existing agricultural uses of the site, its potential for future agricultural use, impacts on LPCo and the sugar industry. The Agricultural Assessment Report is included in its entirety in Appendix G.

A. Existing Conditions

According to the Agricultural Assessment, the agricultural suitability of the proposed project can be expressed in terms of impacts on LPCo, the County of Kauai and the State of Hawaii.

The Lihue Plantation Company

LPCo is the largest sugar plantation on Kauai and the second largest in the State that has not announced plans to close. It currently farms approximately 11,200 acres on lands it either owns or leases from Grove Farm, and the State of Hawaii. From these lands, approximately 50,000 tons of raw sugar and 14,000 tons of molasses are produced annually. The Project Area consists of approximately 5 percent of the total lands farmed by LPCo. Electricity is also produced by burning bagasse which is then sold to Kauai Electric and also used for internal purposes. LPCo is currently operating at a slight loss.

Even though the Project Area is relatively close to the mill, indirect costs are incurred which largely offset this benefit. The fact that the airport, hospital, schools and residences are adjacent to these fields imposes cultivation restrictions that increase costs. Consequently, burning days and cultivation days are limited to those when weather and soil conditions will minimize the impact of the smoke and dust. From a broad agricultural market perspective, the Project Area does have the advantage of being proximate to the principal shipping points, Nawiliwili Harbor. However, this advantage is lost when compared to similar agricultural lands on Oahu which are much closer to the primary market.

State of Hawaii and County of Kauai

According to Appendix G, Agricultural lands of similar or better quality are not scarce, but found throughout the State. As of 1992, 212,000 acres in Hawaii were used for crop production compared to 325,400 used in 1968, down by 113,000 acres. On the Island of Kauai, the acreage of land taken out of production since 1968 was 19,000 acres, the majority of which is due to the loss of sugarcane acreage, resulting in a balance of 35,000 acres in active cultivation.

The agricultural significance of the subject lands can be examined in terms of the total amount of existing lands of similar quality. For example, on an island-wide basis, the Project Area is comprised of lands which constitute a very small percentage of lands with a rating of "Prime" (less than 1 percent of Kauai's prime agricultural land).

B. Anticipated Impacts

The Lihue Plantation Company

Even though the development of the proposed project will result in the lost production of sugar on the property, replacement lands are available in Kealia of comparable quality. Consequently, the use of the Project Area for urban development will not be a determining factor in the future of LPCo. Rather, LPCo's future will depend on several other factors, including: U.S. sugar policy which determines the price of sugar, land leases to be re-negotiated in 1995 and 1999, management of changes as they occur, and the costs of processing sugar.

County of Kauai and State of Hawaii

The Agricultural Economic Assessment (Appendix G) indicates that on a statewide basis the amount of agricultural land taken out of production exceeds the amount of land converted to urban land uses by tens of thousands of acres. Therefore, the amount of land used for agriculture has declined primarily due to economic factors, rather than the conversion of land to urban uses.

For the County of Kauai to enter potential export markets, shipping costs and existing problems with pests must be overcome. With the development of the proposed disinfestation facility planned for the project, the export of papaya to new markets should become feasible. However, markets for other diversified agricultural products, such as floral and nursery products, seed, forage crops, and livestock, all depend on competing favorably with imports. As stated in Appendix G, "It is not the availability of land that is limiting the expansion of diversified agriculture, but rather a combination of the small local market and the lack of suitable export crops."

C. Mitigative Measures

The Lihue Plantation Company

(1) **Kealia Replacement Lands.** To mitigate the impact of project development and to support continued operation of LPCo, 500 acres of replacement lands at Kealia are being planted with seed cane. The Kealia lands are suited for seed cane production and are not located proximate to conflicting urban land uses. No significant agricultural infrastructure or other capital expenditures will be required to bring these lands into production. Minimal additional transportation costs are anticipated since the replacement fields are more distant.

(2) **Coordination with LPCo.** During project construction, removal of sugar cane acreage will be coordinated closely with LPCo to ensure that the necessary agricultural infrastructure is not disrupted or removed prematurely. Cane haul roads will be maintained or alternative routes designated to keep production areas viable to the greatest extent possible. Irrigation systems will be altered while maintaining their continued function.

County of Kauai and State of Hawaii

(1) **Kauai Tropical Fruit Disinfestation Facility.** Although the Project Area will be irretrievably lost to future agricultural production, the development of the proposed disinfestation facility will directly benefit diversified agriculture on Kauai by opening up significant new markets for papaya.

(2) **Real Estate Diversification.** In addition, the economic health of Amfac/JMB depends on its two divisions, sugar and real estate. As sugar is operating at a loss, the success of the real estate division could prolong LPCo's sugar operations.

4.5 GROUNDWATER RESOURCES

A. Existing Conditions

To identify existing hydrological conditions, availability of groundwater resources, existing and potential sources of water supply, and potential impacts of the proposed project on groundwater resources, the Molokoa Hydrologic Study (Appendix C) was prepared. The study area encompassed approximately 35 square miles in the southeastern quadrant of Kauai.

The hydrologic study concluded that the Hanamaulu Aquifer System has an estimated recharge of 79 mgd and sustainable yield of 40 mgd. A high-level aquifer occurs in the upper part of the Koloa formations to a depth of 180 to 250 feet below sea level. Underlying this high-level aquifer is a basal aquifer in the lower part of the Koloa formation. Based on the poor yields from two drilled wells in the basal aquifer in Kalepa Ridge, the hydrologic study concluded that the high-level aquifer in Koloa lavas represents the most extensive occurrence of ground water in the study area.

Water quality from the high-level aquifer is not subject to salt water intrusion and has generally pristine values of chlorides (16 to 24 mg/l). Some possible contamination from the leaching of fertilizers and herbicides used in cultivation may have the potential to contaminate ground water. However, nitrate, a good indicator of contamination by fertilizers, occurs in almost pristine amounts of 1.1 mg/l, or less in all existing wells. This is well below the primary drinking water standard of 10 mg/l.

Presently, the County of Kauai pumps an average of approximately 3.34 mgd (including the Kokolau Tunnel located outside of the study area) for use in the Lihue Water System. This is down from the pre-Hurricane Iniki withdrawal rate of 5 mgd from the aquifer system; however, as the recovery continues, it is expected that withdrawal will be reestablished at 5 mgd. Two exploratory wells have been planned by the Kauai Department of Water in the Hanamaulu and Puhi areas. Hanamaulu 1 has been constructed. If successful, water from these new wells will serve the Lihue Water System.

B. Anticipated Impacts

As previously described, the potable water requirements of the proposed project (based on a maximum of 1,800 units) estimates that average daily demand will be approximately 1.75 mgd. Maximum daily demand is projected at approximately 2.68 mgd.

Presently, the County's Lihue Water System, which currently serves the area surrounding the proposed development, does not have sufficient source capacity to meet the projected water requirements of the project. However, the 40 mgd sustainable yield of the Hanamaulu Aquifer System far exceeds the estimated 5 mgd withdrawal from the aquifer system. Consequently, adding the 1.75 mgd demand from the proposed project (totaling 6.75 mgd) represents only 16.9 percent of the sustainable yield and will not significantly impact the groundwater resource.

According to the Molokoa Hydrologic Study (Appendix C),

"The withdrawal of 1.75 mgd of ground water at full build-out of the proposed development will have no measurable impact on groundwater quality of the aquifer system because the amount represents only 2.2 percent of estimated 79 mg of aquifer recharge. The proposed development lies hydrologically down-gradient of existing urban areas and is underlain by the seaward part of high-level and basal aquifers which are not considered a potential source of drinking water because they are subject to salt water intrusion and potential contamination from existing urban developments.

The State Department of Health has established the UIC line along Kapule Highway which runs through the Project Area. The primary purpose of the UIC line is to protect potential sources of drinking water by not allowing wastewater injection wells or cesspools mauka of the line. However, no injection wells or cesspools are proposed and any runoff or wastewater disposal required for the project will be done in full compliance with the UIC and other applicable regulations."

C. Mitigation Measures

No measurable impact on groundwater quality is anticipated since the sustainable yield of the Hanamaulu Aquifer far exceeds the expected demand of the project and the current withdrawal rates of the County; therefore no mitigative measures are necessary.

4.6 MARINE RESOURCES

The marine environment nearby the Project Area was studied by Richard E. Brock, Ph.D. of Environmental Assessment Co. to evaluate the existing marine communities and water quality to establish a baseline. The study area included Hanamaulu Bay and the shoreline in the vicinity of three existing ocean drain channel discharges nearby the project. In addition to the baseline analyses the studies assessed the potential impact on these areas as a result of the development of the Lihue-Hanamaulu Master Plan.

The Hanamaulu Bay study (Appendix H) was undertaken in July 1994. A separate study on Hanamaulu Stream was done by Ron Englund (Appendix I). Together the studies provide a snapshot of the Hanamaulu Stream, estuary and bay ecosystem. Subsequent to the publication of the Draft EIS in October 1994, and in response to the recommendation of the County Planning Department, the drain channels study was undertaken by Dr. Brock. All studies are appended to this Final EIS.

A. Existing Conditions

Hanamaulu Bay

To identify the potential impacts of the project on Hanamaulu Bay, Dr. Brock's study "A Quantitative Assessment of the Marine Communities and Water Quality in Hanamaulu Bay, Kauai" (Appendix H) was undertaken. This study established baseline conditions for the existing marine communities and water chemistry characteristics of Hanamaulu Bay. Water quality samples were collected at 20 locations; five from Hanamaulu Stream and estuary and 15 from points within the bay to other points approximately 500 meters seaward of the shore (Figure 4-4).

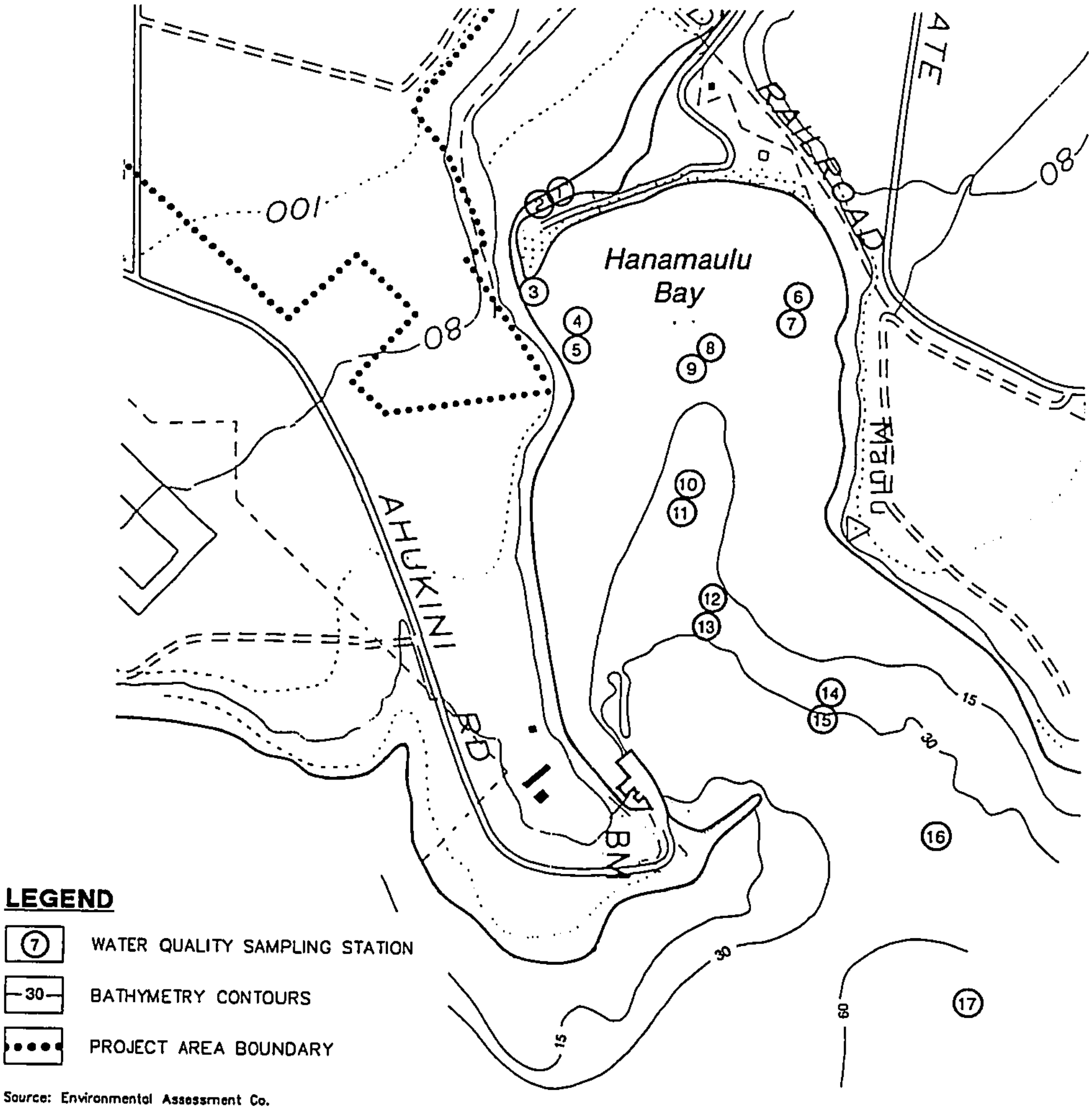
Hanamaulu Bay is an estuary/embayment that was found to be largely influenced by the inputs of Hanamaulu Stream. In general, the study found that the marine communities in Hanamaulu Bay are not well-developed. Coral growth is influenced by freshwater flows of Hanamaulu Stream and by occasional disturbance caused by high surf that impinges on the outer portions of the bay. Because the coral is not well established, shelter for many invertebrate and fish species is lacking or is poorly developed.

The threatened green sea turtle is present in Hanamaulu Bay. The rocky intertidal areas of the bay with its well-developed algal communities could serve as forage for the turtles. Recreational fishing is prominent in Hanamaulu Bay where a number of commercially and recreationally important fish species are taken. Schools of akule are avidly sought in the summer by the public using both nets and hook and line methods.

The marine waters within Hanamaulu Bay have been classified by the State Department of Health as "Class A" (Chapter 54 - Water Quality Standards of Title 11, State Department of Health Administrative Rules). Under this classification, water quality is maintained to provide recreation and aesthetic pursuits. Hanamaulu Bay is also defined as a marine pool, where water collects in depressions on sea level lava rock outcrops and solution benches, behind large boulders fronting the sea.

Vicinity of Existing Ocean Drains

The coastline east of the Lihue Airport receives some recreational fishing effort and in times of calmer seas, small boats are used by local fishermen. The fish community is diverse in spite of the rough seas conditions and the abundance of fish is high possibly due to the relatively low fishing pressure. Along the shoreline at Ahukini Bay and Kalapaki Beach where more sheltered and easy access is available, fishing activity is higher.



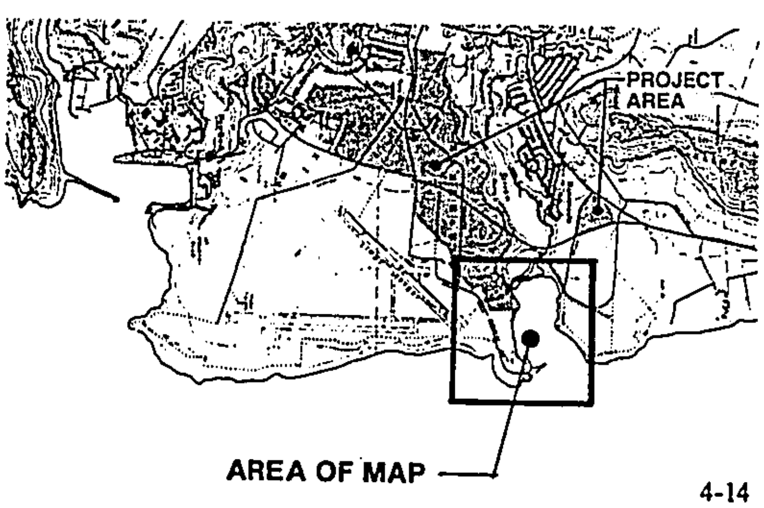


FIGURE 4-4
HANAMAULU BAY
MARINE SURVEY/WATER QUALITY SAMPLING STATIONS

LIHUE-HANAMAULU

AMFAC/JMB HAWAII

LIHUE DISTRICT, ISLAND OF KAUAI

NORTH

NOT TO SCALE

PBR HAWAII

North Drains. The Ahukini Makai portions of the proposed project and the existing Lihue Airport facilities discharge stormwaters through two existing drainages referred to as the "two north drains" (Figure 4-5). The more northerly channel drains directly into the head of Ahukini Bay and discharges across a basalt boulder/coral rubble beach. The second channel, located about 450m south of Ahukini Bay, referred to as "the large south drain" on Figure 4-5; discharges across a basalt boulder bench and into the sea.

The coastline is characterized with high wave action with no offshore reef to protect and dissipate the impact of ocean swells which break directly on the shoreline. As a consequence, shallow marine communities are under the influence of frequent high energy conditions. Marine communities in Ahukini Bay and the intertidal areas include a characteristic assemblage of species of native and non-native marine animal and plant species. During the survey, one green sea turtle was observed heading north toward Hanamaulu Bay.

Under the present conditions, peak period stormwater currently discharging through the Ahukini Bay drain is 382 cfs and the lower or southern drain is 1,511 cfs.

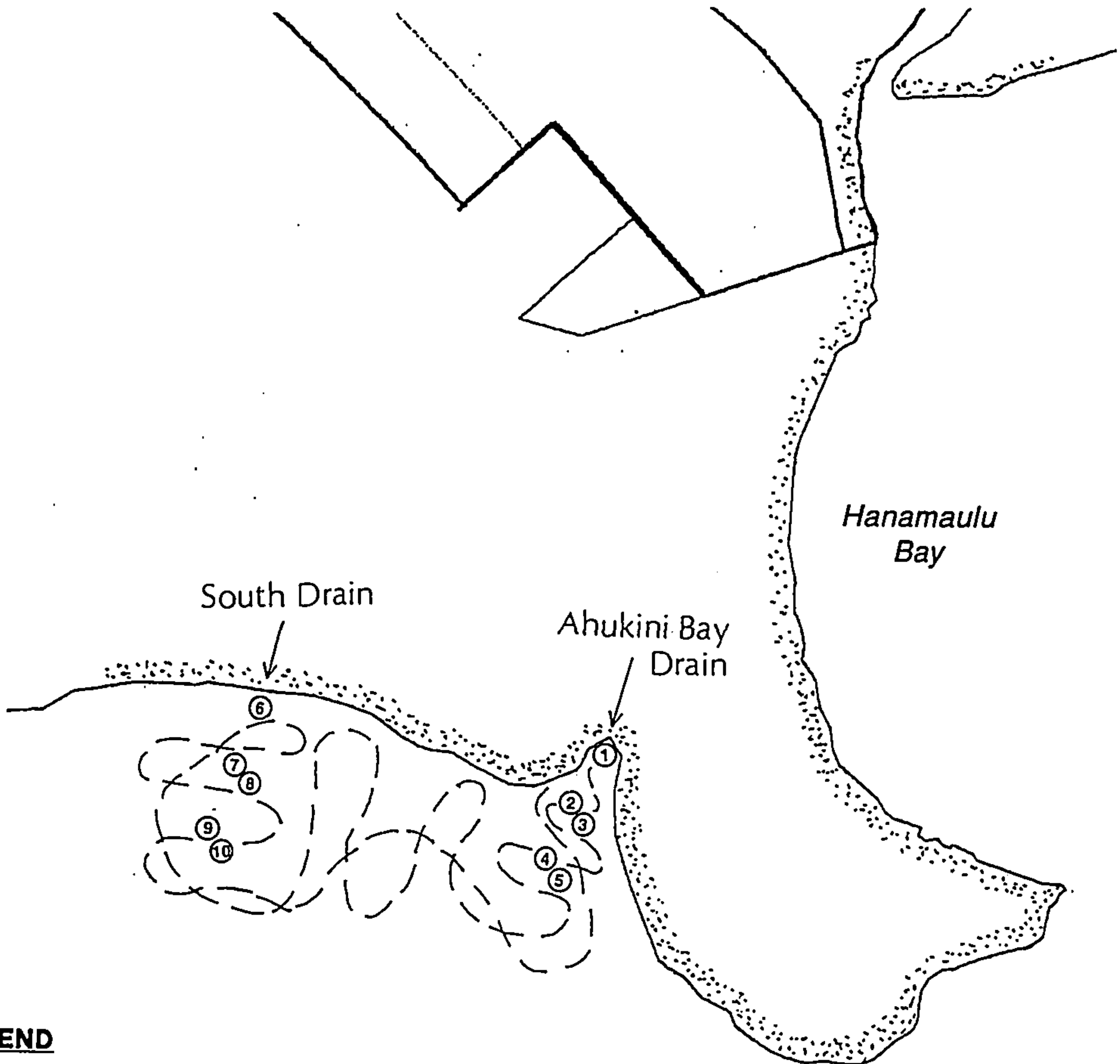
The water quality samples collected offshore of the Ahukini Bay drain and the lower south drain are from open coastal waters. There is a slight salinity depression and concurrent higher concentration of nitrate nitrogen and silica in the nearshore samples at Ahukini Bay similar to that found in freshwater which impinges through groundwater and runoff from land.

Nawiliwili Stream. Nawiliwili is a perennial stream which carries some of the stormwater runoff from Lihue town, surrounding residential areas, Kauai Lagoons and the Molokoa area of the proposed development during heavy rainfall and delivers it to Nawiliwili Bay nearby Kalapaki Beach Park (Figure 4-6).

Because of the near continuous input of freshwater from Nawiliwili Stream, marine communities are not well developed in the shallow water fronting the stream terminus. Marine communities also are not well developed further seaward because of the high energy conditions. Marine plants and animals that are present are characteristic with both native and non-native species typical of the area. Fishing activities at Nawiiiwili Bay appear to be in areas away from the Nawiliwili Stream estuary.

Peak period stormwater from the Molokoa portion of the project currently discharging to Nawiliwili Stream is 811 cfs.

Water quality samples were collected at Nawiliwili Bay. There is a slight salinity depression and concurrent higher concentration of nitrate nitrogen and silica in the nearshore samples similar to the North Drains.



LEGEND

⑤	WATER QUALITY SAMPLING STATION

Source: Environmental Assessment Co.

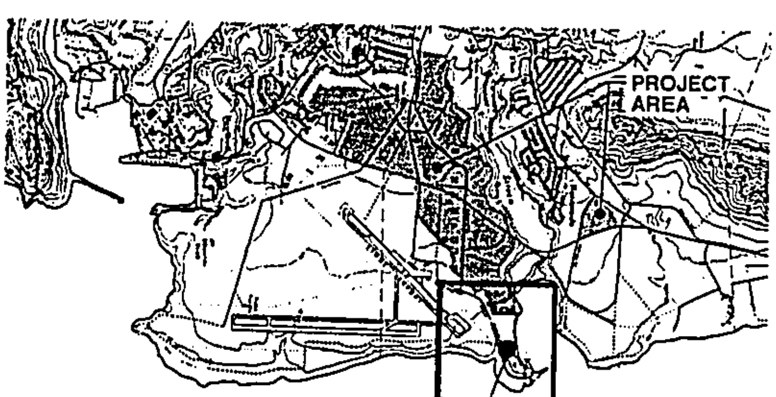


FIGURE 4-5
NORTH DRAINS
MARINE SURVEY/WATER
QUALITY SAMPLING STATIONS

LIHUE-HANAMAULU

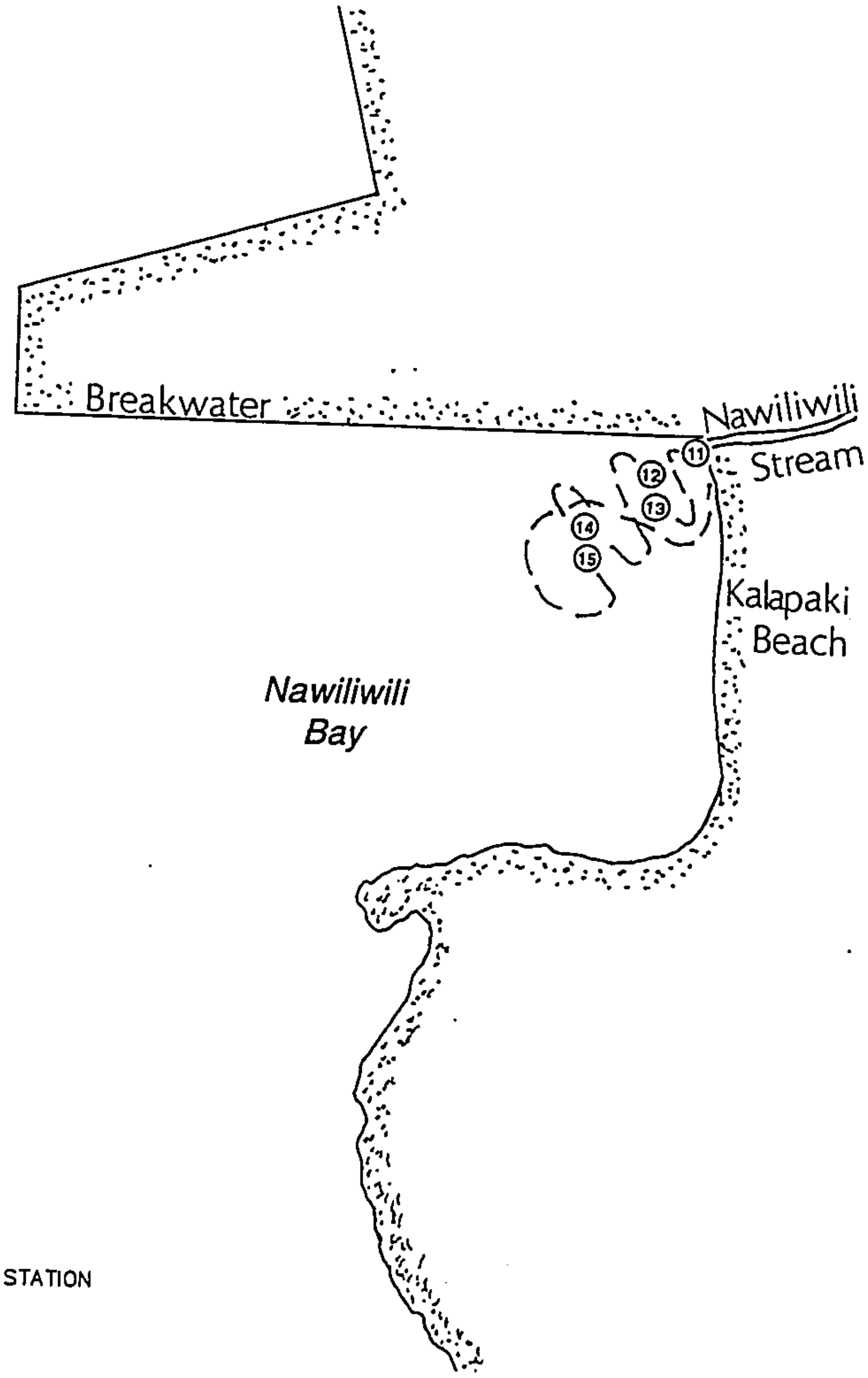
AMFAC/JMB HAWAII

LIHUE DISTRICT, ISLAND OF KAUAI

NORTH

NOT TO SCALE

PBR HAWAII



LEGEND

⑪ WATER QUALITY SAMPLING STATION

Source: Environmental Assessment Co.

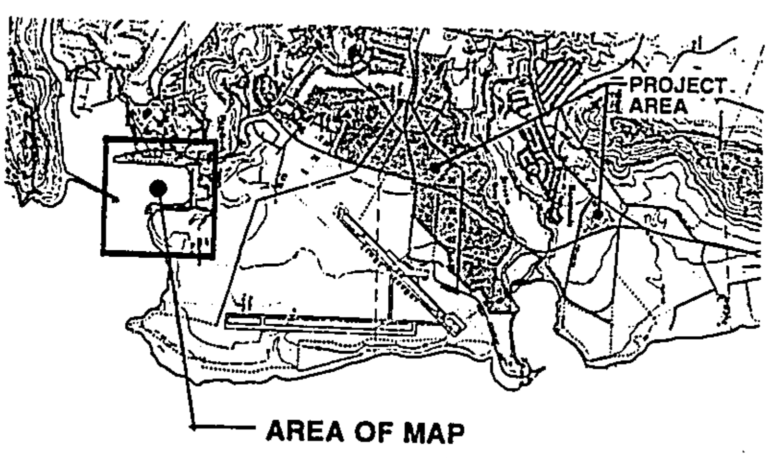


FIGURE 4-6
NAWILIWILI BAY
MARINE SURVEY/WATER
QUALITY SAMPLING STATIONS

LIHUE-HANAMAULU

AMFAC/JMB HAWAII — LIHUE DISTRICT, ISLAND OF KAUAI

NORTH

NOT TO SCALE

PBR HAWAII

B. Potential Impacts

Hanamaulu Bay

According to the marine communities and water quality assessment report (Appendix H), the potential for impact to marine communities with the development of the Lihue-Hanamaulu Master Plan is probably greatest during the construction phase of the project when soils are potentially exposed to high rainfall events. However, approximately 97 percent of the 555 acre proposed project site has been in sugar cultivation for many years, which contributes soil erosion and sedimentation when lands are exposed during harvest. For example, a 100-year storm with 17-inches of rainfall will result in sediment loss significantly greater than would occur if these lands are to be developed as proposed. During the same storm, the discharge rate of surface runoff would increase to 1,691 cfs from the present 1,498 cfs. However, this 11 percent increase in freshwater (193 cfs for the 100-year storm) will still result in less sediment than would occur with a 100-year event under the present conditions of agricultural land use.

If prudent construction techniques are used to mitigate potential soil erosion and the development period lasts 15 to 20 years, little sediment is expected to reach the sea. Consequently, the potential for negative impact to the marine communities due to sedimentation should be low during the construction phase.

After project construction, sediment from the project site to the ocean is estimated to be 66 percent less than at present, according to the drainage study (Appendix D). However, environmental concerns will focus on the potential impact that could occur with normal operations on the project site resulting in pollutants (inorganic nutrients, pesticides and herbicides) reaching the stream and eventually, the ocean. Other studies offshore on Maui and Hawaii have identified only one instance where the groundwater chemistry related to coastal development has been detected, but with no detectable or quantifiable changes noted in the aquatic biota. However, these changes only involve the concentration of inorganic nutrients; pesticides and/or herbicides have not been detected in water, sediments or organisms at any of these sites. Furthermore, the changes in inorganic nutrients all fall within the range of concentrations encountered at other Hawaiian coastal localities that have no surrounding development.

In addition, products that are effective on application now have reduced half-lives compared to long-lived products used years ago (i.e. chlordane, DDT). Thus, products used today carry considerably less risk of contamination to the environment. The water quality assessment report states, "It is interesting to note that State standards for coastal waters are frequently exceeded irrespective of the presence of nearby coastal development." The report concludes, "The data to date suggest that there is little opportunity for pollution to occur with modern coastal development such as proposed with the proposed project."

Vicinity of Existing Ocean Discharges

North Drains. The Drainage study estimates that peak discharge would decrease by 41 percent to the Ahukini Bay drain (existing calculated flow is 382 cfs, future calculated flow is 224 cfs) and it would increase by 26 percent at the lower south drain (existing calculated flow is 1,511 cfs and future calculated flow is 1,902 cfs).

Nawiliwili Stream. The expected peak discharge at project buildout from the Molokoa area would not change with the installation of drainage improvements to mitigate any increase that would result from urbanization of the site. The existing rate of 811 cfs would be maintained at 810 cfs at buildout.

C. Mitigative Measures

Several mitigative measure will be employed to minimize the effects of the project on the marine environment.

(1) Erosion Control Measures: The greatest potential for detrimental impacts to the marine environment would probably be during a heavy rainfall in the construction period. To ensure that construction activities on the development property do not significantly impact ocean water quality, an erosion control plan will be developed to retain surface water on site to allow for sedimentation of particulate matter within the drainage detention basins. Proper management of runoff water will be undertaken to ensure that the quantities of runoff leaving the property do not significantly exceed current levels and that the overall water quality of surface runoff is improved. Erosion will also be minimized by compliance with governmental regulations and standards

2) Marine Environment Monitoring: A marine monitoring program will be planned and implemented in coordination with the appropriate agencies. Such a program would extend the baseline established by Dr. Brock for the one-year period prior to construction.

Subsequently, a development period monitoring program (as recommended by Dr. Brock) would entail a "wet" period and a "dry" period sampling to establish the extremes in data with additional sampling occurring as required by the Department of Health and the Department of Land and Natural Resources.

4.7 HANAMAULU STREAM RESOURCES

A. Existing Conditions

As previously described, the Project Area is presently used primarily for sugar cane cultivation. Consequently, no significant habitats are known to exist within the Project Area due to the lack of plant material diversity. Although no wetlands currently exist within the Project Area, an irrigation reservoir was located on the property many years ago, but has since been filled with soil and returned to agricultural production.

The only potentially significant habitats in the area may exist within the Hanamaulu Stream flood plain or Hanamaulu Bay, both of which are located outside of the Project Area boundaries. Since these areas may receive surface runoff during intense storm events, a biological assessment of the Hanamaulu Stream (Appendix I) and the marine and water quality assessment for Hanamaulu Bay (Appendix H) were conducted in 1994. In addition, a letter report by Pacific Aquatic Environmental (December 29, 1994) which addresses additional drainage issues related to Hanamaulu Stream is attached as Appendix I-1. Within Hanamaulu Stream, thirteen sampling stations were assessed which showed that Hanamaulu Stream and its tributaries have been heavily impacted by past and current land-use practices. This survey extended from the downstream end of the Hanamaulu Stream estuary and into the upper tributaries of Hanamaulu Stream on the flanks of Kilohana Crater.

The biological assessment determined that Hanamaulu Stream has been extensively modified along its entire length by diversions for sugar cane irrigation at the 540-foot, 400-foot, and 350-foot elevations. Below 200 feet, the stream traverses the outskirts of Lihue and Hanamaulu, where it is partially channelized in certain sections and subject to periodic contamination from existing land uses. Introduced aquatic biota was predominant with little diversity and low overall numbers of native stream fish and aquatic insect species. Only in the extreme upper section of the stream near Kilohana Crater, was a native plant species identified, the uluhe fern (*Dicranopteris linearis*).

With the exception of one large *A. stamineus* found in the lower Lihue ditch, native gobies were not found in the upper watershed or upper tributaries of Hanamaulu Stream. This indicates that the lower area of the Hanamaulu Stream contains altered and disturbed aquatic habitats that preclude native 'o'opu from gaining access to the upper reaches of the stream. Native fish do not appear to recruit to the upper Hanamaulu Stream because of introduced fish predators, amphibians, and crustaceans, stream channelization, stream diversions, and large reservoirs.

B. Potential Impacts

Due to the predominance of introduced aquatic biota throughout Hanamaulu Stream and the heavily disturbed nature of the watershed, no significant impacts to native stream biota are expected from the proposed development. According to the Hanamaulu Stream Biological Survey, no significant impact to current populations of native freshwater Hawaiian stream fish within the Hanamaulu Stream or within the Island of Kauai will result from project development. The Hanamaulu Stream Survey states: *"As the Hanamaulu Stream exhibits characteristics of a highly impacted stream with numerous past disturbances, the proposed development should result in a minimal impact on the existing native fish biota."*

The stormwater runoff calculations by Kodani & Associates, the civil engineer for drainage improvements (Appendix D) to Hanamaulu Stream from the project area have been evaluated by Pacific Aquatic Environmental. The expected increase in peak stormwater runoff of 25 percent which drains from the Ahukini Mauka area to Hanamaulu Stream is not expected to affect the aquatic resources.

Water flow in Hawaiian streams naturally fluctuates widely during the year, with no deleterious effects to native aquatic biota. Flow in the Hanamaulu Stream currently varies dramatically. Because the proposed project accounts for only three percent of the total watershed, impacts to aquatic biota from the two percent increase in peak flow in the Hanamaulu Stream will most likely be immeasurable. Native stream biota are adapted to the dynamic flow regimes of Hawaiian streams. Stream 'o'opu reproduction and recruitment are timed to make use of high flows associated with flood events. 'O'opu nakea (Awaous guamensis) typically spawn after the first fall storm, and post-larval fish in streams with dry lower sections ascend only during flood events.

The 80 percent reduction in sediment runoff from the project area could have beneficial effects on aquatic biota. Fine sediment clogs interstitial spaces among substrate particles and interferes with 'o'opu spawning. Decreased sedimentation would result in lower turbidity and, therefore, improved water quality. Moreover, a reduction in sediment could have beneficial effects on estuarine and near-shore marine fauna, particularly corals.

Given the likely improvement of water quality resulting from the proposed development's erosion control mitigation measures and relatively reduced soil exposure (compared to continued agricultural use of the project area), the slight increased runoff during 100-year storm events is not expected to negatively impact the aquatic biota of Hanamaulu Stream.

Insects also largely consist of introduced species which further emphasizes the disturbed character of the system. It does not appear that the proposed development will have any adverse impact on the aquatic insect biota of this system, since the probable disturbances will be negligible in comparison to previous environmental perturbations that have occurred along the length of the catchment.

C. <u>Mitigative Measures</u>

(1) **Drainage Controls.** Mitigation measures identified in this EIS for erosion and drainage control will also mitigate potential negative impacts to Hanamaulu Stream. Overall water quality will improve and the quantity of runoff will only slightly increase during intense storms. Future conditions will be an improvement over the current land use of cultivated sugar cane, especially if the upper reaches of the stream continue to block the access of native fish to the aquatic habitats found upstream of Kapaia Reservoir which is less impacted by urban development.

(2) **Biological and Water Quality Monitoring.** A monitoring program for Hanamaulu Stream will be planned and implemented in coordination with the Department of Health and Department of Land and Natural Resources. In concept, an aquatic biology monitoring plan could involve sampling fish, crustaceans, mollucs, and aquatic insects. In addition, testing of water quality field parameters could include stream flow measurements, temperature, dissolved oxygen, turbidity, salinity, and conductivity.

4.8 NATURAL HAZARDS

A. Existing Conditions

Natural hazards are events such as tsunami, earthquakes, floods, hurricanes, soil slippage and volcanic hazards. Clearly, the project area may be subject to hurricanes and minor earthquakes in the future; the site is not unique to these potential hazards. Earthquakes in the Hawaiian Islands are associated with volcanic eruption or tectonic movement. Kauai is rated in seismic zone one in the Uniform Building Code and volcanic eruption is unlikely.

Flood hazards are primarily identified by the Flood Insurance Rate Map (FIRM) prepared by the Federal Emergency Management Agency (FEMA), National Flood Insurance Program. According to the FIRM of March 4, 1987, the entire project area is located within "Zone X", an area defined as outside of the 500-year flood plain (Figure 4-7). In addition, the project area lies entirely outside of the coastal flood zone attributable to either high wave action or tsunami.

B. Potential Impacts

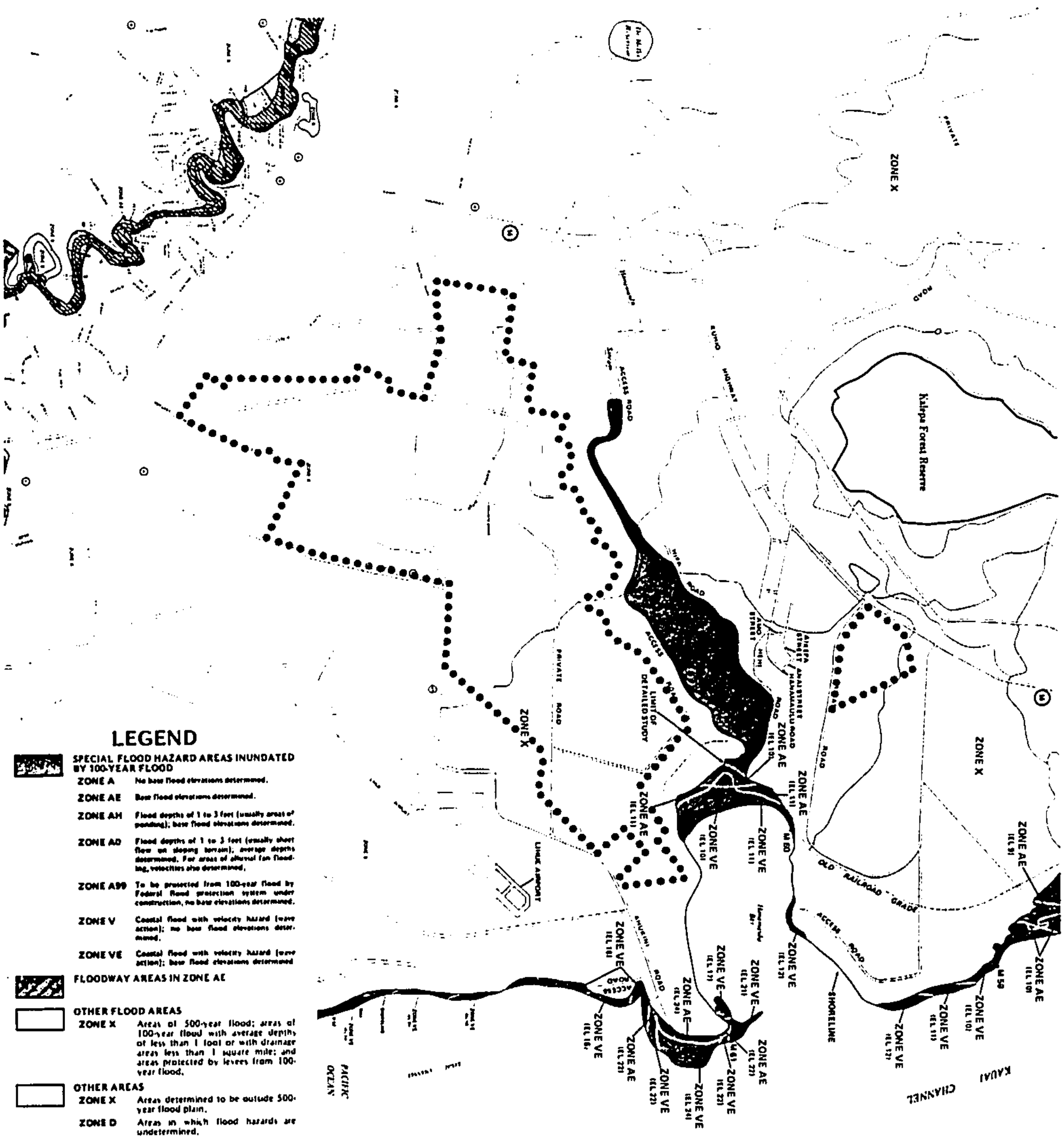
Because the project area is not located within a floodway or a flood fringe area, nor within a designated tsunami inundation area, no part of the Project Area will be impacted by potential flooding hazards. Storm drainage will be controlled by detention areas established in Ahukini Mauka and Molokoa which will minimize and control potential off-site flooding both within and at downstream areas of the project. As noted in the Drainage Study (Appendix D), discharge of runoff (rates and volumes) from the project will increase approximately 17.5 percent from the existing conditions.

The County of Kauai has been affected twice since 1982 by devastating hurricanes, Iwa in 1982 and Iniki in 1992. While it is difficult to predict these natural occurrences it is reasonable to assume that future events could be likely given the record of the past twelve years. The project area, as the rest of the island, is no more or less vulnerable to the destructive winds and torrential rains associated with hurricanes and cyclones.

C. Mitigative Measures

(1) **Protection of Buildings.** The potential impact of destructive winds and torrential rainfall of tropical cyclones/hurricanes on structures within the project will be mitigated by compliance with the Uniform Building Code adopted by the County. All structures will be constructed for protection from earthquakes and tropical cyclones/hurricanes in accordance with the requirements of the County.

(2) **Drainage Improvements.** Drainage improvements will include adequate provisions to prevent any localized flooding problems. No other mitigative measures are required to avoid potential flood hazard areas since none exists within the project area.



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** No base flood elevations determined.
- **ZONE AE** Base flood elevations determined.
- **ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE A99** To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
- **ZONE V** Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** Areas determined to be outside 500-year flood plain.
- **ZONE D** Areas in which flood hazards are undetermined.

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 Base Flood Elevation Line; Elevation in Feet*

Cross Section Line

(EL 987) Base Flood Elevation in Feet Where Uniform Within Zone*

RM7 X Elevation Reference Mark

*Referenced to the National Geodetic Vertical Datum of 1929

PROJECT AREA BOUNDARY

Source: FEMA, National Flood Insurance Program, Mar. 4, 1987.

FIGURE 4-7
FLOOD INSURANCE RATE MAP
LIHUE-HANAMAULU

AMFAC/JMB HAWAII — LIHUE DISTRICT, ISLAND OF KAUAI

NORTH — LINEAL SCALE 500 0 500 1000 2000 FEET

PBR HAWAII

(3) **Siren Warning Device.** Two sirens and siren warning infrastructure will be purchased and installed by Amfac/JMB to help alert residents and workers of potential events that may threaten the area. The siren locations as shown in Figure 4-8 are at a minimum of 250 feet from the nearest planned residential development. The installation of the equipment will follow the necessary governmental approvals and will be coordinated with the State and County Civil Defense Agencies.

(4) **Public Emergency Shelters.** Future structures built within the project area may be surveyed by the Civil Defense Office for their potential use as public emergency shelters.

4.9 VEGETATION

Field studies to assess the botanical resources of the subject property for Molokoa, Ahukini Mauka, Ahukini Makai, and Hanamaulu were finalized by Char & Associates in June, 1994 (Appendix J). Prior to conducting a walk-through survey, a search was made of the pertinent literature. The primary objectives of the surveys were to: 1) describe the major vegetation types; 2) inventory the flora; 3) search for threatened and endangered plants, 4) identify areas of potential environmental problems or concerns, and 5) propose appropriate mitigation measures.

A. Existing Conditions

According to the flora assessment, areas most likely to harbor native plant communities or rare species, are along the margins of fields adjacent to gulches, around reservoirs, and along irrigation ditches, etc. These were the areas most intensively surveyed.

The species that were recorded, are indicative of the season ("rainy" vs. "dry") and the environmental conditions at the time of the survey. Consequently, a survey taken at a different time and under varying environmental conditions, would no doubt yield slight variations in the species list, especially of the weedy annual taxa.

The south section, bound by Kapule Highway, Ahukini Road, and Lihue town, consists of recently planted sugar cane fields on its lower one-half, and taller, older cane on its upper one-half. Weedy species on the younger, open fields are primarily pink bindweed and white thunbergia. Locally common are clumps of hyacinth bean (Lablab purpureus). Scattered through the dense grass cover are shrubs of pluchea (Pluchea symphytifolia), castor bean, Macaranga, and papaya (Carica papaya); about six trees of Panama cherry (Muntingia calabura) can also be found here. A large reservoir, no longer in use for water storage, is found near the Kapule-Ahukini corner and is planted in sugar cane.

The largest section surveyed, is bounded by Ahukini Road, Kapule Highway, Hanamaulu Gulch, and Wilcox Hospital. This area contains largely older cane fields, thus most of the weedy species are found along the margins of fields, along several irrigation ditches, the edges of Hanamaulu Gulch, and a small ridge which runs parallel to the gulch. The gulch and the small ridge support a forest composed mainly of Java plum. Other trees and shrubs commonly found are guava, lantana, Chinaberry tree (Melia azedarch), kolomona, Christmas berry, hau, silk oak, and ironwood.

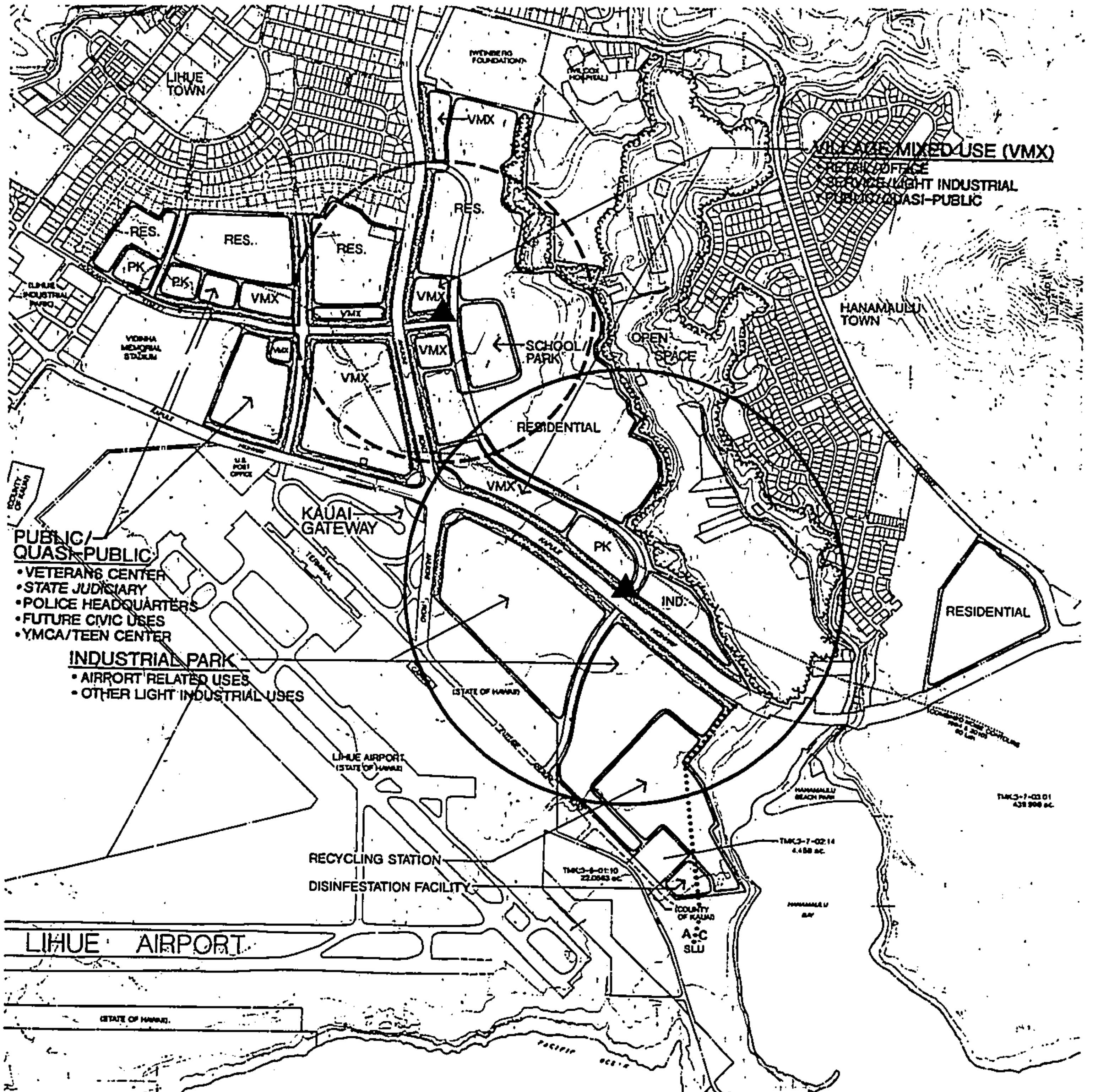


FIGURE 4-8
CIVIL DEFENSE
SIREN LOCATIONS
LIHUE-HANAMAULU

AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI

NORTH
LINEAL SCALE
375 0 375 750 1500
FEET

PBR HAWAII

LEGEND

▲ CIVIL DEFENSE SIREN LOCATION (PROPOSED)

California grass, Guinea grass, and molasses grass (Melinis minutiflora) form dense mats along the edges of the forest. Where people have dumped lawn trimmings, a few ornamental plants have become established; these include Monstera sp., Philodendron sp., Chinese fan palm (Livistona chinensis), and golden dewdrop (Duranta repens). In places, yellow granadilla vines (Passiflora laurifolia) with their orange-colored fruits form dense tangles over trees and shrubs.

The makai section, bounded by Ahukini Road, Kapule Highway, and Hanamaulu Stream and Hanamaulu Bay, consists of recently harvested fields. On this section the common weedy species are swollen fingergrass, Guinea grass, spiny amaranth, pink bindweed and, along irrigation ditches, barnyard rice (Echinochloa crus-galli). Forested areas are found on the steep slopes bordering the stream and the bay. Ironwood trees form the predominant cover, although smaller areas with Java plum and (Eucalyptus citriodora) are common. Where the trees are less numerous, Guinea grass and koa-haole are dense. Otherwise the understory is rather bare with fallen "needles" from the ironwood trees and scattered clumps of sour grass (Digitaria insularis). In these more makai sites, the other passionfruit species or liliko'i (Passiflora edulis) is more abundant than the yellow granadilla. Linney and Char (1988) also recorded similar findings when they surveyed the nearby Kauai Lagoons' proposed third golf course site, located makai of the airport.

There is little of botanical interest or concern on the portions of the four sites which are actively under sugar cane cultivation. The fields support a weedy mix of species commonly associated with such agricultural activities. The forests found in the gulches which border some of the properties are dominated by introduced or alien species such as Java plum, koa-haole, Christmas berry, guava, California grass, etc. Of a total of 186 species found on the three sites, 159 (85 percent) are introduced; 9 (5 percent), including sugar cane, are originally of Polynesian introduction; and 18 (10 percent) are native. Of the natives, 2 (coastal sandalwood, 'akia) are endemic, i.e., occur only in the Hawaiian Islands, and 16 are indigenous, i.e., are native to the islands and elsewhere.

Native plants are found outside of the Project Area, primarily in the coastal vegetation, along the forest reserve boundary, and in the wetland areas.

None of the plants inventoried during the field studies are officially listed threatened or endangered species (U.S. Fish and Wildlife Service 1989); nor are any candidate or proposed for such status (U.S. Fish and Wildlife Service 1990). Other botanical surveys of areas adjacent or near to some of the sites (Char and Linney 1988a, 1988b; Char 1989, 1990) have recorded similar findings.

B. Potential Impacts

Implementation of the Lihue-Hanamaulu Master Plan is not expected to have a significant impact on the botanical resources of the four sites. Development will take place on portions of the areas now under active sugar cane cultivation. No development is planned for the coastal areas or for the wetland areas which are under the jurisdiction of the U.S. Army Corps of Engineers.

C. Mitigative Measures

(1) **Erosion Control.** Measures will be taken to alleviate runoff and soil erosion effects on undisturbed vegetation throughout the project site. Steps will be taken during the construction phase to reduce soil erosion tendencies, as discussed in Section 4.6.

(2) **Landscaping.** Landscaping is planned for the project within the village core, parks and residential areas. Plant materials will be selected to maximize the efficient use of irrigation water while enhancing the urban setting. Native plants will be utilized where site conditions and aesthetic considerations permit.

4.10 WILDLIFE

To identify bird and mammal species and/or their unique habitats that may exist on the project area and the adjacent Hanamaulu Gulch area a field survey was conducted by Philip Bruner in July 1994 (Appendix K). The presence or likely occurrence of any native fauna, particularly any that are considered "Endangered" or "Threatened" was also the primary purpose of the investigation. This study was supplemented by a report prepared by Pat Hart and Ron Englund, Pacific Aquatic Environmental (September, 1994) entitled "Recommended Mitigative Measures to Reduce Bird Attractants Associated with the Proposed Lihue Debris Recycling Station and the Tropical Fruit Disinfestation Facility" to assess the impacts of certain aspects of the project on Lihue Airport operations. The report is attached as Appendix L.

A. Existing Conditions

Clarification of the Project Area

The Lihue-Hanamaulu Master Plan area includes approximately 555 acres located at Lihue and Hanamaulu with the project boundary nearest the Hanamaulu Stream Gulch situated at the top of the bluff. No development is proposed or planned for Hanamaulu Gulch which is characterized as "open space" on the Master Plan. Wetlands are present in the valley and four species of native waterbirds which are listed as "endangered" inhabit the wetlands. The walls of the gulch are comprised of steep generally densely vegetated slopes with natural swales and gullies which serve as a natural shield and create a large buffer between the development and the wetland.

Much of the approximately 220-acre Hanamaulu Gulch area near the project boundary is owned by Amfac/JMB. In addition, there are 13 kuleanas, representing approximately 15 acres owned by various landowners scattered throughout the gulch. As such, land uses are varied, including residential, cattle pasture, agricultural and industrial uses and vacant open space.

Overall Project Area

Bruner's survey of the Project Area and the Hanamaulu Gulch assessed the faunal resources. Presently, the subject property is in sugarcane with introduced brush covered habitat occurring along the edges of the cane fields. Wetland habitats exist outside of the Project Area in Hanamaulu Gulch that consist of flooded pasture and stream habitats.

Based on the results of the survey (Appendix K), no native land or water birds were identified on the Project Area. However, four Hawaiian Duck and Common Moorhen were found off-site in the Hanamaulu Gulch wetlands. Similarly, no native seabirds or migratory native birds were identified. During the winter, the Pacific Golden Plover and Wandering Tattler may occur along cane roads and ditches; these species are not endangered or threatened.

No seabirds were recorded during this survey. However, it was noted that the endangered Newell's Shearwater may fly over the property as it travels between nesting burrows in the mountains and the open sea where it forages.

The only feral mammals identified were the fairly common Hawaiian Hoary Bat. Two hoary bats were observed foraging over the wetlands in Hanamaulu Gulch. Although this native species is considered endangered, its ecology is poorly understood. On other surveys, bats were observed in a variety of habitats on Kauai. These habitats included native forest, agricultural lands, residential and urban areas as well as river valleys and bays. Their occurrence on the subject property was, therefore, not unexpected since the species appears to be adaptable to a wide array of habitats.

Ahukini Makai/Lihue Airport Area

In response to concerns of potential bird and aircraft impacts raised by the Department of Transportation, Airports Division and the US Department of Agriculture Animal Damage Control agency to the County's proposed Lihue Debris Recycling Station adjacent to the existing Lihue Refuse Transfer Station, a special study was undertaken to assess impacts and to recommend mitigative measures for minimizing those impacts. The Recycling Station environmental review process has raised concerns that a planned sedimentation basin would potentially attract birds which would fly across Runway 3-21 at Lihue Airport to the basin and consequently pose a risk to aircraft flight safety.

Hart and Englund surveyed over a broad range to assess the spatial relationships of Lihue Airport and other existing surrounding land uses (i.e., the surrounding cane land, the Kauai Lagoons resort and Hanamaulu Gulch) to two proposed public facilities within the Ahukini Makai Industrial area - the Recycling Station and the University of Hawaii's Tropical Fruit Disinfestation Facility.

Several bodies of water that provide bird habitat or foraging opportunities currently exist at the surveyed areas, including the natural landmarks, Hanamaulu Bay and Hanamaulu Stream, and man-made structures and facilities associated with the Kauai Lagoons resort, Lihue Airport settling ponds, agricultural irrigation ditches and drainage control channels. Consequently, birds are already utilizing these permanent and ephemeral waters opportunistically or permanently for foraging or as habitat, flying between bodies of water across Lihue Airport Runway 3-21, thus creating a hazard for aircraft as they take-off and land. DOT Airports Division has enlisted the US Department of Agriculture - Animal Damage Control agency to control the wildlife within the airport environment to reduce the bird strike hazards.

B. Potential Impacts

Overall Project Area

The only significant habitat for native birds was identified in the Hanamaulu Gulch wetlands. Presently, this wetland area is surrounded by existing agricultural, urban and residential land uses. Consequently, the fauna report concludes that the proposed land use changes for the areas nearby this wetland should have little or no effect on the few native waterbirds at the Hanamaulu Gulch wetlands.

The only potential negative impact resulting from development of the proposed urban/light industrial development, may be on the Newell's Shearwater that are attracted to lights as they move back and forth from their nest burrows. The attraction to light may confuse them as they often collide with power lines or vehicles.

Ahukini Makai/Lihue Airport Area

The proposed County's Debris Recycling Station and the University's Tropical Fruit Disinfestation Facility have been evaluated for their potential impact to generate additional birds which could impact airport operations.

The site plan for the Recycling Station, in particular, includes a sedimentation basin which could likely attract birds within the airport environment. Ingestion of large-sized birds such as ducks, egrets, or herons, or flocks of birds such as doves or pigeons, could result in aircraft engine failure and jeopardize flight safety.

Cull fruit discarded at the adjacent Lihue Transfer Station, could attract birds. However, if operated in the manner recommended, no negative impacts should occur.

C. Mitigative Measures

Overall Project Area

(1) **Urban/Residential Lighting Design.** To protect the Newell Shearwater from lights associated with urban development, shields on street lights and around buildings should be provided which direct the light towards the ground. The Department of Land and Natural Resources, Division of Forestry and Wildlife has specific details on how to minimize the impact of urban/residential lighting on the Newell Shearwater. These guidelines will be followed.

(2) **Hanamaulu Stream Conservation.** The native waterbird species, including Koloa and Moorhen, were observed in Hanamaulu Gulch. Amfac/JMB is committed to proper stewardship of its Hanamaulu Gulch land and the natural resources and endangered waterbird species which inhabit this area. Recognizing that water quality within the stream is vital, a drainage control plan, revegetating program for eroded areas, and cattle fencing will be considered to promote better water quality.

Amfac/JMB has contacted the U.S. Fish and Wildlife Service ("FWS") about its Private Lands Program and will be exploring the potential of utilizing this program which could provide cattle fencing to protect sensitive endangered species habitat in exchange for a ten year commitment to maintain the land in conservation. Ducks Unlimited ("DU") has also been contacted about its taro lands program. DU is working closely with FWS at Hanalei; the State's model for dual purpose use of agricultural lands as waterbird habitat.

Ahukini Makai/Lihue Airport Area

Four broad mitigative measures have been recommended by Hart and Englund in conjunction with the U.S. Department of Agriculture Animal Damage Control regarding the Lihue Debris Recycling Station sedimentation basin:

(1) **Sedimentation Basin Design and Operation.** Design considerations for the sedimentation basin that would prevent birds from foraging in and around the pond include: 1) lined bottom to prevent growth of aquatic and emergent vegetation; 2) steep sides and three-foot water depths to prevent use by wading species and shorebirds; 3) enough freeboard to maintain surface water level at 18 inches; 4) posts wired with cables around the perimeter of the basin; 5) toad barrier; 6) landscape vegetation unsuitable and unattractive to birds; and 7) contract a trained staff to actively haze birds from the basin and surrounding area.

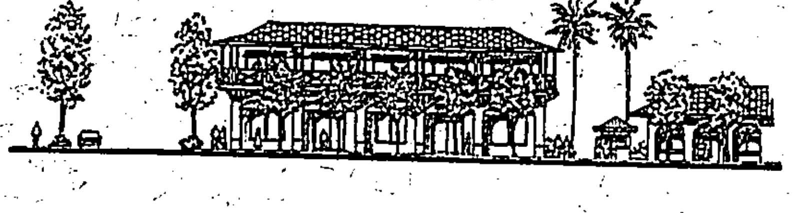
(2) **Visual Detraction of Sedimentation Basin.** The natural behavior of many bird species is an attraction to water. To reduce the attractiveness of water to birds, a shade cloth cover is recommended to obstruct its view from the air. Implementation of this measure would preclude the need for certain mitigative measures (i.e., hazing).

(3) **Diversion of Stormwater to Drainage Channel.** Elimination of the sedimentation basin would probably be the best mitigative measure to reduce the bird impact. Diversion of all stormwater runoff to the ocean, as is presently done by the existing land uses, would preclude the need for a stormwater detention pond on-site and thus minimize the amount of standing water available to birds. From an aviation safety perspective, this is the most desirable option.

(4) **Sedimentation Basin and Drainage Channel.** A combination sedimentation basin/channel diversion would reduce the amount of water on site. Mitigative measures as described in 1 and 2 would still be required.

5.0

ASSESSMENT OF EXISTING HUMAN ENVIRONMENT, POTENTIAL IMPACTS AND MITIGATIVE MEASURES



5.0 ASSESSMENT OF THE EXISTING HUMAN ENVIRONMENT, POTENTIAL IMPACTS AND MITIGATIVE MEASURES

This section presents summary background information on the existing human environment. Subject areas such as archaeology, traffic, air, noise and visual conditions are addressed in this section. It also includes a presentation of demographic conditions in the project area, and the potential effects of the project on the resident population. Economic factors, employment, government expenditures and revenues are also considered. Technical studies and analyses have been undertaken to address the potential impacts of the project and mitigative measures are recommended to minimize the potential short and long term impacts.

5.1 ARCHAEOLOGICAL AND HISTORIC RESOURCES

Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted an archaeological survey of the Project Area in April 1994. The overall objective of the survey was to provide information appropriate for the preparation of an EIS and satisfaction of all historic preservation inventory requirements of the Kauai County Planning Department and the Department of Land and Natural Resources-Historic Preservation Division (DLNR-HPD). This report is attached as Appendix M.

The subject archaeological inventory survey updated the relevant historical research data and archaeological findings from applicable PHRI survey reports and other work prepared by Alan Walker. No significant archaeological site requiring preservation were identified in either the Rosendahl or Walker surveys.

A. Existing Conditions

As described in the archaeology report, the Walker/Rosendahl survey covered the planning area of Hanamaulu. The Hanamaulu parcel consists of approximately 30 acres located approximately 0.26 mile inland of Hanamaulu Bay.

Parcels surveyed by Walker included the Ahukini Makai parcel, consisting of approximately 150 acres, the Molokoa parcel consisting of approximately 160 acres, and the Ahukini Mauka parcel consisting of approximately 215 acres.

Approximately 32.7 percent of the Hanamaulu parcel was subjected to a ground survey by Rosendahl due to the extent of disturbance by sugar cane cultivation. The parcel was subsequently tested for subsurface cultural deposits; nine backhoe trenches were placed throughout the parcel. The trenches yielded no cultural matrices, buried pondfields, subsurface horizontal features, portable cultural remains, nor datable materials of any kind. The ground survey strategy for the Ahukini Mauka, Ahukini Makai, and Molokoa parcels also considered the extensive ground disturbance by sugar cane cultivation. A 100 percent ground survey was conducted in all portions of these parcels not cultivated in sugar cane. This included all unaltered stream gulches and drainages within sugar cane fields.

Two sites, a historic house (Site 9402) and a wall (SIHP Site 1842) were identified within or immediately adjacent to the Master Plan area. Site 9402, a historic house at Molokoa was built in the late 1930's on LPCo land to house Kauai's first radio station, KTOH, which began broadcasting on May 8, 1940. The building is unoccupied and in disrepair. The wall (Site 1842) lies along the edge of the Ahukini Mauka parcel, at the top of the Hanamaulu Stream valley. Significant data has been collected from this site which is assessed as no longer significant (NLS). Both sites are important for information content only and no further data collection is necessary.

No significant archaeological remains of any kind were encountered in the surface or subsurface surveys of the Hanamaulu parcel. The only cultural remains encountered in this parcel were several small isolated coral pebbles. Within the Hanamaulu parcel, settlement was either non-existent or very limited, or the lack of cultural remains could be due to the intense land modification caused by sugar cane cultivation. Similarly, no significant archaeological remains were found in the Ahukini Makai parcel.

B. Potential Impacts

The archaeological report concluded that the inventory-level survey consisted of 100 percent ground survey of all areas not planted in sugar cane, and limited surface survey in sugar cane fields. Given the extensive modifications associated with the cultivation of sugar cane within the lands proposed for the project, it is not surprising that the present survey confirmed that only two archaeological sites are present in the project area. As such, the development of the Lihue-Hanamaulu Master Plan is not expected to cause any significant impacts to the cultural resources.

C. Mitigative Measures

(1) **Standard Procedures.** No archaeological sites requiring preservation are identified on the subject property. Based on the findings of the archaeological field work, the conclusions drawn by the consulting archaeologist, and DLNR Historic Preservation Division's review of the material presented, no mitigation measures to minimize potential adverse impacts appear warranted. However, in accordance with DLNR's and the Kauai Historic Preservation Review Commission's ("KHPRC") recommendation, should subsurface remains, artifacts, deposits of charcoal or shells be found during construction activities, work in the area will be stopped immediately and the Department of Land and Natural Resources and the County Planning Department will be contacted to determine the significance of the site and to identify appropriate mitigation measures.

(1) **Site 9402.** With regard to a request by the Kauai Historic Preservation Review Commission, Amfac/JMB is presently in the process of retaining a preservation architect to study the radio station building to determine rehabilitation costs and, if the building is deemed rehabitable, to prepare a preservation plan. At the very least, the architect selected will document historical information about the building, including measured drawings and black and white photographs. When a preliminary

report and recommendations are available from the architect, Amfac/JMB would present this information to the KHPRC.

5.2 ROADWAYS AND TRAFFIC

The traffic impact report was prepared by Austin, Tsutsumi and Associates, Inc. ("ATA") (January 1995) (Appendix E). The Traffic Impact Report evaluated the existing traffic condition, and the Years 2006 and 2016 traffic conditions with and without the project at seven existing and three future intersections.

Existing Intersections:

- Kuhio Highway and Kaumualii Highway/Rice Street (signalized)
- Hoolako Street and Rice Street (stop-controlled)
- Kapule Highway and Rice Street (stop-controlled)
- Kuhio Highway and Ahukini Road (signalized)
- Kapule Highway and Ahukini Road (signalized)
- Kapule Highway and Kuhio Highway (signalized)
- Kapule Highway and Post Office Driveway/future Kaana Street extension (stop-controlled)

Future Intersections:

- Hoolako Street Extension and Ahukini Road
- Kapule Highway and Mauka-Makai Road
- Road "X" (from Hanamaulu II development) and Kuhio Highway

The overall findings of the report indicate that transportation improvements are necessary with and without the project. With project development, associated transportation improvements are recommended that would accommodate future traffic demand in the Lihue area.

A. Existing Conditions

The Master Plan area is at one of Kauai's major roadway intersections, Kapule Highway and Ahukini Road. Surrounding the project area are Lihue Airport, and towns of Lihue and Hanamaulu. Kapule Highway serves as the primary north/south arterial. The intersection of Ahukini and the proposed future Hoolako Street Extension establish the central core of the conceptual master plan. Ahukini Road extends mauka with traffic traveling two ways from Lihue Airport, through the central portion of the project area, eventually connecting to Kuhio Highway mauka of the petition area.

Roadway Conditions. The study area is bounded by Kuhio Highway on the north and west, Rice Street on the south and Kapule Highway/Lihue Airport on the east. Major roadway facilities within the study area are Kuhio Highway, Kapule Highway, Ahukini Road, and Rice Street (Figure 5-1).

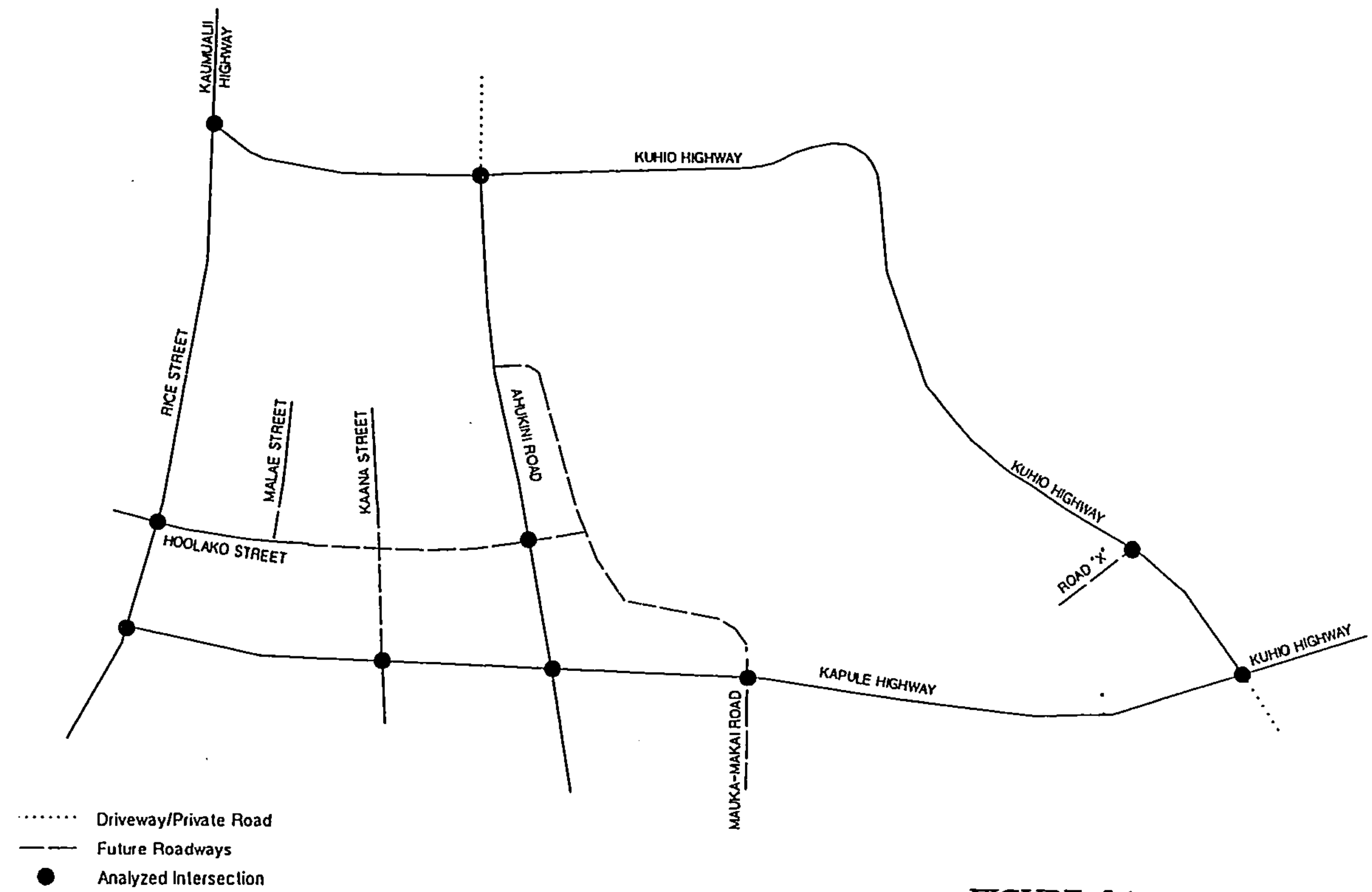


FIGURE 5-1
ROADWAYS IN THE
TRAFFIC STUDY AREA
LIHUE-HANAMAULU
AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI
NORTH
NOT TO SCALE
PBR HAWAII

Source: Austin, Tsutsumi & Associates, Inc.

Observed Traffic Conditions. Morning and evening peak traffic counts were conducted by ATA at the seven existing intersections. Existing traffic volumes within the study area are relatively moderate with few significant traffic problems. Under existing conditions, the following intersections are currently operating at LOS E or F during either the AM or PM peak hour or both.

- Kuhio Highway and Kaumualii Highway/Rice Street
- Hoolako Street and Rice Street
- Kapule Highway and Rice Street
- Kapule Highway and Ahukini Road

The delay experienced by the four intersections are caused by localized physical constraints and can be mitigated by intersection improvements.

B. Future Traffic Projections and Impacts

To determine the potential traffic impact of the Lihue-Hanamaulu Master Plan development, traffic projections were developed under conditions both "with" and "without" project development for the Years 2006 and 2016. Project generated trips were developed utilizing "Trip Generation" 5th Edition, Institute of Transportation Engineers (ITE), 1991, and assumed that a portion of the traffic generated would remain on-site, and not affect roadways outside of the project area. For example, 30 percent of the retail and office traffic, and 50 percent of the park traffic will be internal. Approximately, 10 percent of the industrial traffic would be airport related. The development of the background traffic growth rate was based on the 1990 "Kauai County Highway Planning Study". the growth rate contained in the study was adjusted to reflect a deferred traffic growth resulting from Hurricane Iniki. An annual average growth rate of 3.9 percent was derived.

Year 2006

Without Project

Without development of the Lihue-Hanamaulu Master Plan, only the Kuhio Highway/Kaumualii Highway intersection would operate at an acceptable level of service. The Hoolako Street/Rice Street, Kapule Highway/Rice Street, Kuhio Highway/Ahukini Road, Kapule Highway and Ahukini Road, and Kapule Highway/Kaana Street intersections would all be operating at LOS F. The intersection of Road "X"/Kuhio Road is projected to operate at LOS E.

To mitigate the Year 2006 Base (w/o project) over capacity condition, the Kauai Highway Planning Study (Appendix E, Traffic Impact Report) recommends the following improvements:

- Widen Kuhio Highway to four lanes from south of Wailua Bridge to Kapule Highway.

- Widen Kapule Highway to four lanes from Kuhio Highway to Ahukini Road (includes widening of Hanamaulu Stream Bridge).

- Widen Kapule Highway to four lanes from Ahukini Road to Rice Street.

- Realignment of Kapule Highway and the east-leg of Rice Street to become the major through street while the west-leg of Rice Street will terminate as a T-intersection at Kapule Highway.
- Widen Rice Street to four lanes through Lihue Town between Kuhio-Kaumualii Highway and to a point east of Kapule Highway.
- Provide the southbound approach of Kuhio Highway and Ahukini road with an exclusive left-turn lane and the northbound approach with an exclusive right-turn lane.
- Signalize the intersections of Kapule Highway/Rice Street, Hoolako Street/Rice Street, Kapule Highway/Post Office Driveway, and Kuhio Highway/Road "X".

With the above recommended improvements, all eight analyzed intersections will operate at acceptable level of service during both the AM and PM peak hour of traffic. These improvements are needed even if the proposed project is not developed.

With Project

With development of the proposed project, all of the analyzed intersections would operate at LOS F or over capacity except for: Kuhio and Rice/Kaumualii, Hoolako and Ahukini, and Road "X" and Kuhio. However, if the Year 2006 base improvements described above are implemented, only the following additional improvements are recommended with project development.

- Additional westbound left-turn lane at the intersection of Kuhio Highway and Ahukini Road.
- An additional eastbound exclusive left-turn lane and an exclusive westbound right-turn lane at the intersection of Rice Street and Hoolako Street.

With the recommended improvements, all the analyzed intersections will be operating at acceptable Levels of Service.

Year 2016

Without Project

Under base conditions without the project, seven of the eight analyzed intersections will be operating at LOS E, F, or at over capacity either during the AM or PM peak hours, or both. To mitigate the Year 2016 Base (w/o project) overcapacity condition, the Kauai Highway Planning Study (Appendix E, Traffic Impact Report) recommends the following improvements:

- Construction of a mauka Lihue bypass road.
- Extension of Ahukini Road mauka to the future bypass road.
- Widening of Kuhio Highway to four lanes from south of Wailua Bridge to Kapule Highway.

- Widening of Kapule Highway to four lanes from Kuhio Highway to Ahukini Road.
- Widening of Ahukini Road to four lanes from Kapule Highway to the future bypass road.
- Widening Kapule Highway to four lanes from Ahukini Road to Rice Street.
- Realign the intersection of Kapule Highway and Rice Street to become the major through street.
- Widen Rice Street to four lanes through Lihue Town between Kuhio/Kaumualii Highway and to a point east of Kapule Highway.
- Signalize intersections at Kapule/Rice Street, Hoolako /Rice Street, Kapule Highway/Post Office Driveway, and Kuhio Highway/Road "X".

Even without project development, the above transportation improvements are necessary to ensure that all eight analyzed intersections will operate at acceptable levels of service during both the AM and PM peak hours for the Year 2016.

With Project

If the transportation improvements are implemented as described above, only the intersection of Kuhio Highway and Ahukini Road will be operating at LOS F during the PM peak hour. The remaining nine intersections will be operating at an acceptable levels of service. To mitigate the project related traffic impacts, the following mitigation measures are recommended in the Traffic Impact Report (Appendix E) to accommodate the projected Year 2016 traffic demand.

- At the Kuhio Highway/Ahukini Road intersection provide each approach with dual, exclusive left-turn lanes, and the northbound approach with a dual exclusive right-turn lane from Kuhio Highway to Ahukini Road.
- Provide an additional exclusive eastbound left-turn lane an exclusive westbound right-turn lane at the intersection of Hoolako Street and Rice Street.

C. <u>Mitigative Measures</u>

As described in the Traffic Impact Report (Appendix E), a series of transportation related improvements are necessary to adequately accommodate projected traffic even if the proposed Lihue-Hanamaulu Master Plan is not implemented.

With development of the project master plan, the traffic report indicates that a portion of total trips will be internal and not affect roadways outside of the project area. These internal trips are related to the following: 40 percent residential, 30 percent retail and office; 50 percent park; and 10 percent industrial.

To mitigate the traffic impacts that may result from development of the master plan, the developer will comply with the Traffic Impact Report "with project" mitigation recommendations for the Years 2006 (Appendix E, page 55, Mitigation Measures 1) and 2) and 2016 (Appendix E, page 58, Mitigation Measures 1 and 2). In addition, the developer will continue to work with the State Department of Transportation and the County of Kauai to coordinate implementation of the necessary project related transportation improvements that are warranted as traffic levels increase during project buildout.

5.3 NOISE

An acoustic study for the project was conducted by Y. Ebisu & Associates (September 1994) and is summarized in this section. The detailed report is attached as Appendix N. The primary noise considerations relate to increased traffic noise generated both internally and externally to the project area, aircraft noise impacting the proposed land uses of the Lihue-Hanamaulu Master Plan, asphalt concrete batch plant noise, and temporary noise associated with project construction. Noise measurement locations for the study are shown in Figure 5-2.

A. Existing Conditions

Traffic Noise

Presently, the ambient noise levels at most interior locations of the project area drop to a range of 40 to 45 dB between aircraft noise events which is considered relatively silent. During very calm periods, ambient noise can drop to less than 40 dB. Along Rice Street, Kapule Highway, and Kuhio Highway, existing traffic noise levels in the project environs vary from levels of approximately 67 Ldn to less than 55 Ldn at the interior locations of the project site. Similarly, the existing 65 Ldn traffic noise contours do not extend into the residential areas of the proposed Lihue-Hanamaulu Master Plan.

Aircraft Noise

Aircraft noise is associated with both fixed wing and rotary aircraft operations at Lihue Airport. Noise contours were developed using current airline flight schedules. Although these contours were slightly higher than previously calculated for the Lihue Airport FAR Part 150 study, existing aircraft noise levels do not exceed 60 Ldn at planned residential or other noise sensitive areas of the project area. Consequently, the proposed land uses are considered to be in the "Acceptable" category as defined by the American National Standards Institute. Only the proposed Public/Quasi-Public area and portions of the industrial area, contain a noise contour greater than 65 Ldn, however, these uses are not considered as incompatible to these noise levels.

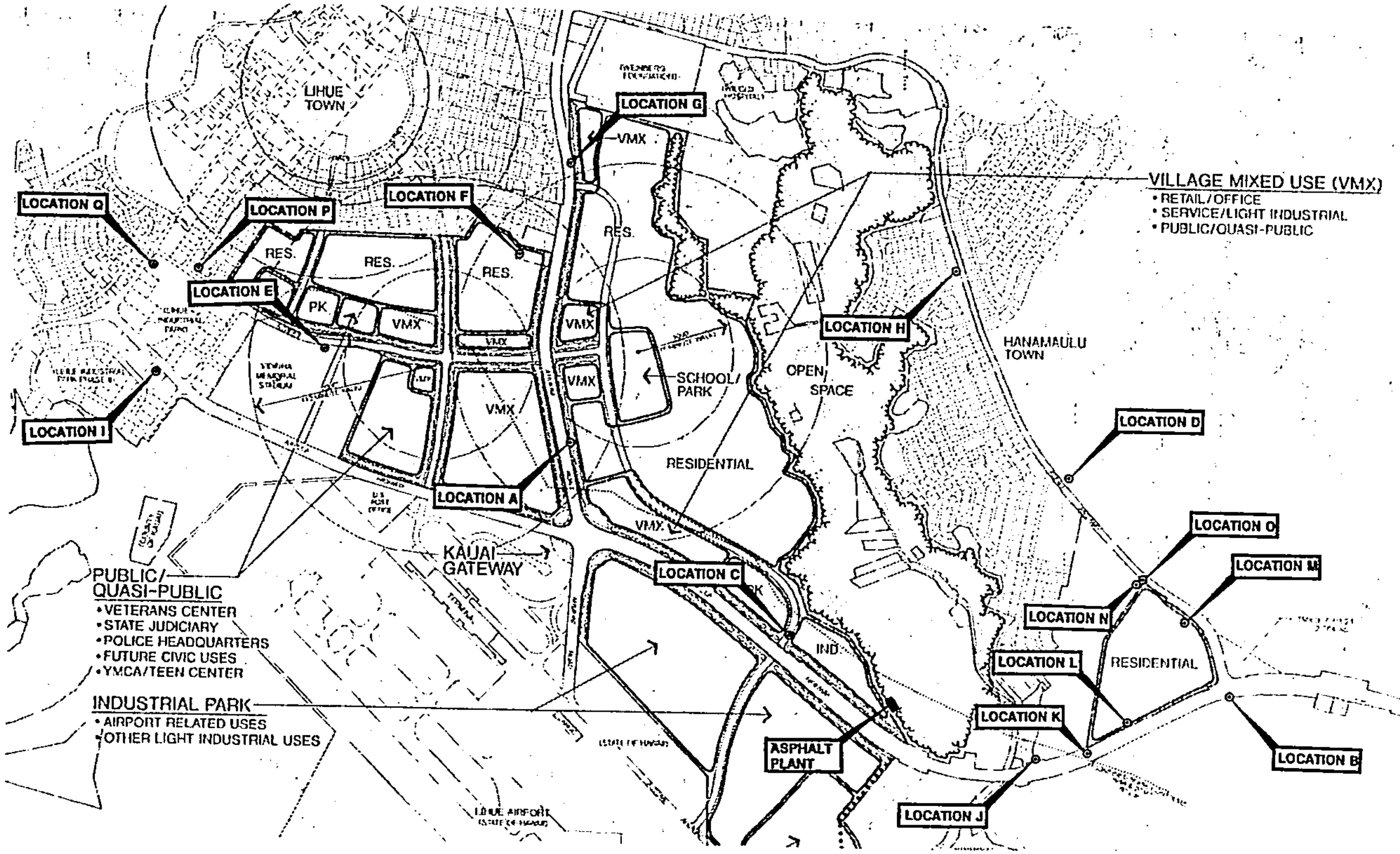


FIGURE 5-2
NOISE MEASUREMENT LOCATIONS
LIHUE-HANAMAULU
AMFAC/JMB HAWAII — LIHUE DISTRICT, ISLAND OF KAUAI

NORTH — LINEAL SCALE 375 0 375 750 1500 FEET

PBR HAWAII

Source: Y. Ebisu & Associates.

Asphalt Concrete Batch Plant

At the northeastern end of Ahukini Mauka, an Asphalt Concrete Batch Plant is operated by Niu Construction, Inc. Noise sources from the plant include a 1 megawatt diesel generator and the asphalt plant's furnace. At the northern end of the project area, noise levels could exceed 70 dBA along the common property boundary. However, in the area of proposed residential development approximately 1,800 feet from the plant, existing noise levels decrease to the range of 50 to 55 dBA. The batch plant is on a short term lease with LPCo and may be relocated to other LPCo lands at the appropriate time.

B. Potential Impacts

Traffic Noise

According to the Acoustic Study, the future traffic noise levels along the primary access roadways to the project were calculated for the Year 2016. Along the existing roadways which will service the project, total noise levels for project and non-project traffic are expected to increase by 3.4 to 8.2 Ldn between CY 1994 and CY 2016. During that same time period between CY 1994 and project buildout at CY 2016, total noise levels for project traffic alone will increase from 0.4 to 5.67 Ldn. Traffic noise increases due to project traffic are predicted to be less than the increases caused by non-project traffic on all roadways except Hoolako Street, and are expected to range from 2.5 to 3.1 Ldn. The increases in traffic noise levels associated with non-project traffic are greater than 2.0 Ldn, and considered to be significant. However, with or without the project, future traffic noise levels are expected to increase along the roadways servicing the project.

For the year 2016 (project buildout) without noise mitigation measures, centerline setback distances to the 65 Ldn contour are expected to range from 179 to 182 feet along Kapule Highway. Setback distances from the centerline are estimated at 224 to 231 feet on Kapule highway, and 67 to 106 feet from the centerlines of Kuhio Highway (near the Hanamaulu Triangle), Hoolako Street, and Rice Street.

The largest increases in traffic noise levels attributable to project traffic are expected to occur along Hoolako Street and along the section of Ahukini Road near the Kuhio Highway intersection. Overall, traffic noise level increases along Kuhio Highway near the Hanamaulu Triangle and along Rice Street between Kapule Highway and Hoolako Street are expected to be insignificant, with essentially no traffic noise impacts expected from the proposed project.

Aircraft Noise

The preparation of the Lihue-Hanamaulu Master Plan took into consideration the Airports Division's Lihue Airport existing noise contours (1994) and the projected contours for 2010 (Figures 5-3 and 5-4) in locating noise sensitive land uses. All noise sensitive uses (i.e.: residences, schools, day care centers) are sited to be outside the 60 Ldn contour as shown in the Master Plan.

Aircraft noise projections for the year 2010 were developed using the most recently available State DOT forecasts for Lihue Airport. Other assumptions included airport improvements, number of inter-island carriers, and type of aircraft.

Based on these assumptions, noise levels in the Molokoa residential area are projected to decrease from current levels due to quieter aircraft technology. Noise will slightly increase, however, in the proposed industrial area mauka of Kapule Highway. Overall, the 60 Ldn contour will expand slightly by the year 2010 and extend into the project site alongside Kapule Highway, but not impact noise sensitive land uses.

The siting of noise sensitive uses of the project comply with both the existing federal noise standard of 65 Ldn (as defined by the American National Standards Institute) as well as the more stringent State of Hawaii planning guideline of 60 Ldn for the siting of noise sensitive land uses in the vicinity of airports, and are considered to be 'Acceptable' by both federal and state noise criteria.

The Master Plan takes into account the existing airport noise contours as shown in Figure 5-3 and the projected 2010 noise contours as shown in Figure 5-4. The Master Plan depicts a combined 60 Ldn noise contour line for 1994 and 2010 and noise sensitive land uses including residential areas and the school site are sited within the acceptable area outside of the 60 Ldn contour line. In the higher noise exposure zone of 65 to 70 Ldn, Industrial and Public/Quasi-Public uses are planned, and are also considered to be 'Acceptable' by local and federal noise criteria. Therefore, special aircraft noise attenuation measures are not applicable to this project.

Combined Aircraft and Traffic Noise

The study of the effects of combined aircraft plus traffic noise was performed to reduce risks of exceeding the FHA/HUD standard of 65 Ldn when siting residential properties, since aircraft noise levels between 60 and 55 Ldn can increase the setback distances to the 65 Ldn traffic noise contours shown in TABLE 4B of Appendix N under unobstructed line-of-sight conditions between the receptor and the traffic and aircraft noise sources. According to the acoustical consultant, Y. Ebisu & Associates, development of additional combined aircraft plus traffic noise contours were not considered appropriate for this study for the following reasons:

(1) The available forecast years for the aircraft operations and the traffic were not the same (CY 2010 and CY 2016, respectively). For demonstration of compliance with the FHA/HUD noise standard of 65 Ldn when federal financial assistance is sought, a separate noise study will be required with a common forecast year.

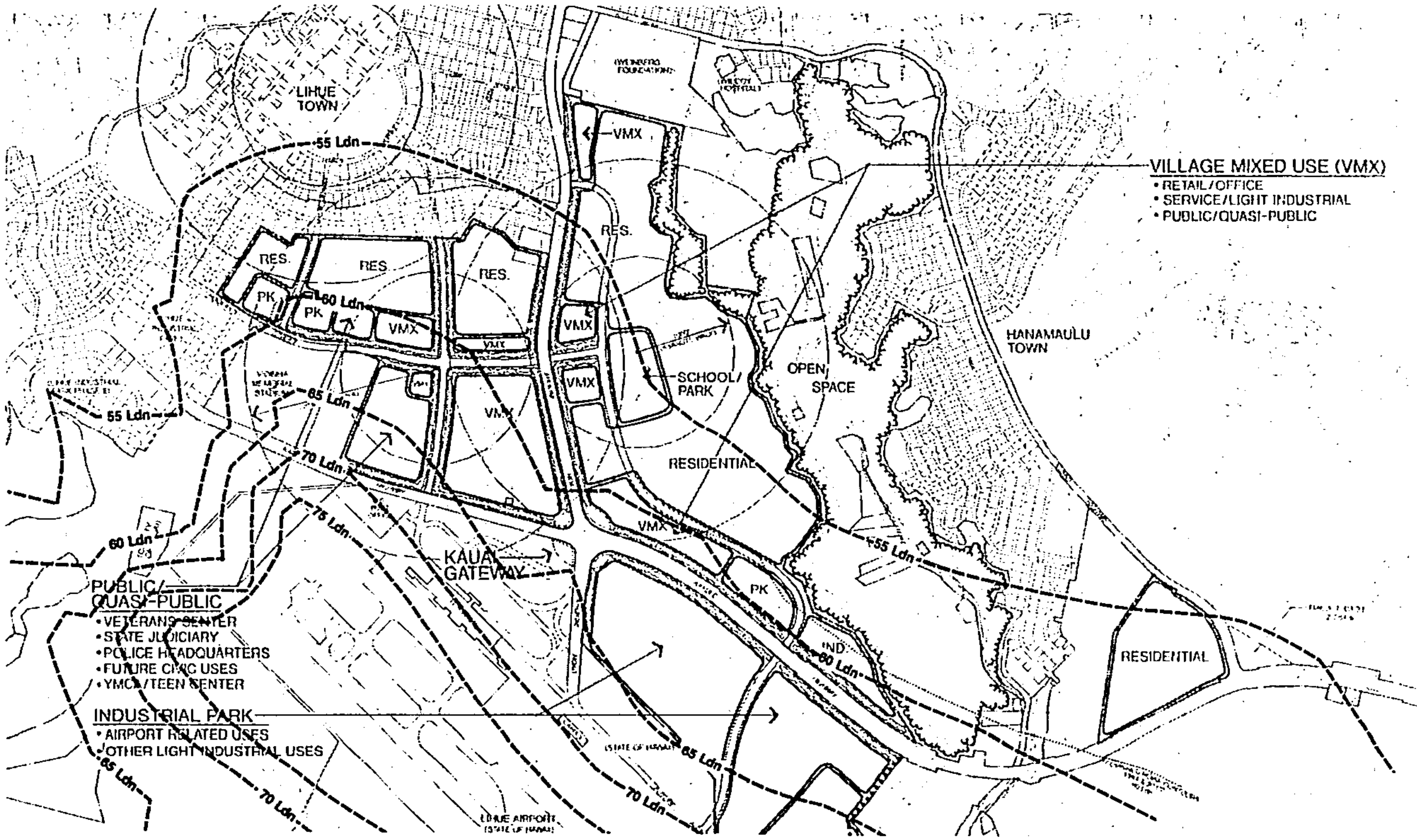


FIGURE 5-3
1994 AIRCRAFT NOISE CONTOURS

LIHUE-HANAMAULU

AMFAC/JMB HAWAII — LIHUE DISTRICT, ISLAND OF KAUAI

NORTH — LINEAL SCALE 375 0 375 750 1500 FEET

PBR HAWAII

Source: Y. Ebisu & Associates.

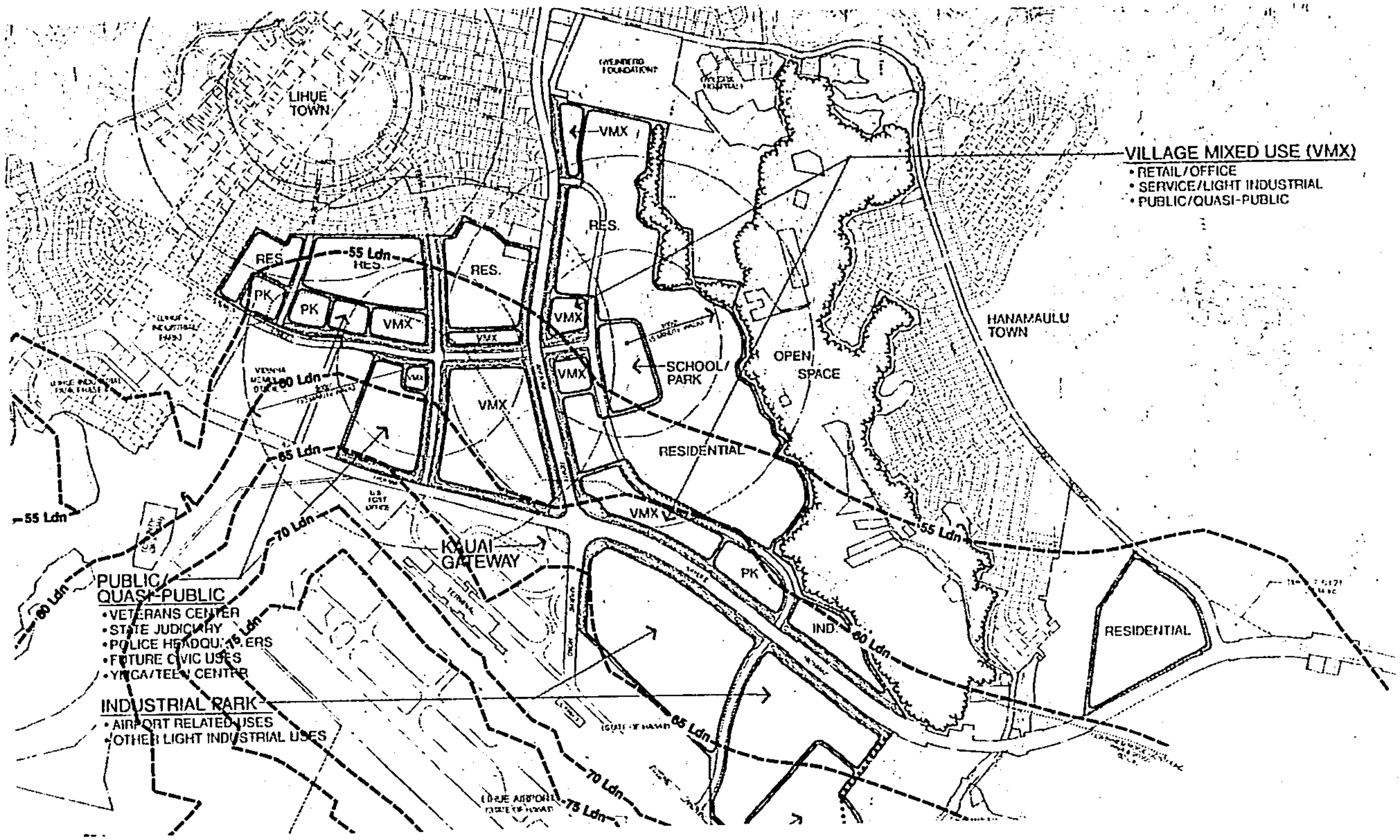


FIGURE 5-4
2010 AIRCRAFT NOISE CONTOURS
LIHUE-HANAMAULU
AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI
NORTH
LINEAL SCALE 375 0 375 750 1500 FEET
PBR HAWAII

Source: Y. Ebisu & Associates.

(2) The general locations of the combined (aircraft plus traffic) 65 Ldn contours using the two different forecast years were provided in Pages VII-4 and VII-5 of Appendix N. As indicated on Page VII-4 in Appendix N, the locations of the combined 70 Ldn contours in the noise sensitive areas of interest should remain at the setback distances indicated in TABLE 4B, since forecasted aircraft noise levels are less than 60 Ldn in these noise sensitive areas. The locations of the combined 60 Ldn contours are generally not definable without knowledge of the locations and characteristics of the future residential structures, since traffic noise shielding effects can be expected from the first row of new homes which would probably be located between the 65 and 60 Ldn traffic noise contours.

Asphalt Concrete Batch Plant

Assuming that the batch plant will continue operations well into the future, primary noise impacts will not occur due to project development, but rather, the project will be impacted by noise from the batch plant. Consequently, the Lihue-Hanamaulu Master Plan has been designed to locate land uses compatible with batch plant noise.

Construction Impacts

Construction noise (80 to 90 dB at 50 feet) will be unavoidable during the entire project construction period, although noise will generally move from one location to another as projects are completed. Properties expected to experience the highest noise levels from construction are the existing residences in the Molokoa, Lihue, and Hanamaulu areas adjacent to the project site. These impacts will be limited to temporary degradation and will not be in the "public health and welfare" category due to the temporary nature of the work and available administrative controls for noise regulation.

C. Mitigative Measures

Traffic Noise

According to the Acoustic Study, traffic noise levels attributable to the project will increase along the roadways in the immediate vicinity of the project. Only along Ahukini Road toward Kuhio Highway, will project traffic noise increases be in the significant category rising 3.0 Ldn. Only along Hoolako Street will project traffic noise increase more than non-project related traffic noise. However, with noise mitigation measures such as a 6 foot wall or berm, at least 5 Ldn units of noise reduction should be possible at ground level.

According to the Acoustic Study, the projected traffic noise along public roadways will be generated mostly by non-project traffic. Usually, mitigation of off-site traffic noise impacts will be performed by individual property owners along the roadways right-of-way or by public agencies during roadway improvement projects. However, on-site mitigation measures will be undertaken for project and non-project related traffic noise during more detailed design phases of project development where appropriate setbacks, landscape buffers, topographical barriers, and physical barriers such as berms and walls can be easily incorporated into project development typical of master planned communities.

Aircraft Noise

According to the Acoustic Study, noise sensitive land uses are not recommended for development in areas with a Ldn level of 60 or higher. These sensitive land uses include residences, schools, churches, health centers, day-care centers, and hotels. Industrial and commercial uses, however, are appropriate for the 60 Ldn threshold, since closure and air conditioning of industrial and commercial office spaces is the rule rather than an exception.

(1) **Master Plan Design.** The Lihue-Hanamaulu Master Plan has located all noise sensitive land uses outside of the 60 Ldn noise contour in accordance with the Acoustic Study recommendations. By siting planned noise sensitive uses in this manner, adverse aircraft noise impacts have been mitigated to acceptable levels.

(2) **Disclosure Provision.** The disclosure provision of Section 467-31, HRS, will be followed to reduce risks of occupant dissatisfaction with aircraft noise levels in the area. Additional aircraft noise mitigation measures should not be required.

Construction Impacts

(1) **Compliance with DOH Rules.** Mitigation of construction noise to inaudible levels will not be practical due to the intensity of development and nature of the work (grading, trenching, concrete pouring, hammering, etc.). However, properly muffled construction equipment will be used on the job site. In addition, all applicable State Department of Health regulations regarding construction noise limits, curfew times, and holiday work, will be applied to the project to ensure that noise exceeding 95 dB does not occur off-site.

Asphalt Concrete Batch Plant

(1) **Project Design Considerations.** In addition to establishing noise compatible land uses adjacent to the batch plant operations, noise mitigation measures in the form of enclosing the asphalt plant's furnace opening and providing silencers at the air openings, may be required to bring the plant into conformance with the State DOH limit of 70 dBA at the boundary line of the project's proposed industrial area mauka of Kapule Highway. If the State DOH noise limits are adopted by the County of Kauai in the near future as anticipated, additional mitigation of asphalt plant noise levels along the plant's other property boundaries may be required.

(2) **Alternative Location.** Given the short term lease and the conditional use permit that must be periodically reviewed, Amfac/JMB will work with the owners of the plant to find a suitable alternative location if required.

5.4 AIR QUALITY

An air quality study of the proposed project was prepared by Ogden Environmental and Energy Services (September 1994). The results of the study are summarized below and the complete report is attached as Appendix O. According to the Air Quality Impact Analysis, the overall project is an "indirect source" of air pollution as defined in the Federal Clean Air Act. Thus, the focus of the Air Quality Impact Analysis was to identify the project's potential to reduce or enhance the impact of the surrounding air quality as a result of the new development.

A. Existing Conditions

Although the background concentration of potential air pollutants have not been monitored regularly by the Department of Health Clean Air Branch (the Lihue monitoring station has not operated since October 1985) the air quality on Kauai is generally considered as "good". To ensure that existing air quality continues, both Federal and State standards have been established to identify ambient air quality conditions and potential changes as they may occur in the future. The only major air quality impacts presently impacting the project area are from agricultural activities and vehicular traffic. Presently, the State of Hawaii is considered by the U.S. Environmental Protection Agency to be in attainment for all criteria pollutants.

Surface winds are generally around twelve miles per hour from the northeast. Wind velocities and directions are influenced to an important extent by the mountainous terrain to the south and west. Daily variations includes diurnal effects of winds from the southwest quadrant during the night and morning hours, shifting to the northeast during the day.

B. Potential Impacts

Based on the Air Quality Study, no significant air quality impacts will result from the proposed project. During project construction, measures will be taken to ensure that fugitive dust emissions are controlled. Emission sources include construction equipment, workers' vehicles, and fugitive dust.

Although vehicular emissions will increase above current levels, these emissions are not considered significant. Fugitive dust emissions during clearing is estimated at 1.2 tons per acre per month of activity, however, these air quality impacts will be localized and temporary. According to the Air Quality Report, current air quality impacts originating from agricultural operations will gradually decrease as the project is developed over the 15 to 20 year development period. The net result will be an improvement in air quality (i.e., less particulates, better visibility, etc.) for the development site and surrounding areas, such as the nearby hospital, existing urban community and the airport.

Long-term impacts associated with everyday use of the property are comprised primarily of emissions from projected increased vehicular traffic resulting from a higher population concentrated within an urban center. To determine whether carbon monoxide (CO) concentrations would exceed State or Federal air quality standards, computer models were utilized for various locations where traffic will likely be congested. A complete description of the modeling methodology is provided in Appendix O.

Based on the findings of the model analysis and projected traffic levels, some intersections may exceed the State air quality standards if the LOS remains at "F" at major intersections. However, if traffic mitigation measures are implemented as described in Appendix E, and all LOS at project intersections are increased to LOS "D" or higher, it is likely that the air quality impacts will also improve as queuing times are reduced and the worst case scenario will not occur as projected in the model.

Indirect sources of air quality impacts will result from increased electrical generation associated with population growth on Kauai. Although increased electrical demand will contribute to the regional air pollution background, total air pollution generated will have little impact in the area and will remain well below the State's air quality standards. Assuming population growth occurs as projected, these indirect air quality impacts will occur with or without development of the project.

C. Mitigative Measures

(1) ***Construction Period Mitigative Measures.*** Fugitive dust and heavy equipment use during construction are the primary short-term emission sources associated with the project. Although similar impacts presently result from agricultural operations on the property, mitigation measures during project construction can be more easily implemented as part of the construction management program. Specific mitigation measures include minimizing the amount of cleared area and related construction activity at any one time, and watering of exposed areas.

(2) **Project Design for Alternative Transportation.** According to the Air Quality Impact Analysis, the development of the Lihue-Hanamaulu Master Plan is not expected to significantly raise CO concentrations in the surrounding area. Nonetheless, mitigation measures can be incorporated into the project planning to encourage reduced dependence on vehicular transportation. These include public access to alternate forms of transportation, car pooling, bicycling and walking.

(3) **Long-Term Base Traffic Improvements.** Based on the base improvements and mitigation measures recommended by the traffic consultants, the modeled intersection will improve to a below capacity LOS rating if the mitigation measures recommended with project development are provided. The CO concentrations produced by other intersections along the development are expected to be equivalent to or less than the CO concentrations at the modeled intersection due to their equivalent or smaller traffic volumes. As the base traffic improvements and mitigation measures are implemented during project development, the LOS ratings will improve and CO concentrations reduced.

Indirect pollutant impacts are not considered to be significant. Due to the negligible impact of these sources, no additional reduction measures are warranted.

5.5 VISUAL RESOURCES

Existing views of the project site from the surrounding area have been inventoried in this section, both descriptively and by photographs. Short-term and long-term effects of views of the site which will result from development of this project are assessed, and measures are proposed to minimize adverse effects.

A. Existing Conditions

The Project Area is in four geographic locations along major roadways, Kapule Highway and Ahukini Road, in Lihue and at Hanamaulu along Kapule Highway and Kuhio Highway. Primary views of the project area are presently available from these roadway corridors. A project site photograph key map (Figure 5-5) identifies the locations from which site photographs (Figures 5-5A to 5-5D) were taken.

The present visual character of the Project Area from all approaches towards the intersection of Kapule Highway and Ahukini Road is agricultural. Sugarcane fields under cultivation by Lihue Plantation provide a green backdrop. Distant views of Mts. Waialeale and Kawaikini are seen from Ahukini Road heading mauka and of the ocean while heading makai. From within the Ahukini Mauka area of the project site, northerly views of Hanamaulu Gulch are available, as well as residences at Hanamaulu, with a backdrop of Kalepa Ridge.

B. Potential Impacts

Short-term Visual Impacts - Construction activities will create some adverse effects on the views of the project along the roadway corridors. Depending on the phase of development, construction sites will be undergoing clearing and grubbing, grading, site work, foundation construction, framing and/or finishing.

Long-term Visual Impacts - The visual character of the project site will be changed from its present agricultural appearance to that of an urban mixed use village with commercial, retail, and office complexes, public buildings, industrial and residential uses. Park space and street landscaping will provide greenery along the public areas. Lighting of streets will be designed for safety but also to reduce negative impacts to the Newell Shearwater waterbird species.

C. Mitigative Measures

(1) **Project Design Considerations.** The project will minimize adverse visual effects by conforming to setback requirements, installing appropriate landscaping, and establishing design guidelines for structures which will include building heights, locations, materials, colors and surrounding landscaping.

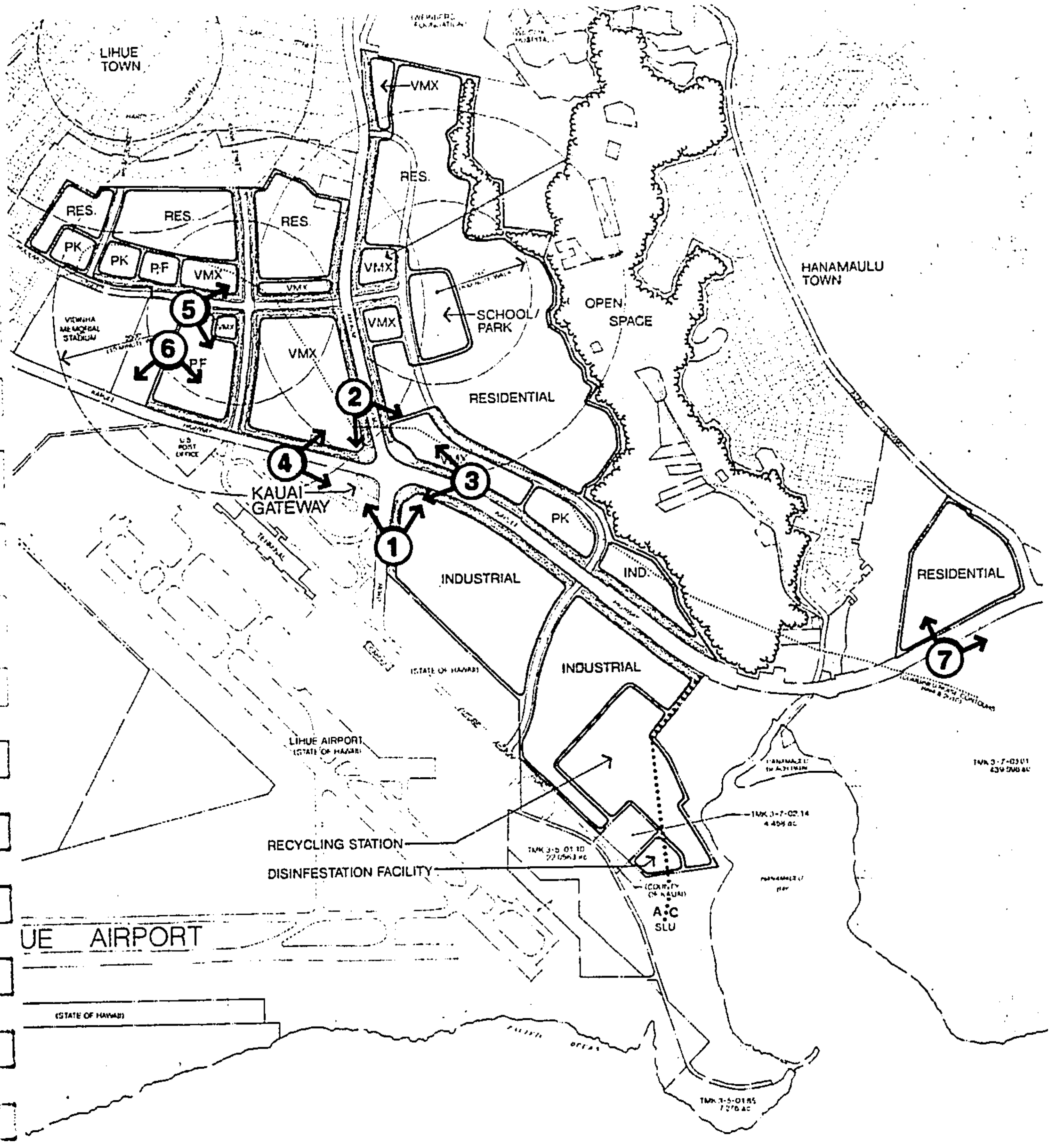


FIGURE 5-5
SITE PHOTOGRAPHS KEY MAP
LIHUE-HANAMAULU

AMFAC/JMB HAWAII — LIHUE DISTRICT, ISLAND OF KAUAI

NORTH — LINEAL SCALE 350 0 350 700 1400 FEET

PBR HAWAII

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

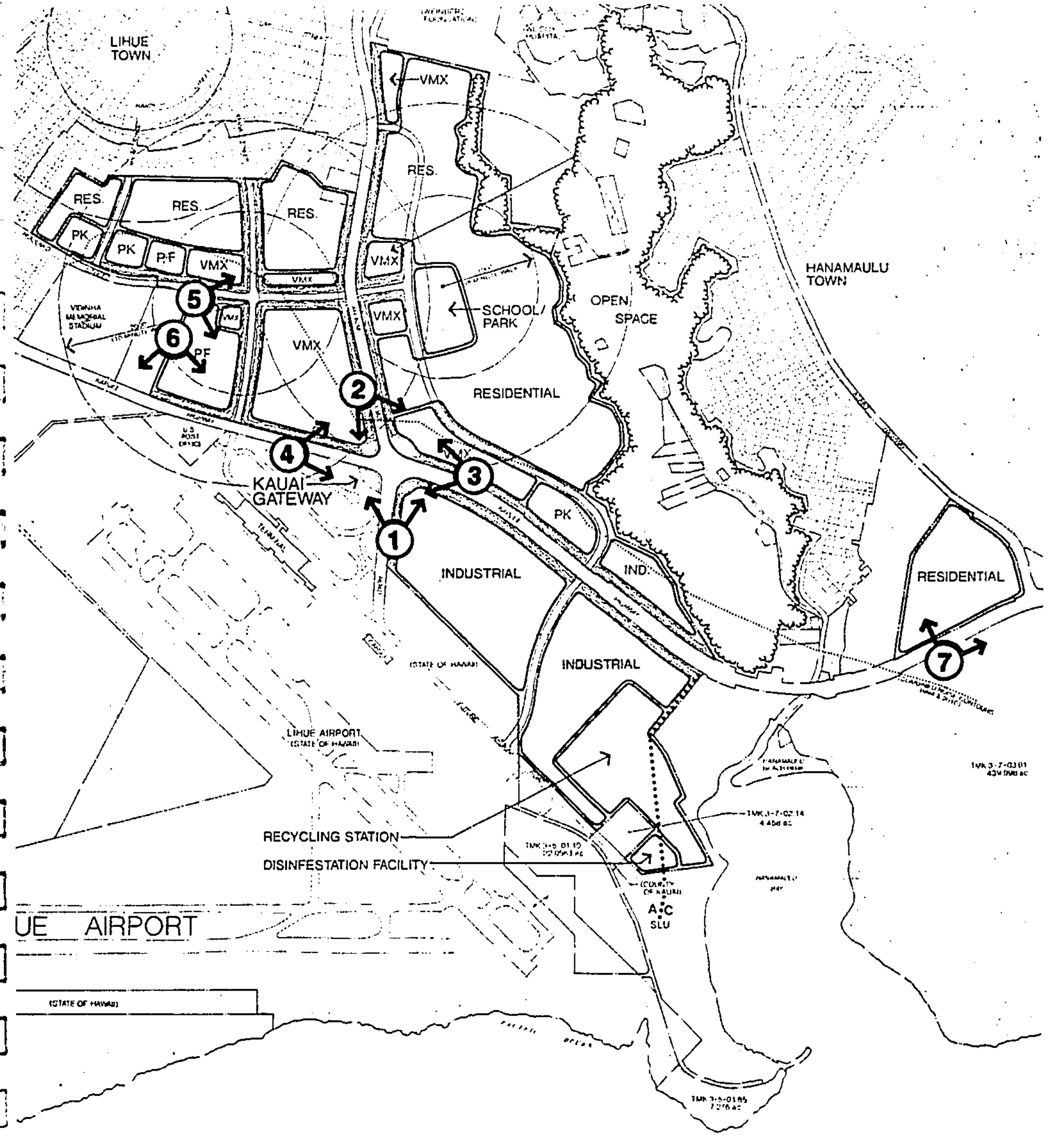
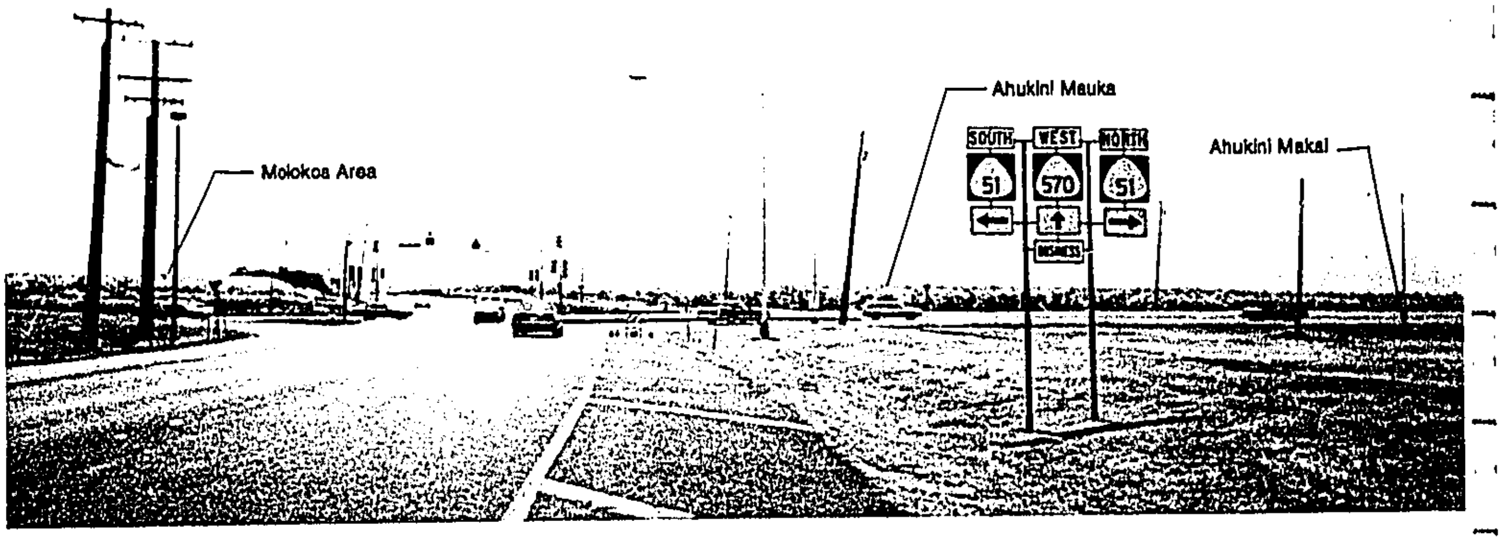
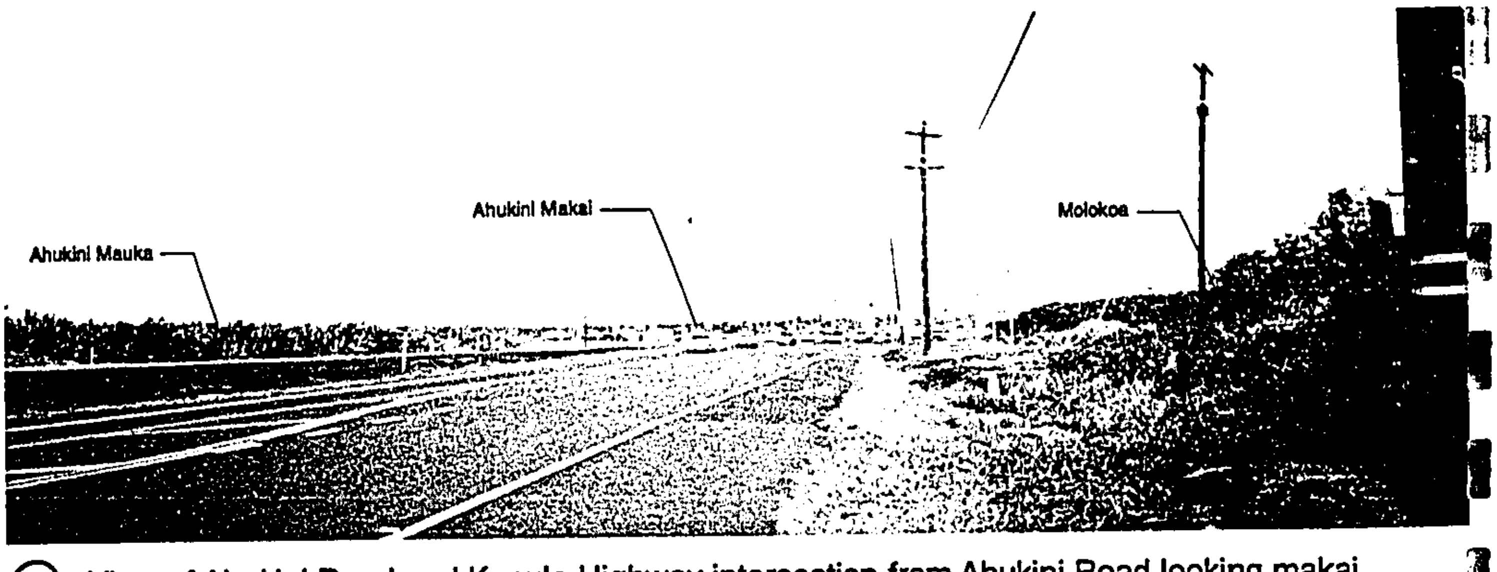


FIGURE 5-5
SITE PHOTOGRAPHS KEY MAP
LIHUE-HANAMAULU
AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI
NORTH
LINEAL SCALE 350 0 350 700 1400 FEET
PBR HAWAII

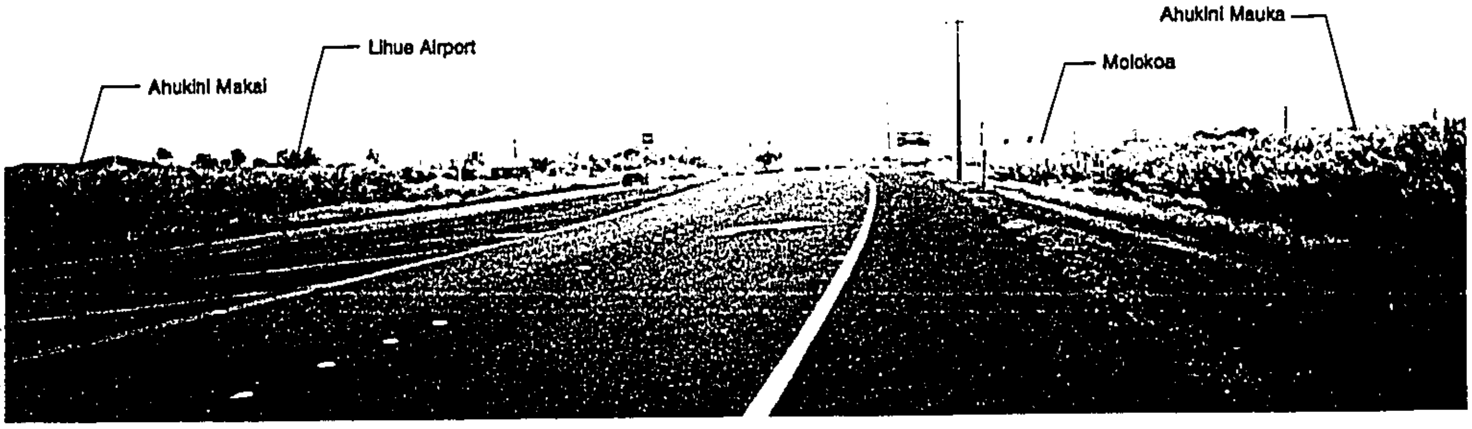


(1) View of Ahukini Road and Kapule Highway departing from Lihue Airport "Gateway" intersection from Ahukini Road looking mauka

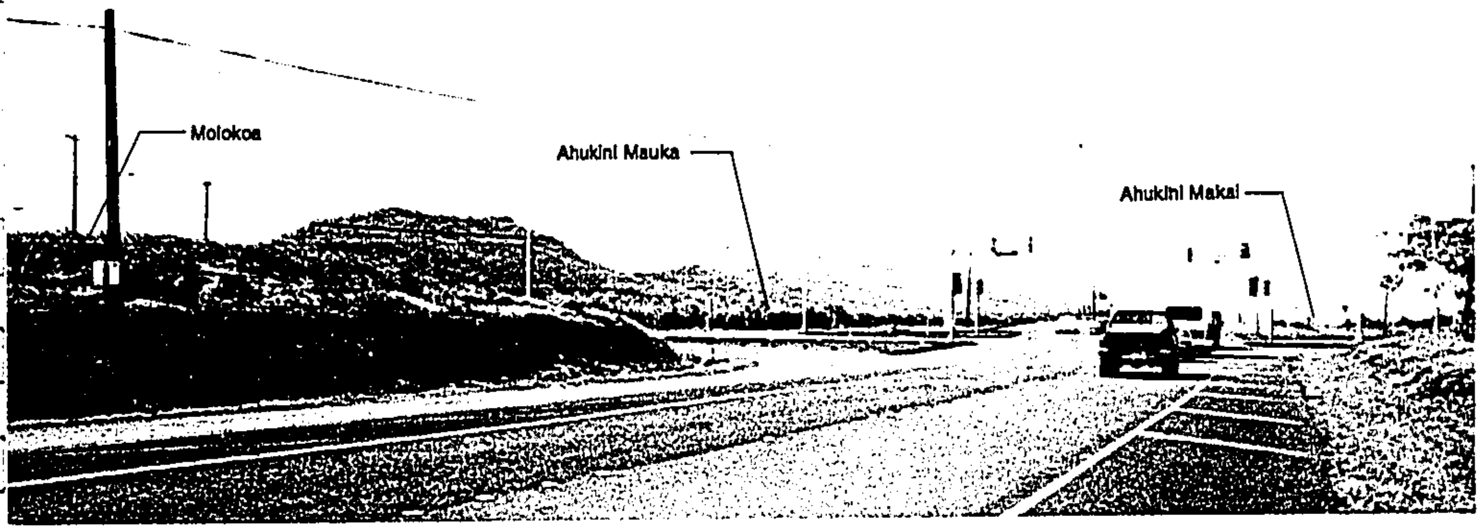


(2) View of Ahukini Road and Kapule Highway intersection from Ahukini Road looking makai

FIGURE 5-5A
SITE PHOTOGRAPHS
LIHUE-HANAMAULU
NO SCALE
LIHUE DISTRICT, ISLAND OF KAUAI
AMFAC/JMB HAWAII

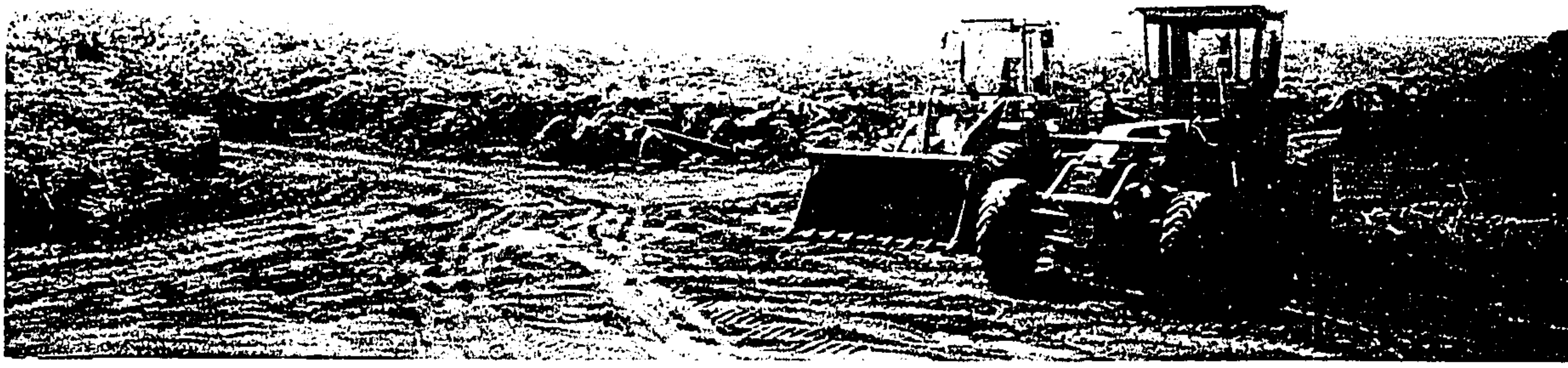


③ View of Kapule Highway and Ahukini Road intersection from Kapule Highway looking south

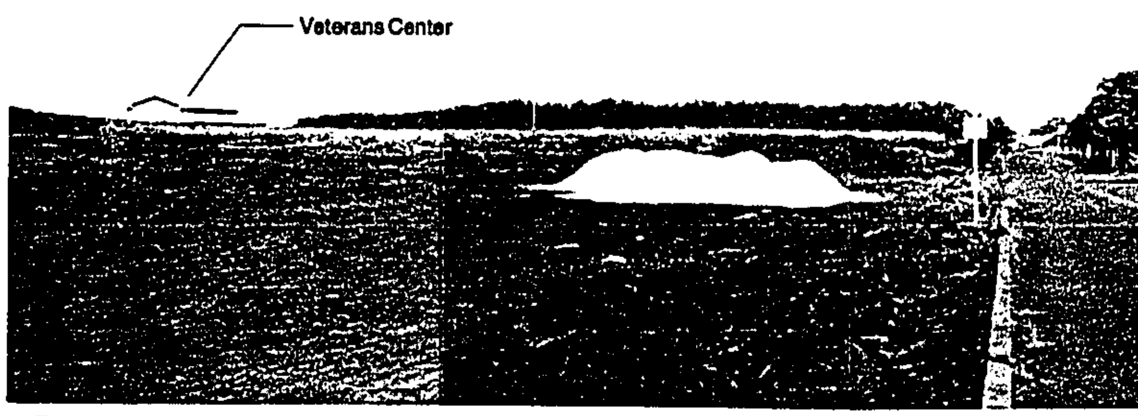


④ View of Molokoa and Ahukini Mauka from Kapule Highway looking north

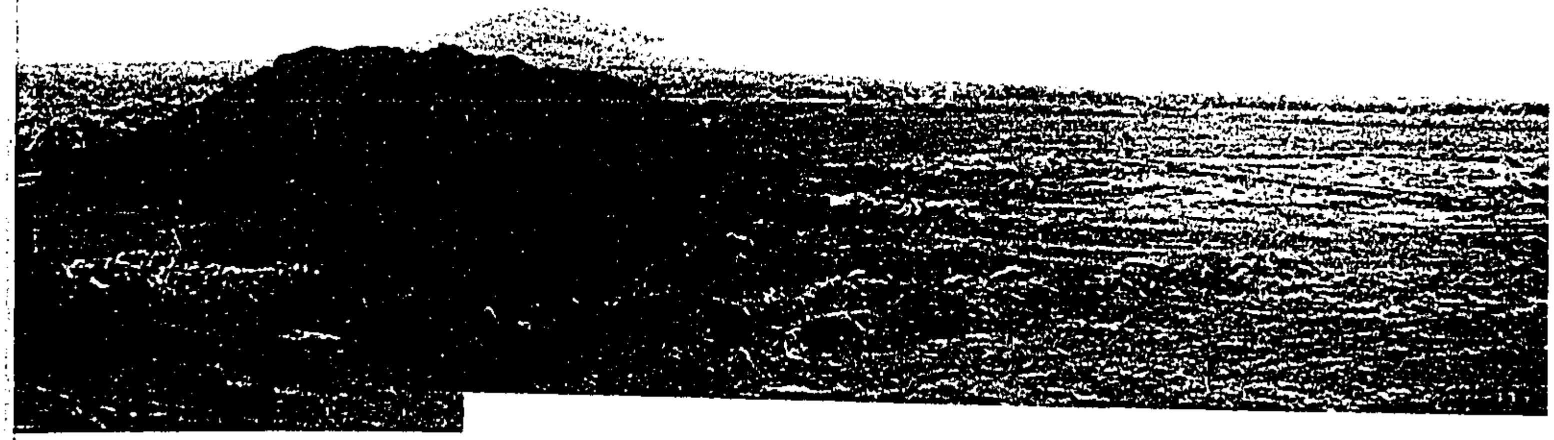
FIGURE 5-5B
SITE PHOTOGRAPHS
LIHUE-HANAMAULU
NO SCALE
LIHUE DISTRICT, ISLAND OF KAUAI
AMFAC/JMB HAWAII



(5) Typical panorama view of Molokoa from end of Hoolako Street looking north

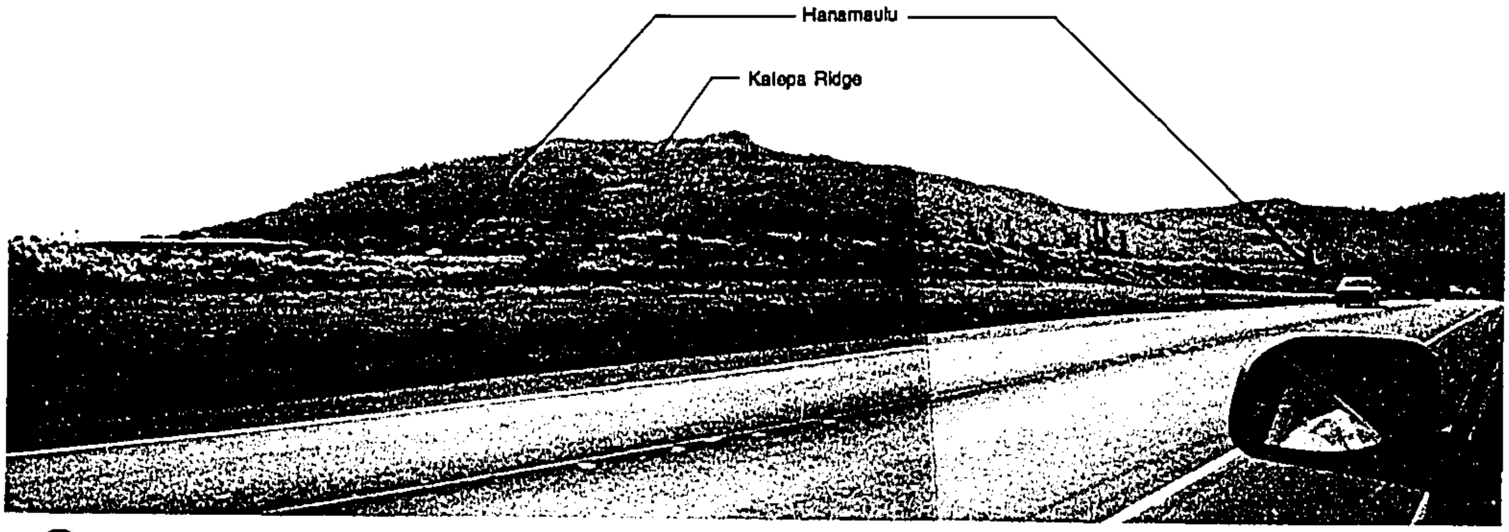


(6) View of the Veterans Center and Antone K. Vidinha Stadium Complex Are



tadium Complex Area looking makai

FIGURE 5-5C
SITE PHOTOGRAPHS
LIHUE-HANAMAULU
NO SCALE
PBR



⑦ View of Hanamaulu (foreground) with Kalepa Ridge in background looking north along Kapule Highway

FIGURE 5-5D
SITE PHOTOGRAPHS
LIHUE-HANAMAULU
NO SCALE
LIHUE DISTRICT, ISLAND OF KAUAI
AMFAC/JMB HAWAII
PBR HAWAII

(2) **Kauai Gateway.** The Ahukini Road/Kapule Highway intersection forms the first major crossroads for visitors and returning residents arriving at Lihue Airport and driving to their destinations. Appropriate landscaping at the four corners will be coordinated and implemented along with the State Department of Transportation's and the "Aloha Plumeria Project" Kauai Gateway beautification efforts.

5.6 SOCIAL CHARACTERISTICS

A Social Impact Assessment was prepared for the Lihue-Hanamaulu Master Plan to identify the social implications of the proposed project by Earthplan (September 1994); the report is attached as Appendix P. The study reviewed historical characteristics of the community, existing social conditions (utilizing interviews with residents), and projected how the Master Plan would impact future lifestyles and socio-economic conditions.

According to the Social Impact Assessment (Appendix P), sugar production has long been the dominant land use and economic activity in the Lihue District. The towns of Lihue, Hanamaulu and Puhi were all originally established to support sugar operations. Labor for sugar was provided by Chinese, Japanese, Puerto Rican, Korean, German, Portuguese, Filipino and other immigrant groups which dramatically added to the population size and cultural make-up of Kauai.

The location of sugar operations, together with the designation of Lihue as the seat of county government, growth of Nawiliwili as the island's main harbor, and the development of Lihue Airport, have all contributed to the establishment of Lihue as the island's primary place for government, commercial and professional activity. Moreover, in recent years, growth of the visitor industry as reflected by the construction of the Kauai Lagoons/Kauai Marriot (previously Westin), the Kauai Resort, the Outrigger Kauai Beach, and Aston Kauai Villas, have begun to replace sugar as the primary economic generator in the area.

5.6.1 Population

Two studies analyzing the existing and future population for the Lihue District and the County of Kauai were prepared for the project: the Market Analysis (Appendix F) and the Social Impact Assessment (Appendix P). Because both studies utilized population projections provided by the Office of State Planning for the Five-year State Land Use District Boundary Review, these projections will also be utilized for planning purposes to maintain consistency.

A. Existing Conditions and Population Forecasts

The historic and projected population and household characteristics of the residents of the County of Kauai are primary influences in the determination of the potential for future development in the Project Area. The County of Kauai experienced significant population growth in the 1970s and 1980s after a period of decline in the 1940s and 1950s, and a virtually dormant 1960s. In the previous decade, the annual population growth rate in the County has been higher than the state-wide rate (approximately 2.7 percent for the county and 1.4 percent statewide). The population of the

County of Kauai in 1990 was 54,099. The County population is projected to increase by approximately 56.4 percent to 84,599 by the year 2010.

Of the 1990 total population, approximately 11,649, or 21.5 percent of the County population, presently reside in the Lihue District. Between 1980 and 1990 the Lihue District's population grew from 8,590 persons to 10,663 persons. This growth represented an annual increase of 2.19 percent or 207 persons. The Lihue District has had a moderate rate of growth of over 2.3 percent between 1970 and 1990 increasing from 6,766 persons in 1970.

Given the central location of the Lihue District, its continued role as Kauai's commercial center and the ready access to other employment areas, the Lihue District's share of the County's overall population should increase in the future. Reflecting this, the Office of State Planning's (OSP) 1992 State Land Use District Boundary Review for Kauai has projected population changes for each of Kauai's five districts from the 1988 to 2010 period.

In the OSP Boundary Review the district's share of Kauai's overall population was projected to increase from 11,649 (21.5 percent) in 1990 to 17,171 (25.2 percent) in 2000, and to 24,384 (28.8 percent) in 2010. Adjustments have been made to account for more current population estimates and the effect of Hurricane Iniki by Arthur Andersen & Company in the Market Analysis (Appendix F).

B. Potential Impacts

According to the Social Impact Assessment, population associated with the Lihue-Hanamaulu Master Plan can be projected utilizing a factor of 2.64 persons per single-family household. The proposed multi-family units have been calculated at 2.00 persons per household. With the development of the Lihue-Hanamaulu Master Plan's 1,400 to 1,800 new single and multi-family homes, the project's population over the 15 to 20 year build-out period will account for approximately 4,400 of the 16,885 additional residents projected to reside in the Lihue District in the year 2020.

A similar population estimate of 4,475 persons to be accommodated in the Lihue-Hanamaulu Master Plan project was independently derived for the 1997 to 2016 period in the Market Analysis (Appendix F). This somewhat higher projection was based on assumptions for the number of homes completed, occupancy rates and average household size.

Assuming both projections are accurate, the Lihue-Hanamaulu Master Plan project should result in a population range of 4,400 to 4,475 persons by the year 2016. Similarly, the Market Analysis (adjusting OSP projections) estimates that the total population of the Lihue District will increase from 10,663 in 1990 to 27,548 in 2020, an increase of approximately 16,885 persons. Assuming the higher population projection for the Lihue-Hanamaulu Master Plan of 4,475 persons is achieved, only 26.5 percent of the projected 16,885 population increase (adjusted) will reside within the project area, or 16.2 percent of the total population of 27,548 projected for the entire Lihue District.

C. Mitigative Measures

(1) **Overall Consistency with General Plan Goals.** The Project Area has been identified by OSP as an urban expansion area for Lihue and recommended for urbanization. As an urban in-fill development, part of the population growth projected for the Lihue District would be accommodated within a master planned community serviced by all the necessary infrastructure connections. As part of the planning for this project and for the Draft EIS, existing water source and delivery systems; wastewater collection, treatment and disposal systems; roadway and drainage systems were analyzed for their capacity to service the project; and the necessary improvements to service the project have been identified. According to the Market Analysis (Appendix F), the project will provide 1,400 to 1,800 new dwelling units or approximately 25 to 30 percent of the projected demand for 5,733 units in the Lihue District over the next 25 years.

(2) **Appeal of the Project to Lihue District and Other Kauai Residents.** The project's design around the village core concept is likely to appeal to residents currently residing in the district. Its proximity to the government and employment centers will be attractive to residents who desire to reduce commuting distances, thereby increasing their leisure and personal time, or those who wish to live within a close range to the many amenities offered within Lihue and by the project. The convenience of a residential community proximate to the necessary employment, shopping and public services is expected to become more important as transportation costs increase and the demand for more leisure time grows in the future.

(3) **Project Phasing.** Phasing of the project and gradual absorption will assist in mitigating the impacts of population growth that will occur in the future. Without the project, population growth pressures will result in higher housing costs, over crowding, longer commuting time, and inefficient use of infrastructure. Buildout of the residential units will be substantially complete within a 15 to 20 year time period. As a result, the project's mitigation of population growth impacts will be spread well into the future as the project achieves ultimate build-out.

5.6.2 Housing

An analysis of housing data and potential impacts of the Lihue-Hanamaulu Master Plan is provided in the project Market Analysis (Appendix F). This section provides a background of housing conditions in the area and the impacts associated with providing new housing opportunities in the Lihue District.

A. Existing Conditions

Household Size - The term household size refers to the average number of persons living in an occupied dwelling unit within a given market area. On Kauai, the average household size has been declining since 1980. For example, in 1990, average household size was 3.10 persons compared to 3.22 persons in 1980. In 1970, the household size was significantly higher at 3.50 persons per unit. Should this trend continue into the future, the demand for more housing units per unit of population can be significant. Even if population growth does not occur as anticipated, reduction in household size alone will generate a significant demand for new housing.

Regional Housing Trends - Based on the 1970, 1980, and 1990 census, the number of dwelling units for the County of Kauai has grown from 9,021 units in 1970 to 17,613 units in 1990. Over the 20 year period, a net increase of 8,592 units had been recorded for the market area, representing an annual net growth in housing stock of 430 units. A shift from single-family to multi-family units during this period was also evident, with multi-family occupied units increasing from 8.7 percent of the total housing stock in 1970 to 14.3 percent in 1990.

Housing Absorption Rates - Housing absorption rates have exhibited steady growth on Kauai at an average rate of one new dwelling unit for every 2.64 full-time residents, or an absorption of 378 dwelling units per each 1,000 resident population change. Based on the historical absorption rate and projected population growth, approximately 16, 295 units will be required to meet the projected demand between 1990 and 2020. Factoring in obsolete units and vacancy rates, the new net housing requirement for the period between 1995 and 2020 is projected to average 633 units per year.

B. Potential Impacts

Based on the "Higher Market Capture Scenario" provided in the Market Analysis, the proposed Lihue-Hanamaulu Master Plan will introduce and capture a total of approximately 1,750 to 1,800 residential units (1,366 single family and 384 multi-family) between 1997 and 2016 into the Lihue District housing market. The potential mix of housing products may include single family units at affordable, gap, and market prices, and multi-family units at market, affordable and rental market prices. According to the Market Analysis, the price range for residential units is estimated (in 1994 dollars) as follows:

PRODUCT TYPE	PRICE RANGE
SF Affordable	\$145,000 to \$155,000
SF Gap	\$175,000 to \$190,000
SF Market	\$200,000 to \$225,000
MF Affordable	\$110,000 to \$120,000
MF Rental	Not Applicable

In 1990, the median value of owner occupied housing units in the Lihue Planning area of \$161,200 was lower than the islandwide median of \$171,500. The median value in Lihue Town was slightly higher than that of the island at \$176,300. The median value for Puhi and Hanamaulu was \$142,400.

As the Master Developer for the Lihue-Hanamaulu Master Plan, Amfac/JMB's role is to develop the land and infrastructure, much like its successful Waikele planned development in Central Oahu. Amfac/JMB will similarly contract with third party builders and sub-developers to construct residential and commercial/industrial developments at Lihue-Hanamaulu. The specific apportioning of the types and quantities of product will be determined through the coordinated effort of Amfac/JMB and the third party and sub-developers. Moreover, the approving agencies may specify a ratio of affordable and market priced residential units. Consequently, a detailed breakdown of the number of units for the different product types has not yet been determined.

C. Mitigative Measures

Based on the historic absorption rate, the projected absorption for the proposed Lihue-Hanamaulu Master Plan residential product (affordable, gap and market housing in single-family and multi-family units), will range from 96 to 127 units per year. Considering the historic island-wide annual absorption rate of 633 units, the proposed project will partially mitigate a portion of the projected demand for new housing.

5.6.3 Lifestyle/Character of the Community

A community survey was undertaken by Earthplan (included in Appendix P) to assist in assessing the community profile and to identify issues and concerns. The survey involved interviews with 62 individuals from a diverse range of backgrounds representing business, environmental, civic and Hawaiian and other cultural interests. This information is used in helping to define the community character and lifestyle aspects of the project.

A. Existing Conditions

According to the Social Impact Assessment (Appendix P), the proposed plan is consistent with community desires for the future development of the area. Expressed through public policies, community objectives call for further growth which, to a large extent, will occur in the Project Area. In addition, many persons interviewed for the social impact assessment expressed that they expected development to occur on the property, especially those in Molokoa and Hanamaulu who pointed out that portions of the project had been targeted for development in the past.

B. Potential Impacts

New communities will bring much needed housing and economic development to the area and increase the critical mass needed to support existing retail operations, service establishments and professionals in Lihue Town. A need to accommodate the future population was further validated by the OSP's Five-Year Boundary Review which recommended that the area be utilized for urban purposes.

With the planned infrastructure improvements, proposed parks, housing, YMCA/teen center, police protection, judiciary complex, Debris Recycling Station, Fruit Disinfestation Facility to support diversified agriculture, and school facilities, the overall social impact resulting from the project will be positive.

Although the population and lifestyle of Lihue will change in the future, the alternative of not planning for the future population growth (which will occur even without the project) next to Lihue Town, will clearly result in some negative social impacts. Without proper planning, housing could become more expensive and overcrowded, a more scattered land use pattern would result, there would be more pressure to urbanize rural or agricultural areas in the Lihue District or elsewhere on Kauai, and inefficient use of existing infrastructure and resources would increase the cost of public services to the residents of Kauai.

And finally, without proper design controls new developments which are not sensitive to the existing culture and character of the community could potentially be disruptive visually and socially.

C. Mitigative Measures

(1) **Appropriate Location for Urban Expansion.** From a policy standpoint, the Social Impact Assessment indicates that Lihue Town should be retained as the center of a larger region which includes the proposed project. Newer communities should be supportive of the existing town, rather than competitive or duplicative. The planned public and quasi-public facilities of the proposed Lihue-Hanamaulu Master Plan are intended to complement and expand upon what exists in Lihue Town today. The intent of this urban in-fill project is to provide Lihue with room for expansion at a location which is appropriate for growth in accordance with State and County land use policies.

(2) **Design Controls.** The design and operation of the development is planned to complement the low-rise character of Lihue while providing opportunities for the County to improve its facilities and services to its residents. The Lihue-Hanamaulu Master Plan will implement guidelines for all development within the Project Area. As shown in Figure 5-6 the design character is intended to be compatible with the existing Lihue area and will maintain open spaces through park space dedication and appropriate landscaping.

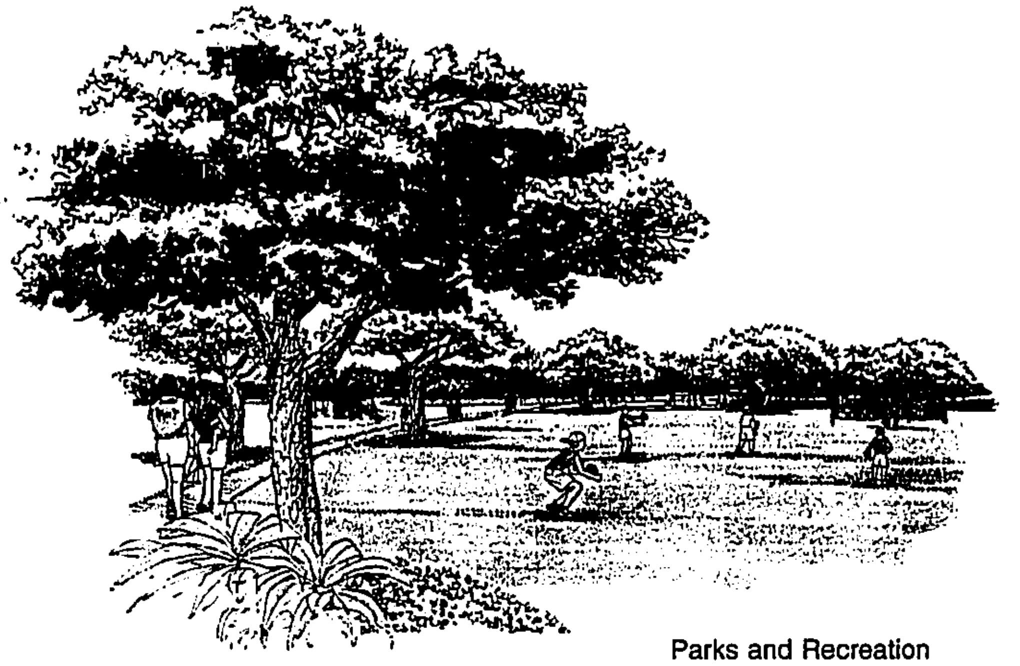
5.7 ECONOMIC CHARACTERISTICS

5.7.1 Employment, Personal Income and Expenditures

A. Existing Conditions

Employment

According to the Social Impact Assessment, employment on Kauai held relatively steady from 1988 to September of 1992 when Hurricane Iniki struck the island. In 1993, a drop of more than two thirds in the number of visitors compared to the average totals between 1989 and 1991 resulted in an increase in the unemployment rate from 3.7 percent to 12.5 percent in 1993. Total jobs also declined from 28,900 to 26,006 during the same period. Both the decrease in job count and the significant increase in unemployment are due to a decline in the tourism industry.



Parks and Recreation

Commercial and Office Mixed-Use

Retail and Office Mixed-Use

FIGURE 5-6
COMMUNITY CHARACTER
SKETCHES
LIHUE-HANAMAULU
NO SCALE
LIHUE DISTRICT, ISLAND OF KAUAI
AMFAC/JMB HAWAII

PBR HAWAII

Personal Income

Prior to Hurricane Iniki, real and nominal per capita income levels for the County of Kauai showed a general pattern of growth in the period between 1980 to 1991. Nominal per capita income increased from $9,499 in 1980 to $17,682 in 1991. Real per capita income based on 1982 dollars increased from $11,403 in 1980 to $11,947 in 1991. The average per capita income for Kauai residents during the 1980 to 1991 period ranged between 81 percent to 89 percent of the average per capita income for a resident of the State of Hawaii.

B. Potential Impacts

Employment

Permanent operations in the commercial and industrial area are projected to generate 3,410 full time equivalent jobs based on the absorption of the projected retail, office and industrial space in the Project Area (exclusive of government facilities). Short-term direct employment associated with construction is estimated at 195 to 264 man-years of labor on an annual average basis. Indirect and induced jobs which support construction activity will also contribute to the total jobs produced by project development.

Personal Income

Average annual wages during the 20 year development period are projected to increase from $27.8 million during the initial five year period to $88.4 million by the last five year period of the development, beginning 15 years after commencement of construction, in 1994 constant dollars.

C. Mitigative Measures

The impacts of the project on employment, personal income, and consumer expenditures appear to be beneficial to the area residents and businesses, therefore, no mitigative measures are needed or recommended.

5.7.2 Economic Factors/Government Revenues

Fiscal issues relating to the project were studied for the project in a Economic & Fiscal Analysis by Arthur Andersen & Co. (Appendix Q). Government revenues associated with the general excise tax, property taxes and income taxes increased by the economic activity are also addressed.

A. Existing Conditions

Revenues/Expenditures

Presently, revenues generated by the planning area to the State of Hawaii and the County of Kauai are primarily limited to property collected at agricultural tax rates and income tax from plantation workers. Consequently, revenues to the County or State presently generated on site are not significant. Similarly, governmental expenditures are also minimal since no significant public infrastructure or services are present on the property.

B. Potential Impacts

Revenues

The reclassification of the project area from agricultural to urban, as well as the proposed improvements would increase assessed land valuations to approximately $515.3 million in constant 1994 dollars or approximately $1.1 million per acre. Based on the estimated valuation, the Fiscal Impact Analysis (Appendix Q) projects that property taxes generated from the property will be approximately $2.9 million.

Expenditures

Although these revenues will go to the County's general fund, they can be indirectly utilized to fund the following major services to be provided by the County of Kauai: General Government; Public Safety; Sanitation; Health and Welfare; Transportation Facilities; and Culture and Recreation. Similarly, the State of Hawaii provides the following services to residents which would be directly impacted by the proposed development: Education; Highways; Hospitals; Health; and Sanitation.

Net Fiscal Impacts

According to the Fiscal Impact Analysis (Appendix Q), the proposed project will result in a net positive increase in overall revenues over expenditures.

C. Mitigative Measures

Future tax revenues that will be collected by the County of Kauai and the State are expected to offset the costs of providing public services. No additional mitigative measures are considered necessary with respect to government expenditures.

5.8 INFRASTRUCTURE

This section includes brief descriptions of the existing infrastructure on the project site and in the surrounding area for water supply, wastewater treatment and disposal, drainage facilities, roadways and solid waste disposal. Anticipated project impacts are evaluated along with mitigative measures proposed to minimize impacts on infrastructure.

Kodani and Associates, Inc. has prepared preliminary engineering reports for the project's water and drainage requirements. Austin, Tsutsumi & Associates, Inc. has prepared a wastewater management plan. The reports are attached as Appendices B, D & A, respectively. Information from these reports is included in this section.

5.8.1 Water Supply Facilities

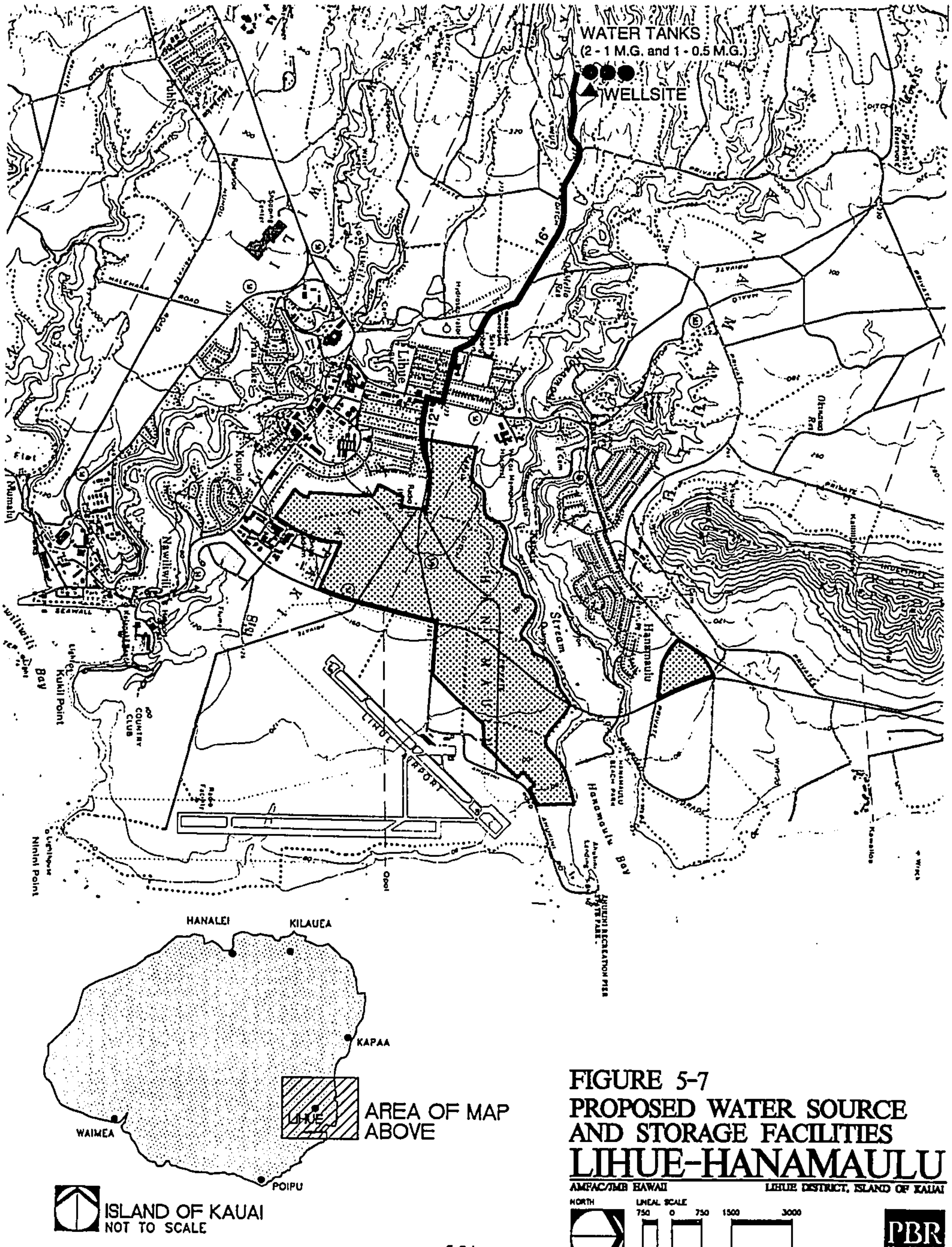
A. Existing Conditions

Presently, there is an existing 12-inch water line running along Ahukini Road from its intersection with Kuhio Highway to the Lihue Airport. Other existing lines include a 12-inch water line running along Kapule Highway between Ahukini Road and Haoa Street (industrial center road). However, there is no water line along Kapule Highway from its intersection with Ahukini Road and proceeding northward to Hanamaulu (Hanamaulu-Ahukini Cutoff Road). An existing 12-inch high pressure water line exists along that portion of Kuhio Highway which abuts Hanamaulu, but cannot be used in conjunction with proposed development at the Hanamaulu Triangle. However, there is an 8-inch water line along Hanamaulu Road which branches off to Amo Street and Anai Street. Both streets are serviced by 6-inch water lines stubbed out for future connections to the Hanamaulu Triangle parcel.

Major storage facilities include two 1.0 million gallon (mg) tanks located above the German Hill area in Lihue and a 1.0 mg and a 0.5 mg tank located on Kalepa Ridge above Hanamaulu. There is a 12-inch water line from the 1.0 mg storage tank on Kalepa Ridge that runs along Hulei Road down to Kuhio Highway. This line currently serves King Kaumualii Elementary School which abuts the Hanamaulu Triangle.

B. Potential Impacts

The Department of Water has determined that water source and storage facilities servicing Lihue and the Hanamaulu Triangle are at or near capacity. Based on Department of Water standards, and the maximum development density of 1,800 residential units, the average daily demand for the project area is projected to be 1.79 million gallons per day (mgd).



Source: Kodani and Associates, Inc.

FIGURE 5-7
PROPOSED WATER SOURCE
AND STORAGE FACILITIES
LIHUE-HANAMAULU
AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI
NORTH
LINEAL SCALE 750 0 750 1500 3000 FEET
PBR HAWAII

C. <u>Mitigative Measures</u>

(1) **Water Source Development.** To mitigate the water demand requirements of the proposed project, approximately nine wells are proposed to be located at an elevation of approximately 393 feet as shown in Figure 5-7. For planning purposes, it is assumed that the wells will have an average pump capacity of 350 gpm. Accordingly, nine wells would be required to meet the ultimate average-day demand of 1.79 mgd for the proposed development and fire control facilities, with 2.68 mgd of storage capacity comprised of three storage reservoirs.

(2) **Water Transmission System Development.** From the new wells and storage facilities, a large 16-inch transmission main is planned to connect to the Lihue Water System at Ahukini Road. Transmission mains (12-inch) would also be required along Ahukini Road and Kuhio Highway and along interior roadways of the Project Area.

5.8.2 Water Source Development

A. <u>Existing Conditions</u>

To identify existing hydrological conditions, availability of groundwater resources, existing and potential sources of water supply, and potential impacts of the proposed project on groundwater resources, the Molokoa Hydrologic Study (Appendix C) was prepared. The study area encompassed approximately 35 square miles in the southeastern quadrant of Kauai.

The hydrologic study concluded that the Hanamaulu Aquifer System has an estimated recharge of 79 mgd and sustainable yield of 40 mgd. A high-level aquifer occurs in the upper part of the Koloa formations to a depth of 180 to 250 feet below sea level. Underlying this high-level aquifer is a basal aquifer in the lower part of the Koloa formation. Based on the poor yields from two drilled wells in the basal aquifer in Kalepa Ridge, the hydrologic study concluded that the high-level aquifer in Koloa lavas represents the most extensive occurrence of ground water in the study area.

Water quality from the high-level aquifer is not subject to salt water intrusion and has generally pristine values of chlorides (16 to 24 milligrams per liter (mg/l)). Some possible contamination from the leaching of fertilizers and herbicides used in cultivation may have the potential to contaminate ground water. However, nitrate, a good indicator of contamination by fertilizers, occurs in almost pristine amounts of 1.1 mg/l, or less in all existing wells. This is well below the primary drinking water standard of 10 mg/l.

Presently, in the two years since Hurricane Iniki in October 1992, the County of Kauai pumps an average of approximately 3.34 mgd (including the Kokolau Tunnel located outside of the study area) for use in the Lihue Water System. It is expected that withdrawal rates will be restored to 5.0 mgd once the recovery is complete and prior water users such as hotels and resorts resume service. The County Department of Water has plans (as of 1994) to construct two exploratory wells at Hanamaulu (Hanamaulu 1 is currently under construction) and one in the Puhi area and will develop these sources if they prove to be successful. Water from these new wells will serve the Lihue Water System.

B. Potential Impacts

As previously described, the potable water requirements of the proposed project (based on a maximum of 1,800 units) estimates that average daily demand will be approximately 1.79 mgd. Maximum daily demand is projected at approximately 2.68 mgd.

Presently, the County's Lihue Water System, which currently serves the area surrounding the proposed development, does not have sufficient source capacity to meet the projected water requirements of the project. However, the 40 mgd sustainable yield of the Hanamaulu Aquifer System far exceeds the 1.79 mgd demand from the proposed project. Presently, an approximate 5.0 mgd is withdrawn from the Hanamaulu Aquifer System. This represents only a small percentage of the sustainable yield and will not significantly impact the groundwater resource.

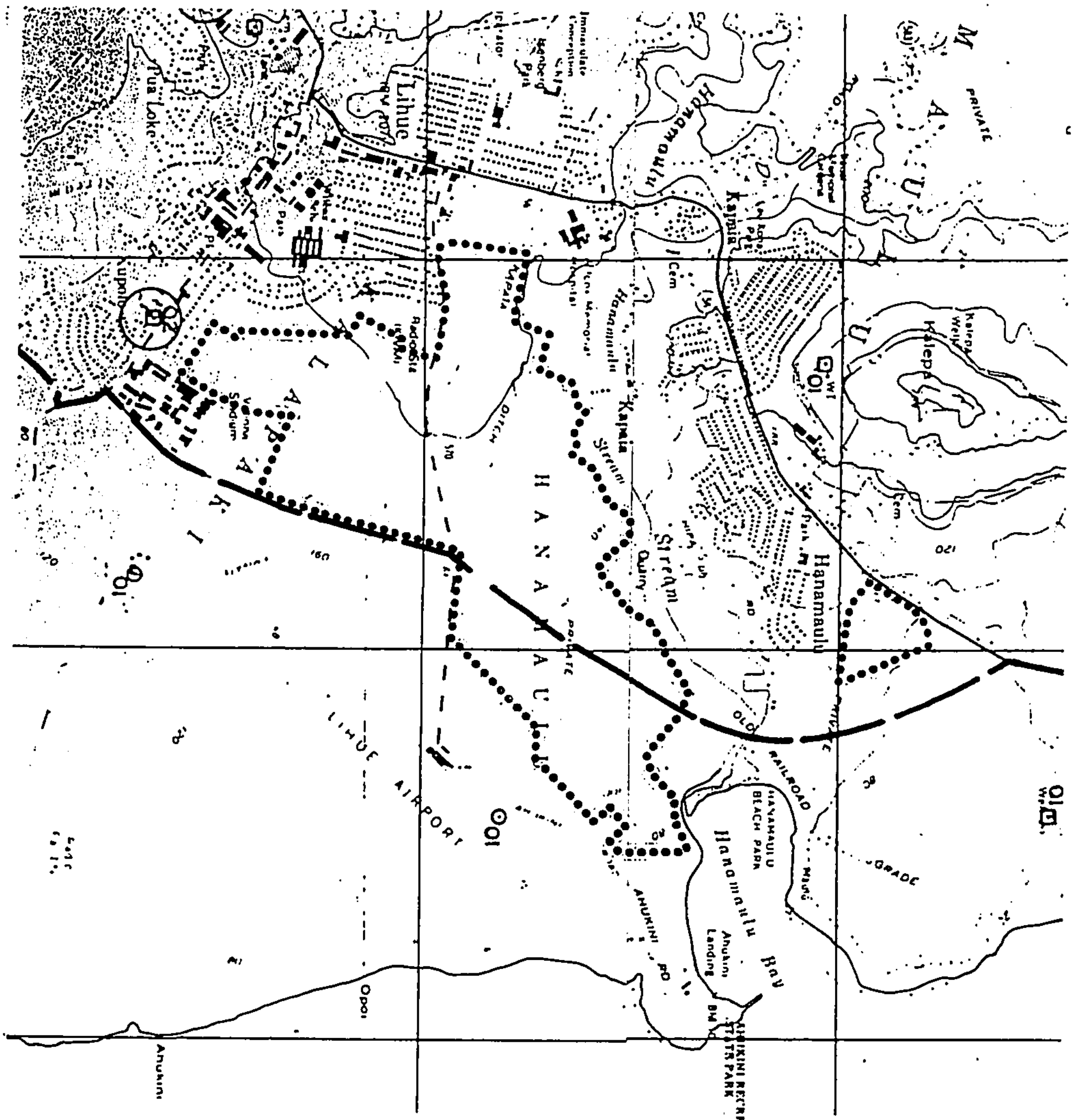
According to the Hydrologic Study (Appendix C):

"The withdrawal of 1.75 mgd of ground water at full build-out of the proposed development will have no measurable impact on groundwater quality of the aquifer system because the amount represents only 2.2 percent of estimated 79 mg of aquifer recharge. The proposed development lies hydrologically down-gradient of existing urban areas and is underlain by the seaward part of high-level and basal aquifers which are not considered a potential source of drinking water because they are subject to salt water intrusion and potential contamination from existing urban developments.

The State Department of Health has established the UIC line along Kapule Highway which runs through the project area (shown in Figure 5-8). The primary purpose of the UIC line is to protect potential sources of drinking water by not allowing wastewater injection wells or cesspools mauka of the line. However, no injection wells or cesspools are proposed and any runoff or wastewater disposal required for the project will be done in full compliance with the UIC and other applicable regulations."

C. Mitigation Measures

(1) Hanamaulu Aquifer Sustainable Yield. To ensure that the groundwater resource is developed in a manner which will protect its quality and continued sustainability, the Hydrologic Study has identified a potential well site (as shown in Figure 2-3) within the Hanamaulu Aquifer at an elevation of approximately 393 feet mean sea level (msl), approximately 1.5 miles mauka of the proposed project. Estimates of the sustainable yield within the Hanamaulu Aquifer far exceeds the current withdrawal rate and the projected demand of the proposed project.



LEGEND

— — Underground Injection Control (UIC) line

⊙ Injection well

Drinking source

Other well

PROJECT AREA BOUNDARY

Source: S.O.H., Dept. of Health, Underground Injection Control Program, Effective July 6, 1984.

FIGURE 5-8
UIC LINE
LIHUE-HANAMAULU

AMFAC/JMB HAWAII — LIHUE DISTRICT, ISLAND OF KAUAI

NORTH — LINEAL SCALE 500 0 500 1000 2000 FEET

PBR HAWAII

(2) **Guidelines and Approval for Water Source Development.** The criteria used to determine the location of the proposed well sites was based upon these four factors: 1) Sector recharge and sustainable yield, 2) Accommodation of existing and planned well sites, 3) Well elevations ranging from 300 to 400 feet, and 4) Individual well capacities of 350+ gpm. For planning purposes, it is assumed that these wells will have an average depth of 400 feet and an average pump capacity of 350 gpm (0.5 mgd). Accordingly, nine wells would be required to meet the average-day demand at full build-out of 1.75 mgd without measurably impacting groundwater resources. Water source development will be in accordance with approval from the Commission on Water Resource Management.

5.8.3 Wastewater Facilities

New wastewater facilities including collection, transmission, treatment and effluent disposal will be developed as part of the Master Plan project. A complete description of the proposed wastewater collection, treatment, and disposal systems is provided in Appendix A. The following summary describes the existing conditions, probable impacts, and mitigation measures for the wastewater system.

A. Existing Conditions

Wastewater Collection

According to the Lihue-Hanamaulu Infrastructure Report Wastewater System (Appendix A), wastewater originating from the Kauai Lagoons Sewage Pump Station and Lihue Town runs along Kuhio Highway, Hardy, Umi, Rice and Lighthouse Roads to the Lihue Wastewater Treatment Plant (WWTP). These collection lines vary from a diameter of 10 inches to 24 inches as they near the WWTP. Current wastewater collection lines proximate to the project area consists of a 21-inch sewer line along Kapule Highway near the entrance to the new Lihue Post Office Distribution Center (next to the airport), and proceeding southward towards Haoa Street (industrial center) and on to the Lihue WWTP. There are no other sewer lines along Ahukini Road or Kapule Highway.

There is also an existing wastewater line within the Hanamaulu Subdivision which abuts the Hanamaulu Project Area at its southerly boundary. These lines gravity flow toward the Hanamaulu sewage pump station located at the end of Hanamaulu Road. From this pump station, a 10-inch force main conveys the wastewater along Kuhio Highway to the County's existing Kapaia sewage pump station and on into the Lihue WWTP.

Wastewater Treatment

The existing Lihue WWTP is located on a 5 acre parcel of land that is surrounded by property owned by the Kauai Lagoons. Presently, the Lihue WWTP has a treatment capacity of 1.5 mgd, however, flows have generally been below 1.3 mgd since Hurricane Iniki. Currently, the Lihue WWTP is being upgraded to expand the operating capacity to 2.5 mgd with a scheduled completion date of February 1996.

The Hanamaulu Project Area is also located within the Lihue WWTP district. Treatment of wastewater for that portion of Hanamaulu Triangle within the Urban District, would be allowed under the current Lihue WWTP expansion program, because wastewater treatment from Hanamaulu was considered in the planning and design of the Lihue WWTP expansion. This expansion will be completed well before development of Hanamaulu Triangle commences.

Effluent Disposal

Treated effluent from the Lihue WWTP is currently used for irrigation by the Kauai Lagoons golf courses. The balance of the effluent not needed for irrigation is disposed of through on-site rapid sand filter/injection wells as an alternate disposal method. Solids remaining in the Lihue WWTP after sewage treatment are disposed of at the Kekaha landfill.

B. <u>Potential Impacts</u>

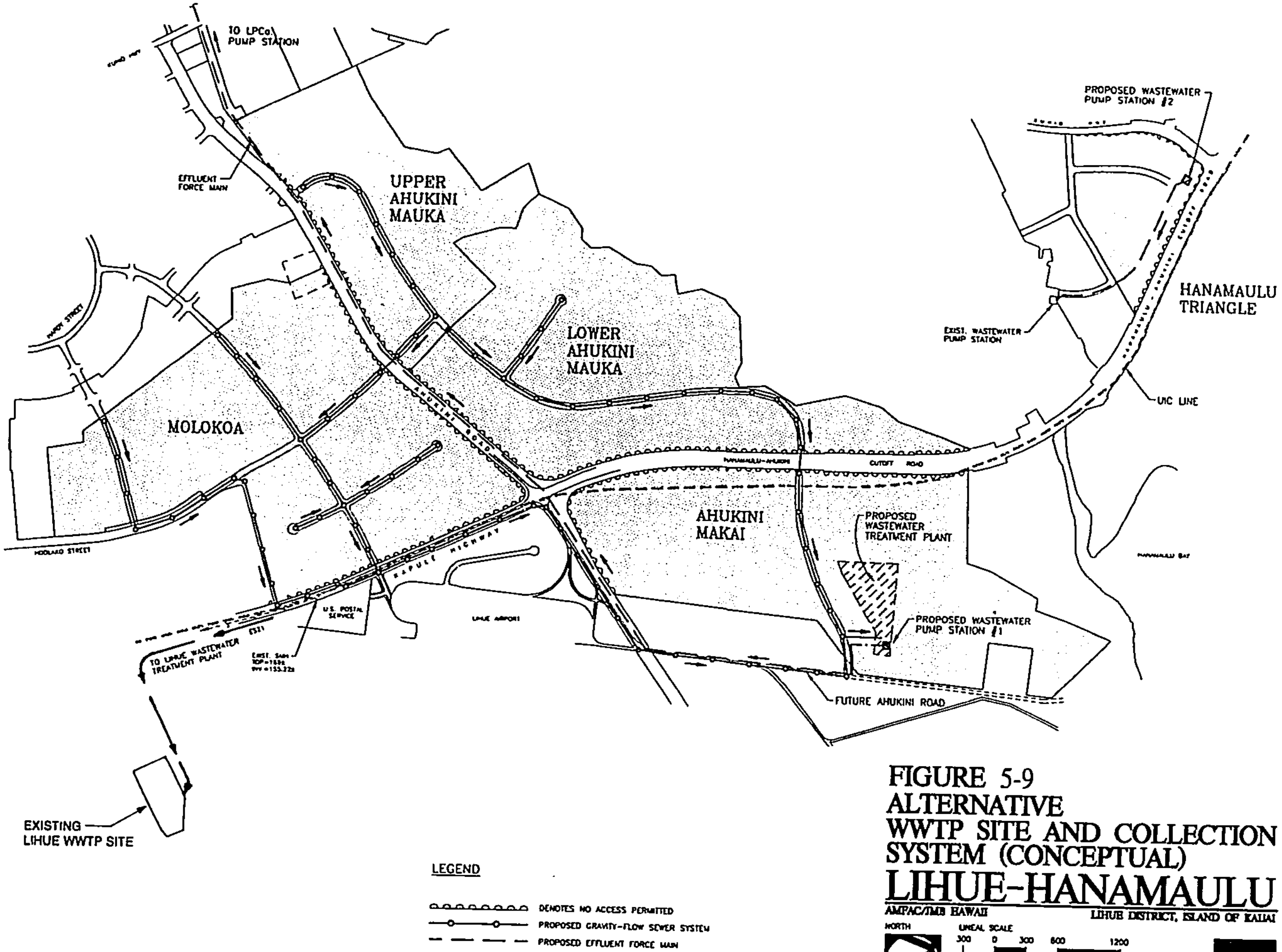
The proposed Lihue-Hanamaulu Master Plan will require the collection, treatment, and disposal of wastewater from a maximum of approximately 1,800 multi-family and single-family residential units, as well as retail, office, light-industrial, public and park facilities. Consequently, the design flow rates used by the County of Kauai to calculate the ultimate wastewater flows that will be generated by the project totals approximately 1.6 mgd. However, 95,600 gallons per day (gpd) of this demand will be generated by the Hanamaulu Triangle which is already accounted for in the current expansion program for the Lihue WWTP. Therefore, the full implementation of the proposed development, exclusive of the Hanamaulu Triangle, will generate the need for additional treatment capacity of approximately 1.51 mgd to accommodate the projected wastewater flows.

There are presently four treatment alternatives being considered to accommodate the additional 1.51 mgd of projected wastewater; 1) expansion of the existing Lihue WWTP; 2) construct a new WWTP in Ahukini Makai; 3) a combination of a new WWTP and expansion of the Lihue WWTP; and 4) expansion of the existing Lihue WWTP to accept the project's wastewater with the liquid processing facilities maintained at the current Lihue WWTP site, but with the solids processing facilities relocated to a new facility at Ahukini Makai. Figure 5-9 shows the existing Lihue WWTP site as well as the proposed on-site location of the new treatment facility at Molokoa.

Wastewater Collection

The new on-site wastewater collection system would generally follow the alignment of the proposed street system, however, the final design of the collection system will depend on the alternative method and site selected for wastewater treatment.

Generally, wastewater flows (except for a relatively small, isolated portion of Ahukini Mauka which would require pump stations) will gravity flow toward Kapule Highway. Wastewater flows from the upper portion of Ahukini Mauka will gravity flow to Kapule Highway via Molokoa to the off-site collection system and either be treated at the expanded Lihue WWTP or at a new WWTP located on-site at Ahukini Makai. Wastewater from the lower portion of Ahukini Mauka will gravity to



Source: Austin, Tsutsumi & Associates, Inc.

FIGURE 5-9
ALTERNATIVE
WWTP SITE AND COLLECTION
SYSTEM (CONCEPTUAL)
LIHUE-HANAMAULU
AMFAC/JMB HAWAII
LIHUE DISTRICT, ISLAND OF KAUAI
NORTH
LINEAL SCALE
300 0 300 600 1200
FEET
PBR HAWAII

either a pump station at Ahukini Makai which would transport the wastewater to the expanded Lihue WWTP or to the new on-site WWTP.

Wastewater collected from the proposed Hanamaulu Triangle would gravity flow to a new pump station located at the end of Hanamaulu Road. From the pump station, wastewater conveyed to the expanded Lihue WWTP. Both the Hanamaulu and Kapaia sewage pump stations will likely require upgrading to handle the additional flows generated by Hanamaulu Triangle.

Wastewater Treatment

The proposed treatment options consist of phased expansion of the existing Lihue WWTP and/or development of a new on-site WWTP adjacent to the proposed Ahukini Road in Ahukini Makai (Appendix A, Figure 4). All four options described above can accommodate the projected 1.51 mgd of additional treatment capacity that will be generated by the project.

All treatment plant options will require on-site collection and transmission and effluent disposal. If all wastewater is treated at the Lihue WWTP, a new pump station will be necessary at Ahukini Makai to convey flows from that area to the Lihue WWTP.

All wastewater treatment alternatives are currently being evaluated, and are being closely coordinated with the County.

Effluent Disposal

The project would generate approximately 1.51 mgd of additional R-2 reclaimed water (effluent derived from secondary treatment with disinfection to achieve a coliform limit of 4 cfu/100 ml. as defined by the DOH "Guidelines for the Treatment and Use of Reclaimed Water"). The land area required for disposal is dependent on the type of vegetation used and the application rate of the reclaimed water. Required infrastructure include force mains, a holding system and transmission lines. Application of R-2 reclaimed water would likely be by drip or subsurface irrigation.

Several options are available for the disposal of treated effluent, but all must comply with Department of Health regulations. The near-term and long-term solution involves pumping treated effluent to the existing Lihue Plantation hydroseparator and pump station located just mauka of the Kuhio Highway/Ahukini Road intersection. Here the efluent would be blended with mill wash water and reused to irrigate Lihue Plantation fields. LPCo would control and be responsible for the effluent use or disposal after it is pumped to the hydro-separator. This option would be applicable to wastewater treatment facilities at either the Lihue WWTP and/or the new WWTP at Ahukini Makai.

Both treatment plants may require on-site injection wells designed to handle emergency disposal of treated effluent. These injection wells would be located next to the facilites which are situated below the UIC line which has been established along Kapule Highway. Should the sugar industry become a non-viable alternative, long-term solutions for effluent disposal will generally rely on irrigation of pasture land, future golf course(s) and landscaped areas along roadways, and other public areas. Discussions are on-going between Amfac/JMB and Lihue Airport for the possible use of reclaimed water for [runway and] landscape irrigation within the Lihue Airport property.

The Wastewater Report outlines four alternatives for the transporting of the effluent for near-term reuse by LPCo. These alternatives are based on the four wastewater treatment alternatives described earlier. A detailed evaluation of the reclaimed water reuse options will be conducted when the wastewater treatment alternative for the project has been selected in coordination with the County Department of Public Works. A subsequent engineering study will be undertaken prior to final recommendation and selection of the acceptable methods for treatment and disposal of the wastewater.

C. Mitigation Measures

(1) **Conformance to DOH Regulations.** The proposed wastewater system will be designed and developed in accordance with all applicable State Department of Health requirements for wastewater systems.

(2) **Developer Funding of WWTP System.** The construction of new or expanded wastewater treatment and collection facilities necessary to accommodate the Lihue-Hanamaulu Master Plan development will generally be funded by the developer/ landowner in accordance with County policy. All on-site wastewater infrastructure required for the project will be funded by the landowner/developer. Off-site improvements will also be provided by the developer to accommodate project generated wastewater. Construction of wastewater facilities will be phased as market conditions warrant and the project achieves buildout over the 15 to 20 year planning period. If the final wastewater master plan results in expansion and/or modifications to existing facilities, or new facilities, which provide capacity or improvements desired by the County which are beyond the project requirements, then the developer/landowner may request the County to fund those portions which are beyond the project requirements.

(3) **Effluent Disposal Through Irrigation.** To ensure that there are no negative water quality impacts, treated effluent to R-2 levels of disinfection will be utilized for sugar cane field irrigation purposes in accordance with all applicable State Department of Health regulations regarding the reuse of water. The system will be designed as a closed system with assurances that reclaimed water will not enter Hanamaulu Stream or the ocean.

(4) **Other Land Application Alternatives.** Long-term options for land application of reclaimed water include irrigation of pasture land, public landscape areas such as roadways, golf course, and landscaping within Lihue Airport.

5.8.4 Solid Waste Disposal Facilities

A. Existing Conditions

The Project Area is currently under sugarcane cultivation. Cultivation practices involve the burning of leaves thus reducing the amount of bulk transported to the mill for processing. Once processed the remaining pulp or bagasse is incinerated as biomass; the heat produced generates steam and electricity which is used internally and the excess electricity sold to Kauai Electric Company. Therefore, no solid waste from the agricultural operation enters the waste stream and required disposal facilities.

B. Potential Impacts

Solid waste generated during construction of the project will be recycled or trucked to the Lihue Debris Recycling Station. This facility is expected to be complete and in operation before the first year of project construction. The recycling station is intended to process debris from Hurricane Iniki and potentially serve as a permanent recycling facility after the hurricane debris is processed.

Once the project begins to achieve occupancy, solid waste will be collected by the Department of Public Works and disposed of at the existing Lihue Refuse Transfer Facility near Lihue Airport or the project's Recycling Station. At full occupancy the project is expected to generate tons of waste annually. Greenwaste from common areas and residential lawn landscaping will be transported to the Debris Recycling Station at the project. The green waste will be reduced in size at the Recycling Station and removed to other locations for additional processing and chipped or mulched for use as ground cover or soil amendment.

C. Mitigative Measures

(1) **Land Set-aside for the Lihue Debris Recycling Station.** At the request of the County of Kauai, 35 acres of land adjacent to the County's Lihue Transfer Station has been set aside in the master plan for the County to purchase for the development of the Lihue Debris Recycling Station (LDRS). The LDRS is intended to initially process the remaining debris which resulted from Hurricane Iniki and potentially provide a means to meet the recycling/diversion requirements (25 percent waste diversion by 1995 and 50 percent waste diversion by 2000) as set forth by State regulations.

(2) **Recycling Programs.** Opportunities to encourage and facilitate solid waste recycling will be explored by the developer. Proposed programs could address both commercial and residential solid waste. Programs such as these could reduce the quantities of solid waste entering the County landfill.

5.8.5 Drainage Facilities

A. Existing Conditions

Since the project area is presently in agriculture, there are limited drainage facilities designed for agricultural purposes along roadways and ditch and trench systems within the sugar cane fields. Runoff from larger storms will overflow the trenches and flow overland to abutting properties. Consequently, all existing drainage facilities originally designed for agricultural use of the planning area cannot generally be used for the proposed urban land uses.

We note that the four geographic areas relative to the Project Area are Molokoa, Ahukini Mauka, Ahukini Makai and Hanamaulu for reference to the drainage areas specified by the project engineer.

According to the Preliminary Engineering Report for Drainage Requirements (Appendix D), the existing agricultural runoff from the Molokoa area flows through the Kauai Lagoons and Marriott properties and then is channelled through grass swales to underground culverts before entering Nawiliwili Stream. The peak discharge for Molokoa is estimated to be approximately 811 cubic feet per second (cfs) for the 100-year 24-hour storm event.

Agricultural runoff from Ahukini Mauka (852 cfs) flows directly to Hanamaulu Stream during the 100-year storm. However, the Hanamaulu Stream drainage area is approximately 11 square miles with a peak discharge of approximately 28,000 cfs. Relative to the total drainage capacity of Hanamaulu Stream, the current agricultural discharge is approximately 3.0 percent of the Hanamaulu Stream peak discharge rate.

During large storms, runoff generated in the Ahukini Makai project area and Lihue Airport flows across Ahukini Road through an adjacent cane field through ditches, swales and a concrete channel which discharges to the ocean. The estimated discharge rate is approximately 736 cfs for the 100-year 24-hour storm.

Flows from the Hanamaulu triangle area presently flow under Kapule Highway through siphons to cane fields located makai of the highway. Runoff flow through ditches, trenches, sumps and swales before discharging to the ocean. The peak discharge is estimated to be 207 cfs.

These flows also increase the potential for soil erosion especially during intense storm events and after sugar cane is harvested and soils are exposed. Presently, it is estimated that the 555 acre project area loses approximately 310 tons of soil every year due to rainfall and agricultural activities on the property.

B. Potential Impacts

The planning of the drainage improvements addresses two issues: 1) prevention of flooding to downstream areas, and 2) water quality impacts to receiving bodies of water. Thus, the drainage study and the marine and stream studies (Sections 4.6 and 4.7 and Appendices H, H-1, I, and I-1) interface in their analyses of results and findings.

As the Lihue-Hanamaulu Master Plan is implemented, land that is currently used for agriculture will be developed into homes, public buildings, offices, roads, and open spaces. This will result in an increase of impermeable areas and the subsequent generation of additional runoff which must be mitigated through implementation of various drainage improvements.

Although at buildout the quantity of runoff for the total Project Area will increase by approximately 17.3 percent, the overall drainage patterns will remain the same except for approximately 29 acres of Molokoa which will flow into the Ahukini Mauka drainage system to maintain the existing flow rates to mitigate against any increased runoff into downstream properties which include the Kauai Lagoons and Marriot properties.

During peak discharge periods, Ahukini Mauka, Ahukini Makai and Hanamaulu will exhibit some increased flows as a result of project development as shown in the table below:

Peak Discharge Rates (100-Year 24-Hour Storm Events)

	Existing Conditions	Future Conditions	Percent Change
Molokoa	811 cfs	810 cfs	-0.1
Ahukini Mauka	854 cfs	1,067 cfs	+24.9
Ahukini-Makai	736 cfs	909 cfs	+23.5
Hanamaulu	207 cfs	274 cfs	+32.0
TOTAL	2,608 cfs	3,060 cfs	+17.3

Ahukini Makai will increase 173 cfs (23.5 percent) and Hanamaulu 67 cfs (32 percent), both of which will surface flow toward the ocean increasing the existing runoff. Runoff from a portion of Molokoa which combines with the flows of Ahukini Mauka entering Hanamaulu Stream that could be generated by the development would result in approximately 25 percent increase in flows from the existing combined total of 854 cfs compared to 1,067 cfs after project development. This change has been evaluated by the stream and marine biological consultants as described in Sections 4.6 and 4.7. Their conclusions as to the impact to Hanamaulu Stream and Hanamaulu Bay were based on the relative small size of the Project Area (three percent) compared to the overall watershed which drains to the stream and ultimately to the bay. Consequently, no significant drainage related impacts are anticipated relative to Hanamaulu Stream or Hanamaulu Bay. Regarding the potential flooding issue, the civil engineer has determined that through incorporation of mitigative mesures (which are described below) the project would result in no expected impacts on downstream properties and receiving waters.

Preliminary peak discharge rates representing present condition and with the future development have been estimated by Kodani & Associates:

According to the Preliminary Drainage Report (Appendix D), as the site becomes more and more developed, the amount of soil loss will decrease accordingly. Assuming an average development area of 36 acres per year over the 15 year development period, it will take only three years to reduce soil loss below current conditions while still maintaining the remaining agricultural operations. Although total increased erosion could occur during the first three years of construction, the establishment of urban landscapes and ground cover will dramatically reduce the amount of soil lost to erosion under the present agricultural land uses.

C. Mitigative Measures

(1) **Short-term Construction Period Measures.** During the construction period, sediment basins will be used to treat the runoff from construction areas before it is discharged off-site. Construction plans will be coordinated with the State Department of Health and County of Kauai to obtain the necessary permits for grading and stormwater discharges (NPDES). Specific mitigation measures during the construction period include:

(a) Minimize the time soil is left exposed by providing temporary vegetative cover.

(b) Construct temporary berms, sediment ditches, filter fences, and sediment basins to divert runoff and trap silt.

(c) Use water trucks and sprinkler systems to keep the area moist during construction to limit fugitive dust emissions.

(2) **Park/Detention Basin.** To ensure that downstream properties and structures are not adversely affected by the increased runoff and to control the quality of surface runoff combination park/detention basins are planned to be constructed in both the Molokoa and Ahukini Mauka areas. The location of the facilities is shown in Figure 5-10. The combination park/detention basins will be designed to County of Kauai requirements with the intent that the improvements will be dedicated to the County who would be responsible for the operation and maintenance of the facilities.

It is noted here that the park/detention basin concept is relatively new and that detailed engineering design will be based on specific site information during the site planning process in coordination with the County: Amfac/JMB and the project engineer have met with the Department of Public Works to design the preliminary plan included in Appendix.

To ensure that continuous use of the park facilities is available, the guidelines for the drainage improvements include the following:

(1) Park areas that are designed as "active recreational areas" will be located above the base (100-year) flood elevation.

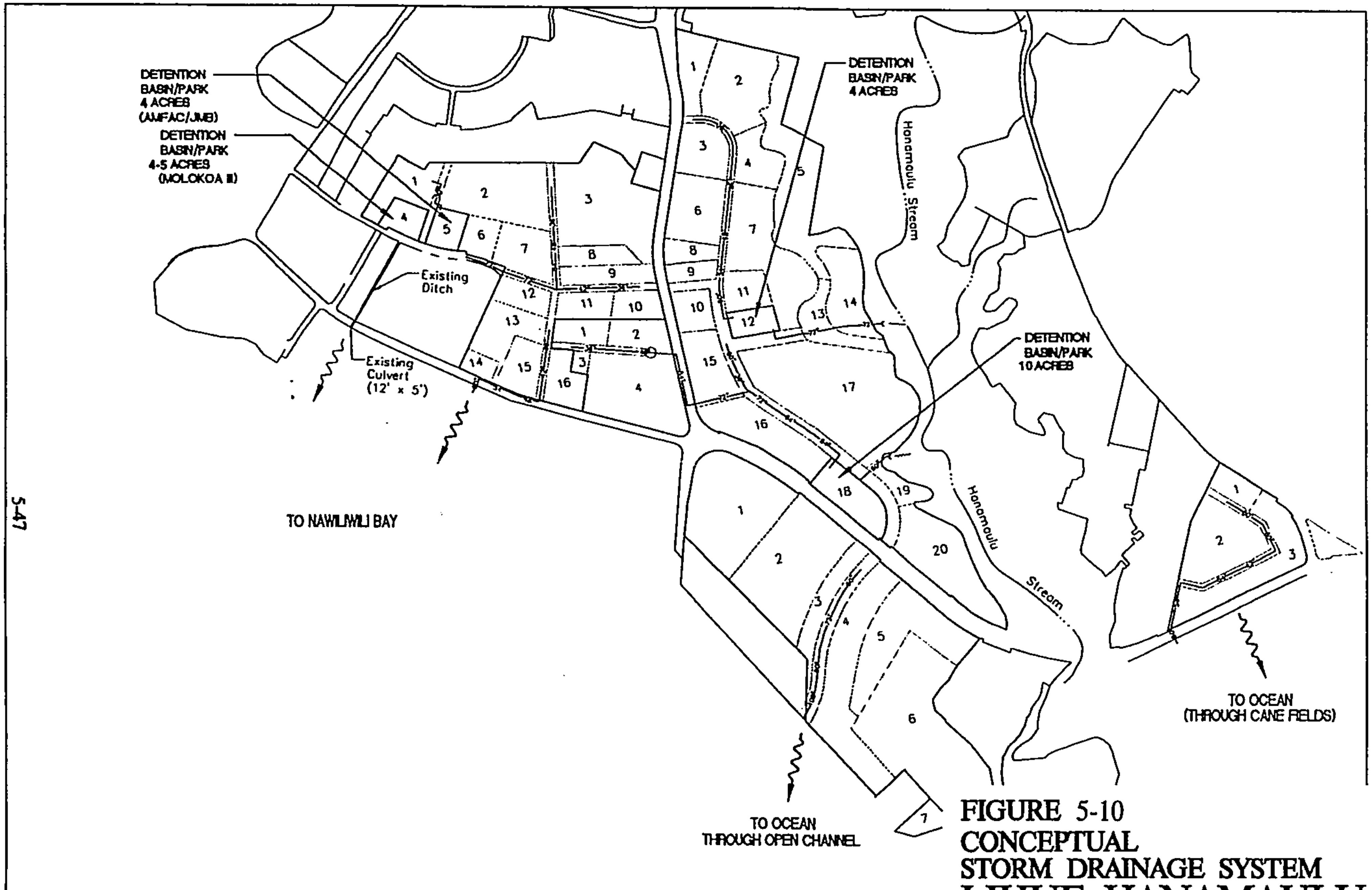


FIGURE 5-10
CONCEPTUAL
STORM DRAINAGE SYSTEM
LIHUE-HANAMAULU
AMFAC/JMB HAWAII LIHUE DISTRICT, ISLAND OF KAUAI

NORTH LINEAL SCALE 375 0 375 750 1500 FEET

PBR HAWAII

Source: Kodani and Associates, Inc.

(2) All other park areas will be located above the 2-year 24-hour flood elevation. This will ensure that the park does not become flooded during the "more frequent storm event".

(3) The depth of flooding in areas, except the area directly adjacent to the outlet, shall be kept relatively shallow for liability and safety purposes. The area near the outlet, which may be deeper, will be fenced off.

(3) **Permanent Long-Term Measures.** Once the project achieves buildout, sediment loss will be minimal. At the time of permit application, site specific plans for erosion and sediment control will be prepared and submitted for review to the appropriate agencies.

5.8.6 Electrical Supply

A. <u>Existing Conditions</u>

The State's Model Energy Code, Energy Efficient Standard for Buildings (DBEDT, July 1993) goal is to reduce the consumption of oil and provide significant savings in utility costs as well as help clean the air by reducing fossil-fuel burning and provide economic benefits by yielding an average rate of return of over 25 percent. The Code is currently being reviewed and revised by the County of Kauai and is expected to be adopted by Spring 1995 according to DBEDT Energy Division staff.

Kauai Electric Company owns and maintains the electrical systems which serve the areas adjacent to the Project Area. An existing 12 kV transmission line is presently located on the property. However, the Project Area itself has no electrical system since the land is currently in agricultural use.

B. <u>Potential Impacts</u>

The development of the project will result in the increased demand for electricity. The electrical peak generating demand was estimated using a factor of 2.5 kilowatts per residential unit and 25 kilowatts per acre of industrial/commercial/public uses. For the proposed residential units and 268 acres of industrial/commercial/public uses, approximately 11,700 kilowatts of electricity will be needed.

The monthly consumption for the project was estimated by using a figure of 500 kilowatt hours per residential unit and 1,500 kilowatt hours per acre of industrial/commercial/public uses for a total monthly consumption of 1,402,000 kilowatt hours.

At this stage of the planning process, it is difficult to estimate precise demand and consumption factors for industrial/commercial/public uses since these will vary greatly depending on the actual type of businesses established.

C. Mitigating Measures

(1) **Electrical System Development.** To meet the increased demand for electricity, a new electrical substation may be required. Main distribution lines from the substation to the project area will be constructed overhead with distribution lines within the Project Area being built underground.

(2) **Coordination with Kauai Electric.** Amfac/JMB will coordinate its planning efforts with Kauai Electric Company's efforts to supply power to the area. Amfac/JMB will participate in providing necessary improvements to the electrical distribution system required to serve the project.

(3) **Model Energy Code.** Applicable standards of the Code for residential and public buildings will be integrated into the Design Guidelines for the project and will become a code requirement to obtain building permits for the various structures planned at the project.

5.9 PUBLIC SERVICES

5.9.1 Schools

As shown in Figure 5-11, three existing schools presently serve the Lihue area nearby the Project Area. In addition several new schools are planned or proposed.

A. Existing Conditions

The Project Area is currently served by two elementary schools and an intermediate/hish school; they are public schools:

- Wilcox Elementary School (grades kindergarten to sixth). Located on Umi Street in Lihue Town, the school has a current enrollment of 1,004 students. Its 1993 enrollment was approximately 1,066 students.

- King Kaumualii Elementary School (grades kindergarten to sixth). Located in Hanamaulu north of Hanamaulu Road, the school enrollment is 835 students. Its 1993 enrollment was 713.

- Kauai Intermediate and High School (grades seventh through twelfth). Located on Lala Street near Nawiliwili Road, its current enrollment is 1,775 students; 1993 enrollment was 1,718.

Wilcox Elementary School, located in the heart of the existing civic center, was built in the 1950's and is currently serving Lihue area students in kindergarten to grade six. Under the present school district boundaries, the Master Plan area would likely be serviced by all three of the above listed schools.

LEGEND

PROJECT AREA

EXISTING SCHOOLS

1. Wilcox Elementary
2. King Kaumualii Elementary
3. Kauai High
4. Island School (Private)

PLANNED/PROPOSED SCHOOLS

5. Lihue-Hanamaulu (Proposed)
6. Puhi Elementary (Proposed)
7. Puhi Intermediate (Planned)

FIGURE 5-11
EXISTING AND
PLANNED SCHOOLS
LIHUE-HANAMAULU

AMFAC/JMB HAWAII   LIHUE DISTRICT, ISLAND OF KAUAI

NORTH   LINEAL SCALE 1000 0 1000 2000 4000 FEET

PBR HAWAII

The Department of Education (DOE) has plans for three new schools to alleviate the current capacity problems: 1) new elementary school for the Kapaa area (near Coco Palms Hotel) to alleviate the over capacity at King Kaumualii, 2) new intermediate school planned for upper areas of Kapaa, and 3) new intermediate school near Nawiliwili proposed by Grove Farm (developer of the Puakea project).

B. Potential Impacts

The project will increase the residential population in the area, thereby adding to the student population. A total of approximately 596 students are expected to be generated by the project according to the DOE standards: 353 elementary students in grades kindergarten to grade five, 107 intermediate students in grades six through eight, and 136 students in the high school grades from nine through twelve. The elementary school enrollment will be augmented by an average of 21 new students per year based on an average build-out of 100 units per year. These increases will impact the three existing elementary schools, which are operating beyond capacity and report a shortage of classrooms.

A new elementary school is proposed to address the impact of the increased student population. The Lihue-Hanamaulu Master Plan includes a 12-acre elementary school and park site as an integral component of the pedestrian oriented master-planned community which will extend the boundaries of Lihue to accommodate the growth which is expected into the 21st century. It would be fitting for Lihue, the County's governmental and economic center to have a state-of-the-art school which would be built in concert with the growth of Lihue.

DOE's has commented that the proposed school site is unacceptable due to the close proximity of two existing elementary schools, Wilcox School in Lihue and King Kaumualii Elementary School in Hanamaulu and its proximity to Lihue Airport. In discussions with the DOE during 1994, Amfac/JMB worked to resolve the need for a new school site in the Lihue area as the existing schools are operating beyond their capacities. In that regard, Amfac has provided the DOE with maps of other off-site properties it owns in the Puhi area. A site visit with DOE staff and staff of the Department of Accounting and General Services on December 15, 1994, was conducted to evaluate potential school sites in Puhi on lands owned by Amfac or its subsidiaries.

During that site visit a new alternative emerged that has merit and warrants the DOE's detailed analysis. The alternative suggested at the site visit involves the eventual phasing-out of Wilcox School and shifting that student population to a new state-of-the-art facility at the Lihue-Hanamaulu Master Plan project area. In addition, an elementary school site in Puhi may also be reserved for future use if needed. The Wilcox School property would then become available to the State and/or County for other civic center land uses. With alternatives to be further studied and considered, Amfac/JMB will continue to assist the DOE in finding a solution that would meet the community's need.

C. Mitigative Measures

(1) **DOE Proposed New Schools.** The three new schools planned for the district will help to alleviate capacity problems which already exist.

(2) **Master Plan Provision of a School Site.** To address future educational requirements of Lihue and the proposed Master Plan development, the DOE was contacted to ascertain facility and personnel needs. Based on the DOE recommendations, the Master Plan provides for the future demand by setting aside lands for a new 12-acre elementary school and park. The DOE may also consider an alternative off-site elementary school site on other Amfac/JMB or LPCo lands. Determination of the most suitable location is on-going through discussions between the developer and the DOE.

(3) **Fair-Share Contribution.** Amfac/JMB continue to work with DOE on mitigating impacts on area schools from the proposed project, and will provide its fair-share contribution.

(4) **Noise Impact of Lihue Airport.** The Master Plan proposed school site is located outside of the line delineating the Lihue Airport 60 Ldn noise contour. In addition, other mitigative factors which could be implemented includes building design and air conditioning.

5.9.2 Police Protection

A. Existing Conditions

The Master Plan area is located in Sector 5 of the Lihue District of the Kauai Police Department. Sector 5 extends from the Wailua Correctional Center and the Wailua Golf Course on Kuhio Highway to the north, and to Rice Street to the south; it includes Hanamaulu. The district's police protection services are provided by officers from the Lihue Police Station located on Umi Street. One officer is on duty in Sector 5 during each shift. Response times are presently two to three minutes to locations near the project area.

At present there are approximately 400 residents per officer on Kauai. When the defacto population is considered, the ratio is approximately 550 persons per officer.

The current station is outdated and overcrowded with no room for further expansion as technology and staffing requirements increase in the future. Presently, the Kauai force consists of 139 officers and 28 civilian employees.

B. Potential Impacts

The Kauai Police Department estimates that an additional 10 to 12 officers will be needed in the Lihue District to service the project population increase at full build-out.

C. Mitigative Measures

(1) **Site for New Police Headquarters.** To ensure continued levels of protective services, the project Master Plan has identified a new nine-acre police headquarters site at Molokoa. Once built, this facility may replace the existing facility on Rice Street. Tentative plans call for a new civil defense headquarters, a crime fighting equipment room and a crime lab which are lacking at the present facility. Detailed planning and design for the station will be completed by the County as future needs are better defined.

(2) **Central Location of the Project.** The project concentrates development at Lihue, thereby minimizing travel distances and response times, and allows for consolidation of efforts and efficient police operations.

(3) **Project Design.** Design of the project will help to deter crime and traffic problems, thereby minimizing the need for police services. Design measures will include well-lit and visible common areas and parks, and an efficient network of roadways to facilitate circulation.

5.9.3 Fire Protection

A. Existing Conditions

Lihue Fire Station No. 3, located on Rice Street in Lihue, has primary responsibility for fire protection of the Master Plan area which can presently be reached in approximately four minutes. The existing fire station houses a pumper fire truck and a HAZ-MAT (hazardous materials) heavy rescue truck. Each vehicle is staffed by four fire fighters in 24-hour shifts. When not in use on hazardous material calls, the HAZ-MAT truck also answers fire alarms with the pumper. The backup station for the area is Kapaa Fire Station No. 2, which is located eight miles from the project area. The County Fire Department has indicated that there are no plans for facility expansion in the next ten years.

B. Potential Impacts

According to the Fire Department, their current facilities have sufficient capability to serve the proposed development. However, the water supply and transmission system may be insufficient. Fire control capabilities will be incorporated into the design of the water storage and transmission system employing accepted standards and regulations for fire protection. The developer has contacted the Fire Department in preparation of the master plan.

C. Mitigative Measures

(1) **Water Source Development and Transmission.** Engineering studies for water source development and water transmission and distribution indicate that the water system has been planned to meet fireflow requirements. Nine new wells are proposed to be developed on mauka lands within the Hanamaulu aquifer system; and infrastructure for water system transmission and distribution

from the well site to the project are sized to meet fireflow standards. The water system will be dedicated to the County upon its completion.

5.9.4 Health Care / Hospitals

A. Existing Conditions

Kauai's three hospitals include G. N. Wilcox Memorial, Kauai Veterans Memorial, and Samuel Mahelona Hospital. Together, they provide 113 acute care beds, 271 long term care beds, and four advanced life support ambulances. The 185-bed Wilcox Memorial Hospital is adjacent to the Master Plan area making ambulance response time to and from the property approximately three to five minutes.

Wilcox Hospital is at approximately 64 percent occupancy, Kauai Veterans Memorial at approximately 37 percent and Samuel Mahelona at approximately 27 percent (State Health Planning and Development, 1993).

B. Potential Impacts

The project will impact medical facilities because of the increase of population. However, this increase is not considered significant for two reasons: 1) nationwide, in-patient care is decreasing while out-patient care is increasing; the need for in-patient beds is therefore declining, and 2) utilization of Kauai's hospitals are relatively low when compared to statewide statistics. The occupancy at G.N. Wilcox, which is close to the project, is at 64 percent occupancy, which is lower than the statewide occupancy of 70 percent. All three hospitals are operating below capacity.

C. Mitigative Measures

(1) Expansion Potential and Land for Wilcox Hospital. Amfac/JMB is currently working with Wilcox Hospital for the acquisition of approximately 28 acres of LPCo land located behind the hospital. This will provide adequate space for future expansion of acute care and out-patient care facilities.

5.9.5 Recreational Facilities

A. Existing Conditions

Several parks are located adjacent to the Project Area. These include a County stadium complex, neighborhood parks, as well as beach park and ocean facilities:

- A. Vidinha Memorial Stadium complex, operated by the County, is open daily and used for personal training and as a venue for public sports events. Master planning for the expansion of the complex is currently underway.

- Peter Rayno County Park, next to King Kaumualii School, provides a baseball field with backstop and bleachers, playground equipment, and can be used for soccer and other activities. The park covers approximately 3.5 acres.
- Laukona Park, a neighborhood park, is located mauka of Kuhio Highway in Hanamaulu near the Kauai Memorial Gardens Cemetery.
- Wiliko Park, a neighborhood park is located in Hanamaulu makai of Kuhio Highway.
- Hanamaulu Beach Park offers pavilions, uncovered picnic tables, rest rooms, and a parking lot. It is used for picnics and beach/ocean activities. The Park covers more than four acres.
- The Ahukini Recreation Pier State Park located at the mouth of Hanamaulu Bay is located adjacent to the Master Plan area and used primarily for fishing.

B. Potential Impacts

The project will accommodate approximately 35 to 45 percent of the expected growth in the population in the Lihue District. A consequence of this is the increased need for community and neighborhood parks. Space for both active and passive recreational activities will be needed to accommodate the additional demand.

The project is not expected to have direct land use impacts on the nearby ocean-related parks. The Ahukini Makai subarea is the nearest to Hanamaulu Beach Park and Ahukini Pier. The project will not impede access to the parks.

The project will add to the increased use for beach parks in the area. This effect is not unique to this project, however. Beach parks are regional and islandwide resources and will continue to be needed due to the overall growth in the islandwide population. Hence, though the project will add population to the area, it will not cause an increase beyond that which is expected for the region or the island.

C. Mitigative Measures

(1) Proposed Park Facilities. Several parks totaling approximately 22 acres have been planned in the Master Plan to mitigate future population growth impacts. These consist of:

1) one park of approximately four acres at Molokoa,

2) an approximately four-acre site for a YMCA/Teen Center type facility at Molokoa,

3) a four-acre park at Ahukini Mauka to serve as a community park and playground for the elementary school, and

4) an approximately ten-acre community park in Ahukini Mauka adjacent to Kapule Highway.

In addition to the 22 acres of park land described, private neighborhood tot lots and recreational facilities may be provided within the single-family and multi-family residential areas.

Portions of the parks will be designed to serve as shallow detention basins during intense storms to improve the quality of surface water runoff and control the quantity of runoff flowing off-site. The facilities will be designed to County of Kauai requirements as parks and will incorporate the requirements to function as detention basins within the drainage system infrastructure improvements. All areas will be landscaped and function as "park", however in larger storms the areas designed to detention basin specifications will collect and funnel runoff through the drainage system.

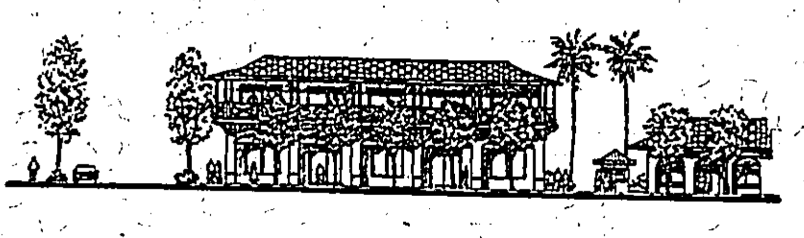
(2) **YMCA/Teen Center**. The proposed YMCA/Teen Center type facility will provide significant opportunities for more formalized "indoor" based recreational opportunities.

Assuming the project build-out achieves 1,800 units, the proposed parks and recreational facilities planned for the project exceed the park dedication requirement of the County of Kauai.

(3) **Expansion of Hanamaulu Beach Park.** Amfac/JMB is currently considering, in a separate effort, providing increased shoreline access through the dedication of land makai of the Kapule Highway bridge to allow the expansion of the County's Hanamaulu Beach Park fronting Hanamaulu Bay. This project would be funded and developed by the County.

6.0

CONTEXTUAL ISSUES



6.0 CONTEXTUAL ISSUES

6.1 CUMULATIVE AND SECONDARY ENVIRONMENTAL IMPACTS

According to the Market Analysis (Appendix F), the Lihue-Hanamaulu Master Plan is projected to absorb approximately 30 to 45 percent of the future demand for new housing within the Lihue District. This demand will occur from the growth of the existing population, immigration, and replacement of old housing. Consequently, cumulative and secondary environmental impacts typical of housing developments may result in this area of the Lihue District from project development. However, if the project were not built, the future demand for new housing and employment would still have to be satisfied by new development located elsewhere within the District or in Kauai. Some of the housing and employment demand would likely occur within master planned communities, but the balance would likely occur as less efficient small scale development scattered throughout the Lihue District or elsewhere on the island, such as Kalaheo, Koloa, Kapaa, Wailua or the North Shore. Such development may occur piecemeal and could eventually be costly to the County in providing infrastructure and public services to scattered small developments.

Consequently, cumulative and secondary environmental impacts would continue to occur in the Lihue District or in the other four districts elsewhere on Kauai with and without the Lihue-Hanamaulu Master Plan project development. Only with the additional land use controls and infrastructure planning afforded by a master planned community can these potentially significant environmental impacts be efficiently mitigated. Weighing the effects of the unplanned or "no action" alternative should receive commensurate consideration during the planning and land use approval process.

6.2 CUMULATIVE AND SECONDARY IMPACTS ON PUBLIC SERVICES AND FACILITIES

As the projected population of Lihue grows in the future, cumulative and secondary impacts on public services and facilities will occur with and without development of the proposed project in response to the needs of a growing population. Although other large scale projects have received some or all of the required land use approvals (or are presently under construction), there is no guarantee that any or all of these projects will be built as originally planned. Unforeseen events can occur that may alter market conditions or future population growth. Consequently, cumulative and secondary impacts affecting the Lihue region will occur as a result of overall population growth and economic fluctuations. Only site or regionally specific impacts to public services and facilities that will result from development of the Lihue-Hanamalulu Master Plan can be reasonably determined assuming project buildout will be achieved as presently envisioned.

As such, the following is an analysis of potential cumulative impacts that will result from development of the Lihue-Hanamaulu Master Plan which will be implemented in response to the projected population growth in the Lihue District.

Land Use Character. As the State of Hawaii undergoes a gradual land use change from sugar dominated agriculture to more diversified agricultural and rural land uses, new community development would required the conversion of some existing agricultural land. These changes in the pattern of land use are occurring to meet a growing population's demand for new housing and employment opportunities.

As the transition from an agricultural economy to a more urban service oriented economy occurs, the cumulative demand for development should be directed toward areas most suitable for urban development. In the Lihue District, new development should be more established on lands adjacent to existing urban development, that are accessible to infrastructure, and where existing public services are most efficiently available.

Traffic. Traffic levels will increase on the project site as the project achieves buildout. Within the Lihue District, regional traffic levels and circulation patterns will also change as the future population of Lihue and Kauai continues to grow. Even without project development, traffic volumes are projected to increase 3.9 percent per year as a result of cumulative population growth. To mitigate the impact of future traffic, regional and local roadway improvements are planned by the State and the County to improve traffic flow in presently congested areas and to accommodate new traffic growth. Project related traffic will be mitigated by improvements planned for the Master Plan.

Potable Water. Although the overall demand for potable water will increase with growth in the population within the Lihue District, the Master Plan addresses the new demand by installation of appropriate water source, storage, and distribution improvements. Where other development projects are planned in areas without potable water service, similar improvements will also be required from the respective developer(s). Consequently, cumulative impacts should be evaluated relative to the capacity of the water source, and not the facility improvements required for the future distribution and storage systems.

The Hanamaulu aquifer, which provides essentially all potable water for Lihue, has a sustainable yield of 40 mgd. Development of the proposed Lihue-Hanamaulu Master Plan will require approximately 1.79 mgd in addition to the 5 mgd pre-Iniki Hanamaulu aquifer withdrawal rate. Consequently, the cumulative impact results in only 6.79 mgd (16.9 percent) of the Hanamaulu aquifer sustainable yield being used for the potable water needs of the Lihue-Hanamaulu Master Plan and Lihue Town.

Schools. Based on DOE recommendations, the cumulative growth of school age children in the Lihue District could be met by the Master Plan which proposes a new school site on a 12-acre elementary school and park site. The DOE is also considering an alternative off-site elementary school site on other Amfac/JMB owned lands that could also address future cumulative increases in student population.

Other Public Services and Facilities. The cumulative impact of the Master Plan and future population growth in Lihue on other public services and facilities (i.e. fire, police protection, and health care), have been addressed in Section 5 of the Final EIS.

6.3 RELATIONSHIP BETWEEN SHORT TERM ISSUES AND MAINTENANCE OF LONG TERM PRODUCTIVITY

As discussed in the previous sections of this Final EIS, the project area is largely vacant except for the existing agricultural uses associated with sugar cane production. Long-term environmental impacts from the current use, primarily as a result of the exposed areas from harvesting activities, continued erosion of soils, and air pollution from agricultural burning have been identified and are considered undesirable to the surrounding urban areas in Lihue and at the Lihue Airport.

Retaining the property in its present use (the "No Action" alternative), would present a less than optimum use of the land especially considering the proximity to existing urban land uses and community services. The proposed land uses of the Lihue-Hanamaulu Master Plan would result in a significant social and economic benefit to the existing community in the form of the proposed public facilities (Veteran's Center, Judiciary Complex, Police Headquarters, YMCA/Teen Center, Debris Recycling Station, Disinfestation Facility, elementary school and parks), increased housing opportunities, increased job opportunities and increased tax revenues. Direct full and part-time employment opportunities and temporary construction employment will be generated by the project and these in turn will impart multiple benefits to the Kauai residents and the island and regional economy. Public revenues in the form of taxes paid by by the project are expected to exceed and offset any expenses associated with the expansion of public services or public facilities needed to meet both the project development and indirect population growth.

Long-term impacts to the environment from the Lihue-Hanamaulu Master Plan are generally considered positive if the proposed mitigation measures are implemented. The physical attributes, including proximity to existing transportation infrastructure, appropriate land characteristics and a mild climate are ideally suited for the proposed uses. The studies performed for this Final EIS have also indicated that the proposed project is generally compatible with the existing natural environment, and that some aspects of the project such as soil erosion and compatibility with surrounding land uses will be enhanced relative to the present condition.

Through careful site planning, the project area will be used in a manner that would maintain the essentially urban character of the region. Open space values comprising the State Conservation District and Hanamaulu Stream Valley would be retained for the long term benefit of existing and future residents. Increased recreational and economic opportunities for all socio-economic levels of the community would also be provided, along with increased community services and facilities.

6.4 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

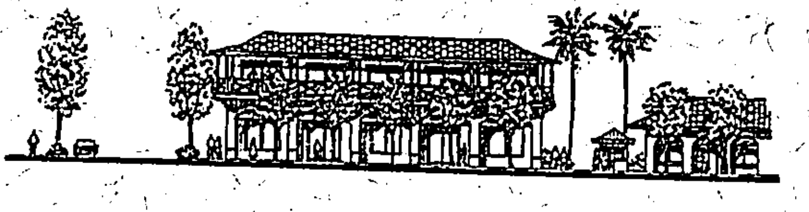
The development of the proposed Lihue-Hanamaulu Master Plan would result in the irreversible and irretrievable commitment of certain natural and fiscal resources. Major resource commitments include the land on which the proposed project is located and the financial commitment of construction materials, manpower and energy required for the project's completion. The impacts reflected by the commitment of these resources, should be weighed against the positive socio-economic benefits that could be derived from the project versus the consequences of either taking no action or pursuing another less beneficial use of the property.

6.5 PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED AND UNRESOLVED ISSUES

Many of the unresolved issues associated with the proposed project are characteristic of many similar community development projects in Hawaii. Two finite resources, agricultural land and potable water, will be utilized; visual alteration of the existing open space/agricultural land will occur; noise and traffic will increase; and air pollution will occur but well within the Federal and State allowable levels. Indirect impacts will also occur that will affect lifestyles and economic conditions for many residents. Issues that arise will be resolved through mitigative measures and coordination with the appropriate agencies.

7.0

CONFORMANCE WITH APPLICABLE STATE AND COUNTY POLICIES AND PLANS



7.0 CONFORMANCE WITH APPLICABLE STATE AND COUNTY POLICIES AND PLANS

The proposed Lihue-Hanamaulu Master Plan is an urban in-fill project requiring a State Land Use District Boundary Amendment, County General Plan Amendment, and Change of Zone land use entitlements consistent with the recommendations of the Office of State Planning 5-year Boundary review. The proposed development of the Lihue-Hanamaulu Master Plan will substantially comply with all applicable land use growth policies and plans of both the State of Hawaii and County of Kauai.

7.1 OFFICE OF STATE PLANNING FIVE YEAR BOUNDARY REVIEW

According to the Office of State Planning ("OSP"), amending the State Land Use District boundaries of the project area from the existing Agricultural District to the Urban District is warranted based on the following excerpt from the OSP Five Year Boundary Review:

> *"The proposed reclassification of Hanamaulu and Molokoa from the Agricultural District to the Urban District is intended to allow for the development of a planned community by Amfac/JMB Hawaii, Inc. The project is anticipated to be a mix of residential, commercial and industrial uses. The residential uses will likely include single- and multi-family units ranging from the affordable to market price. Because Lihue is the economic hub of the island and contains Kauai's principal airport and harbor, commercial and light industrial space will fill an anticipated need."*

Discussion: The proposed Lihue-Hanamaulu Master Plan implements the called-for mix of residential, commercial and industrial uses, with the residential uses comprised of single- and multi-family units ranging from the affordable to market price. Consequently, accommodation of the projected need for additional urban land at this location as recommended by OSP, accomplishes one of the major planning initiatives of the Five Year Boundary Review process.

7.2 THE HAWAII STATE PLAN

According to the Hawaii State Plan, the Plan shall *"serve as a guide for the future long-range development of the State; identify the goals, objectives, policies, and priorities for the State of Hawaii; provide a basis for determining priorities and allocating limited resources, such as public funds, services, human resources, land, energy, water, and other resources; improve coordination of state and county plans, policies, programs, projects, and regulatory activities; and to establish a system for plan formulation and program coordination to provide for an integration of all major state and county activities."*

The Plan is divided into three parts. Part I (Overall Theme, Goals, Objectives and Policies); Part II (Planning, Coordination and Implementation); and Part III (Priority Guidelines). Part II elements of the State Plan pertain primarily to the administrative structure and implementation process of the State Planning process. As such, project specific comments regarding the applicability of Part II (Section

226-52(a) and 226-52(b) - Statewide planning system) do not directly pertain to the proposed project, however, the entitlement review and approval process for the proposed project must follow the adopted planning procedure at both the State and County levels.

The following sections of the Hawaii State Plan are directly applicable to the review of the Lihue-Hanamaulu Master Plan and land use entitlement approvals.

<u>(226-5)</u> **<u>Objective and policies for population.</u>**

(a) *"...guide population growth to be consistent with the achievement of physical, economic, and social objectives...."*

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

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

<u>Discussion:</u> The Lihue-Hanamaulu Master Plan contains a significant component of industrial, office, and commercial land uses. These land uses have been specifically included to provide the existing and future need for new land area and to generate new employment opportunities in an area proximate to existing and future residential areas. The project development will offer short-term (construction-related) and long-term (commercial, industrial, public facilities) employment to residents of the State and County of Kauai by contributing to the overall level of construction activity. Permanent operational employment opportunities will directly and indirectly increase employment throughout the region and state. The mixed use community would assist in providing a diversity of employment opportunities within the region at a scale and character that is consistent with that of the district and adjoining properties, and will stimulate increased economic activities in the region.

By guiding the future population growth (which is forecast to occur with or without the project) in this manner, the achievement of physical, economic, and social objectives will be achieved and encouraged on a Neighbor Island consistent with community needs and desires.

State and county tax revenues (property taxes, income taxes, etc.) are anticipated to more than offset any costs associated with providing public services necessary to accommodate the projected growth. The project area is being carefully planned and located adjacent to an existing urban area designated by the Office of State Planning for urban development.

<u>(226-6)</u> **<u>Objectives and policies for the economy in general.</u>**

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

(b) (6) *"Strive to achieve a level of construction activity responsive to, and consistent with, state growth objectives."*

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

(b) (13) *"Encourage businesses that have favorable financial multiplier effects within Hawaii's economy."*

Discussion: Location of new housing proximate to Kauai's major employment center will foster a higher quality living standard, enhance lifestyles, and provide increased income and job choice. Increased and diversified employment opportunities, when coupled with the added availability of new housing, will provide Kauai County residents with expanded economic opportunities. Production of new homes will respond to Kauai's growing population on a Neighbor Island which is consistent with state growth objectives. The multiplier effect of large scale construction on Kauai's economy will provide local residents with additional opportunities to achieve their aspirations of home ownership and employment within a high quality living environment.

(226-11) Relevant Hawaii State Plan objectives and policies for the physical environment - land-based, shoreline, and marine resources.

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

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

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

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

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

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

Discussion: The Lihue-Hanamaulu Master Plan was prepared after extensive environmental studies for the project area were conducted. These plans integrated environmental considerations into the planning process at the earliest possible stage. No unique and fragile environmental resources were identified during the planning process. Implementation of proposed mitigation measures for the project will ensure continued protection of the land and ocean based environments through better control of runoff and erosion, and reduced water, pesticide, and fertilizer use than under the current agricultural use. No endangered plant or animal species or their habitats will be impacted, thereby establishing a compatible relationship with the natural resources in the area.

(226-12) Relevant Hawaii State Plan policies for the physical environment - scenic, natural beauty, and historic resources.

(a) *"....enhancement of Hawaii's scenic assets, natural beauty, and multi-cultural/historic resources."*

(b) (1) *"Promote the preservation and restoration of significant natural and historic resources."*

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

(b) (4) *"Protect those special areas, structures, and elements that are an integral and functional part of Hawaii's ethnic and cultural heritage."*

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

Discussion: The Lihue-Hanamaulu Master Plan was originated based on its site attributes and integration with surrounding urban development patterns to maintain and/or enhance the natural features of the site. Through the use of design guidelines, developers will be encouraged to site buildings to maintain the primary vistas to the mountains and ocean through the Hanamaulu Stream Valley. The project area will be landscaped to complement by the surrounding environment.

Data on two historical or cultural sites which are significant for informational purposes have been recovered and described in the archaeological report. No other significant historical or cultural resources are known to exist within the project area. Should any subsurface archaeological features be identified during construction, the Historic Preservation Division of the Department of Land and Natural Resources will be notified in accordance with State requirements.

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

Objectives:

(a) *Planning for the State's physical environment with regard to land, air and water quality shall be directed towards achievement of the following objectives:*

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

(a)(2) *Greater awareness and appreciation of Hawaii's environmental resources.*

Policies:

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

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

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

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

Discussion: The Lihue-Hanamaulu Master Plan has been planned and designed in an environmentally compatible and beneficial manner that would foster the recognition, importance, and value of the area's land, air and water resources. The site is not subject to unusual hazards associated with erosion, flooding, tsunami, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters. No significant impacts on ground water are anticipated. Design and construction will take advantage of the existing aesthetic quality of the area while enhancing the physical attributes of Kauai.

(226-15) Relevant Hawaii State Plan objective and policies for facility systems - solid and liquid wastes.

(a) (1) "Maintenance of basic public health and sanitation standards relating to treatment and disposal of solid and liquid wastes.

(b) (1) Encourage the adequate development of sewerage facilities that complement planned growth.

(b) (2) Promote re-use and recycling to reduce solid and liquid wastes and employ a conservation ethic.

Discussion: Wastewater treatment facilities will be expanded or newly constructed prior to the planned growth of the area in accordance with project phasing. Treated wastewater will be disposed of in accordance with applicable State Department of Health regulations as irrigation water on mauka sugar cane fields or other suitable landscaped areas. No residential units will be occupied until adequate collection, treatment, and disposal facilities are available.

Solid wastes will be transferred to County designated facilities and ultimately recycled at the County's proposed recycling station. By recycling both solid and liquid waste products, a conservation ethic will be employed indefinitely into the future.

(226-16) Objectives and Policies for Facility Systems - Water

Objectives:

(a) *Planning for the State's facility systems with regard to water, shall be directed toward achievement of the objective of the provision of water to adequately accommodate domestic, agricultural, commercial, industrial, recreational and other needs within resource capacities.*

Policies:

(b)(1) *Coordinate development of land use activities with existing and potential water supply.*

(b)(3) *Reclaim and encourage the productive use of runoff water and waste water discharges.*

(b)(4) *Assist in improving the quality, efficiency, service and storage capabilities of water systems for domestic and agricultural use.*

Discussion: Potable water will be provided after all necessary water source, storage, and transmission facilities are developed for the project. All applicable Department of Health standards for potable water use and disposal of wastewater will be implemented. Potable water will be derived from mauka ground water wells to ensure sufficient capacity to accommodate the needs of the proposed development. The ground water resource has significant excess capacity to sustain the projected withdrawal levels of potable water. Wastewater effluent will be reclaimed as irrigation water for Lihue Plantation sugar cane fields or other appropriate landscaped areas.

(226-18) Relevant Hawaii State Plan Objective and Policy for Facility Systems - Energy/Tele-Communications.

(a)(2) *Planning for the State's Facility Systems with regard to energy/tele-communication shall be directed towards the achievement of the following objectives: increased energy self-sufficiency.*

(c)(3) *To further achieve the energy objectives, it shall be the policy of the State to promote prudent use of power and fuel supplies through conservation measures including education and energy-efficient practices and technologies.*

Discussion: Through the use of design guidelines, developers will be required to carefully investigate and analyze the most cost effective and energy efficient means of providing water heating and cooling for the planned land uses. The use of energy efficient lighting equipment and the promotion of energy conservation measures in the operation and maintenance of the planned facilities will also be encouraged. The latest tele-communication infrastructure will also be provided to ensure compatibility with advances in future communication technology.

(226-103) Economic Priority Guidelines

(f)(1) *Encourage the development, demonstration, and commercialization of renewable energy sources.*

(f)(2) *Initiate, maintain, and improve energy conservation programs aimed at reducing energy waste and increasing public awareness of the need to conserve energy.*

(f)(3) *Provide incentives to encourage the use of energy conserving technology in residential, industrial, and other buildings.*

Discussion: The project area is located near the governmental, commercial, industrial and employment center of Kauai. The location of the project area adjacent to existing urban land uses and employment centers, will encourage the conservation of existing energy resources by reducing commuting time and distances for many residents. Infrastructure connections to existing facilities can be efficiently designed. Internally, bike routes and pedestrian walkways will encourage alternative forms of transportation that are not dependent on fossil fuels. Renewable energy use will be encouraged through the use of passive solar design techniques (i.e. encourage building orientation to sunlight and trade winds, and landscaping to facilitate natural cooling), and limited active solar energy technologies such as hot water heating systems. By promoting the development of master planned communities, the ability to control energy use through design guidelines and physical design is enhanced. The State's Model Energy Code will be considered during the preparation of the Lihue-Hanamaulu Master Plan's design guidelines.

The cost and energy effectiveness of utilizing energy efficient appliances and equipment within the planned residences and commercial establishments will also be analyzed to determine the most economical and energy efficient methods of providing hot water heating and cooling as well as energy efficient methods of water use and lighting systems for the proposed facilities.

(226-19) Relevant Hawaii State Plan policies for socio-cultural advancement - housing.

1) *Greater opportunities for Hawaii's people to secure reasonably priced, safe, sanitary, livable homes located in suitable environments that satisfactorily accommodate the needs and desires of families and individuals.*

(2) *The orderly development of residential areas sensitive to community needs and other land uses.*

(b) (1) *Effectively accommodate the housing needs of Hawaii's people.*

(b) (2) *Stimulate and promote feasible approaches that increase housing choices for low-income, moderate-income, and gap-group households.*

(b) (3) *Increase home ownership and rental opportunities and choices in terms of quality, location, cost, densities, style, and size of housing.*

(b) (5) Promote design and location of housing developments taking into account the physical setting, accessibility to public facilities and services, and other concerns of existing communities and surrounding areas.

(b) (7) Foster a variety of lifestyles traditional to Hawaii through the design and maintenance of neighborhoods that reflect the cultures and values of the community.

Discussion: The Lihue-Hanamaulu Master Plan concept has been designed to foster a sense of community and cohesiveness. It is the intent of the Master Plan to create a community that reflects values and lifestyle that are traditional to Hawaii, an appreciation and respect for the beauty of the land, and a caring for the community. Feasible approaches to expand housing opportunities for all income levels will be provided and implemented in conjunction with applicable State and County requirements. Affordable housing will also be developed in accordance with adopted State and County policies and regulations. These include for-sale single-family and multi-family housing priced at affordable, gap, and market prices. Affordable rentals may also be provided.

(226-104) Population growth and land resources

(b)(1) Encourage urban growth primarily to existing urban areas where adequate public facilities are already available or can be provided with reasonable public expenditures and away from areas where other important benefits are present, such as protection of important agricultural land or preservation of lifestyles.

(b) (6) Seek participation from the private sector for the cost of building infrastructure and utilities, and maintaining open spaces.

(b) (10) Identify critical environmental areas in Hawaii to include but not be limited to the following: watershed and recharge areas; wildlife habitats (on land and in the ocean); areas with endangered species of plants and wildlife; natural streams and water bodies; scenic and recreational shoreline resources; open space and natural areas; historic and cultural sites; areas particularly sensitive to reduction in water and air quality; and scenic resources.

(b) (12) Utilize Hawaii's limited land resources wisely, providing adequate land to accommodate projected population and economic growth needs while ensuring the protection of the environment and the availability of the shoreline, conservation lands, and other limited resources for future generations.

Discussion: The proposed project will be constructed according to a phased schedule as market demand and infrastructure development progresses. Construction employment over 15 to 20 years will be offered to residents as long-term employment. All public facilities, infrastructure, and services that require improvement or expansion as a result of project implementation will be provided by the developer.

As previously noted, environmental studies have indicated that no critical habitats will be impacted by the project. The proposed reclassification of the project area to Urban will provide new land necessary to accommodate projected population and economic growth needs while ensuring the protection of the environment in accordance with the OSP recommendations during the 5-year land use district boundary review.

(226-106) Housing priority guidelines

(1) *Seek to use marginal or non-essential agricultural land and public land to meet housing needs of low and moderate-income and gap-group households.*

(2) *Encourage the use of alternative construction and development methods as a means of reducing production costs.*

(4) *Create incentives for development which would increase home ownership and rental opportunities for Hawaii's low and moderate-income households, gap-group households, and residents with special needs.*

(6) *Encourage public and private sector cooperation in the development of rental housing alternatives.*

(7) *Encourage improved coordination between various agencies and levels of government to deal with housing policies and regulations.*

Discussion: To meet the anticipated demand for housing within the Lihue District in the future, the developer will work with the public and private sectors to provide all economically feasible forms of housing products. Provisions for affordable housing and special needs housing will be provided in accordance with applicable State and County requirements. As previously described, the project area is proximate to Lihue Airport, Wilcox Hospital, residential and other urban land uses. This proximity to existing urban land uses makes burning and dust control more costly and inefficient, limiting the use of the project area for "essential agriculture". The loss of sugar lands due to the project will be mitigated by the inclusion of a like amount of area of former cane lands in Kealia into Lihue Plantation's operations for seed cane purposes, allowing the present seed acreage in Lihue to be converted to sugar production.

7.3 STATE FUNCTIONAL PLANS

Twelve Functional Plans have been developed by the State to act in concert and coordination with the County General Plans and Development Plans in implementing the Hawaii State Plan. Although the Functional Plans work as the primary guideposts for implementation of the State Plan, at times competing policy interests are found within the Functional Plans and County General and Development Plans. For example, areas designated as Agriculture by the State Land Use Commission adjacent to urban areas may be more appropriately designated for urban land uses by the County Plans. Such is the case with the project area.

7.3.1 State Housing Functional Plan

STRATEGY: Expand the supply of affordably priced residential units through joint public/private sector efforts. Mobilize resources to better assist families seeking home ownership opportunities. Alternate or innovative approaches to developing housing should also be pursued.

POLICY

A(1) Direct Federal, State and county resources and efforts toward the development of affordable for-sale housing units.

A(2) Encourage increased private sector participation in the development of affordable for-sale housing units.

A(3) Ensure that (1) housing projects and (2) projects which impact housing provide a fair share/adequate amount of affordable home ownership opportunities.

A(4) Assist first time home buyers in purchasing a home.

A(5) Use alternative approaches in providing affordable housing for sale.

Discussion: The proposed Project will provide a wide range of housing types with diversity of pricing. This broad mixture of expanded housing opportunities will stimulate and promote increased choices for low-income, moderate-income and gap group households. Increasing the housing inventory will indirectly help to stabilize the price of housing and overall quality, location, style and size of housing. Job opportunities will be enhanced to support the purchase of housing by residents of Kauai.

STRATEGY: Expand the supply of affordable rental units through joint public/private sector efforts. Mobilize resources to better assist families seeking rental housing opportunities. And, pursue sources of funding for rent subsidies.

POLICY

B(1) Direct federal, state and county resources and efforts toward the financing and development of rental housing projects.

B(2) Encourage increased private sector participation in the development of affordable rental housing.

B(3) Ensure that projects which impact housing provide affordable rental opportunities for employees.

B(4) Fully utilize rental subsidy programs funded by the Federal, State or county governments.

Discussion: Housing opportunities will be further enhanced by establishing a wide range of housing types and prices either through "for-sale" or rental housing, joint ventures with other developers and/or HFDC, or through the payment of in-lieu fees in accordance with applicable requirements set forth by the State Housing Finance Development Corporation and County of Kauai. Employee rental housing may also be provided in accordance with applicable State and County regulations.

STRATEGY: Acquire public and, where applicable, privately-owned lands for future residential development.

POLICY

E(1) Promote design and location of housing developments taking into account the physical setting, accessibility to public facilities and services, employment and other concerns of existing communities and surrounding areas.

E(3) Where feasible, acquire privately owned lands that are suitable for housing development.

Discussion: Although none of the project area is comprised of publicly-owned land, it has been demonstrated by the physical setting, accessibility to existing and proposed public facilities and services, and anticipated employment opportunities, that the project area is suitable for the development of new housing. As stated previously, the developer will enter into joint ventures with other developers and/or HFDC as applicable in accordance with requirements set forth by the State Housing Finance Development Corporation and County of Kauai to provide necessary affordable housing.

7.3.2 State Agricultural Functional Plan

The following are applicable Policies of the State Department of Agriculture set forth in the State Agricultural Functional Plan to assist Hawaii's agricultural industry, increase efforts to manage agricultural pests and diseases, and to protect the land and water resources needed to sustain agriculture.

POLICY

D(2) Develop capabilities to convert Hawaii-grown crops into potential new value-added products for the local, visitor industry, and export markets.

F(2) Eliminate fruit flies as a barrier to the uninhibited export of host commodities from Hawaii in accordance with Federal Quarantine requirements.

G(2) Minimize the adverse impacts of agricultural practices on Hawaii's ground water, surface water, air quality, and endangered species.

H(2) Encourage and protect important agricultural lands in accordance with the Hawaii State Constitution.

J(3) Systematically determine the most suitable locations for increased agricultural production.

Discussion: Presently, the State and County land use designations for the project area are not consistent with the adjacent (and downwind) urban land uses of Lihue. The project area's relatively small acreages make plantation agriculture difficult to manage since it is adjacent to residential neighborhoods of Lihue. This is especially the case during harvests when complaints are made about smoke irritation, soot, noise, dust and muddy streets. Because of the proximity of the airport, LPCo is subject to restrictions on burning by the FAA. Other field operations such as plowing, planting and spraying are also cause for concern with urban surroundings. This inherent characteristic of the project area limits its potential for productive agriculture, especially when the demand for additional urban development proximate to existing infrastructure and services is significant.

Although the project area is not presently designated by the Land Use Commission as urban land, it is appropriate for the physical setting. The site is proximate to public facilities and services, employment and other "urban-like" characteristics. The need for additional urban land was documented by the OSP during the preparation of its five-year boundary review. According to the report, reclassification of the project area to urban is appropriate because Lihue is the economic hub of the island and contains Kauai's principal airport and harbor, and the proposed commercial and light industrial space will fill an anticipated need. The establishment of the proposed Kauai Fruit Disinfestation Facility will also promote agriculture by opening new markets for diversified agriculture on Kauai. Immediate new plantings of papaya are anticipated to fulfill the demand for the treated fruit.

The project area is completely surrounded by existing urban uses; the project itself would be a logical in-fill development which would not disproportionately overtax goverment's ability to provide services to the area.

7.3.3 State Historic Preservation Functional Plan - Historic Properties

Issue Assessment: Preservation of Historic Properties
According to the Historic Preservation Functional Plan, "the preservation of historic properties involves three major areas of activity: the identification, protection, and management and treatment of historic properties. Each of these areas of activity has its own specific problems and needs" as addressed by the Plan.

Discussion: An archaeological survey of the project area was completed to locate, describe and determine the significance of any historic sites and features within the project area. The archaeologist's report found two features in the project area, a historic building and a wall. Both were determined to be important for information content and no further data collection was deemed necessary. There were no sites or features which required preservation. Accordingly, the proposed Lihue-Hanamaulu Master Plan will have "no effect" on significant historic sites.

7.3.4 Transportation Functional Plan

The following Policies of the State Transportation Functional Plan are applicable to the proposed Lihue-Hanamaulu Master Plan.

POLICY

I.A.1 Increase transportation capacity and modernize transportation infrastructure in accordance with existing master plans and laws requiring accessibility for people with disabilities.

I.A.2 Improve regional mobility in areas of the State experiencing rapid urban growth and road congestion.

I.B.1 Close the gap between where people live and work through decentralization, mixed zoning, and related initiatives.

I.C.5 Provide for a viable bikeway program.

I.F.1 Enhance air safety and security.

III.A.2 Pursue private sector participation in the financing of transportation systems, developments and projects.

Discussion: As described in the Traffic Impact Report (Appendix E), regional "base" improvements to Kapule Highway and Kuhio Highway are recommended to be implemented by the State during the project development years. These improvements will increase transportation capacity and modernize transportation infrastructure in accordance with the State's plan to improve regional mobility through development of major new transportation arterials. All on-site transportation infrastructure required as a result of project development will be provided by the developer. The project is located proximate to existing residential and employment centers. Bike routes and pedestrian walkways are planned, and mixed use zoning and related initiatives will be utilized.

All land uses have been located in accordance with accepted noise and safety zones associated with operations at Lihue Airport. None of the project's residential development or other noise sensitive land uses are located within the current (1994) or future (2010) noise contours of 60 Ldn or higher.

7.4 MODEL ENERGY CODE

The State's Model Energy Code, Energy Efficient Standard for Buildings (DBEDT, July 1993) goal is to reduce our consumption of oil and provide significant savings in utility costs as well as help improve air quality by reducing fossil-fuel burning. The Code is currently being reviewed and revised by the County of Kauai and is expected to be adopted by Spring 1995 according to DBEDT Energy Division staff.

Discussion: As adopted, applicable standards of the Code for residential and public buildings will be integrated into the Design Guidelines for the project and will become a code requirement to obtain building permits for the various structures planned at the project.

7.5 CHAPTER 205, HAWAII REVISED STATUTES (HRS) - LAND USE COMMISSION

Chapter 205, Hawaii Revised Statutes (HRS), establishes the State Land Use Commission (LUC) and gives this body the authority to designate all lands in the State as Urban, Rural, Agricultural, or Conservation District(s) lands. Presently, most of the project area is located within the State Agricultural District. A small portion of approximately 12 acres is within the Conservation Districts. Consequently, a Land Use District Boundary Amendment (LUDBA) is required to reclassify the project area from the Agricultural and Conservation Districts to the Urban District.

In its review of the proposed reclassification, Chapter 205-17 requires that the Commission shall specifically consider (1) the Hawaii State Plan, (2) the applicable district standards, and (3) impact of the proposed reclassification on areas of State concern. Consideration of these criteria are also embodied in the Section 226, HRS, and the LUC Administrative Rules, Chapter 15-15, Hawaii Administrative Rules, Subchapter 2. Specifically, the following "Standards for determining urban district boundaries" as set forth in Section 15-15-18, Hawaii Administrative Rules are applicable.

Conformance to Urban District Standards

The proposed district boundary amendment conforms to the State of Hawaii Land Use Commission Rules (Hawaii Administrative Rules, Title 15, Chapter 15, Subtitle 2 and 3), decision making criteria for boundary amendments as summarized below.

Criteria - Section 15-15-18

A. *The proposed boundary must be reasonable.*

Discussion: The project area is contiguous to existing urban boundaries and provides for extensions to existing and planned infrastructure systems. Inasmuch as the Lihue-Hanamaulu Master Plan is intended to provide expanded housing, business, and employment opportunities for future residents, the requested boundary change is reasonable. No important natural resources will be impacted.

B. *The proposed boundary amendment must conform to the Commission's Standards for determining Urban District Boundaries, the standards are addressed as follows:*

Standard: (1) It [the urban district] shall include lands characterized by "city-like" concentrations of people, structures, streets, urban level of services and other related uses.

Discussion: The town of Lihue, Lihue Airport, and Hanamaulu are adjacent or proximate to the Project area. These uses are "city-like" in concentration and the proposed Lihue-Hanamaulu Master Plan would expand these characteristics.

Standard: (2) It [the urban district] shall take into consideration the following specific factors:

(A) Proximity to centers of trading and employment except where the development would generate new centers of trading and employment.

Discussion: The proposed Lihue-Hanamaulu Master Plan would be proximate to the trading and employment center of Lihue. In addition, the proposed commercial and industrial uses would add to Lihue's role as a center of trading and employment on Kauai. The new direct and indirect employment opportunities generated by the proposed Lihue-Hanamaulu Master Plan will be established in support of an existing urban area.

Standard: (B) Substantiation of economic feasibility by the petitioner.

Discussion: The market study indicated a significant demand and market for the land uses proposed by the Lihue-Hanamaulu Master Plan. Actual project phasing will be dependent upon market conditions.

Standard: (C) Proximity to basic services such as sewers, water, sanitation, schools, parks, and police and fire protection.

Discussion: The Lihue-Hanamaulu Master Plan is contiguous to existing urban development and associated infrastructure. Public services either exist or will be expanded to correspond with the projected population expansion for the area. To address Lihue-Hanamaulu Master Plan requirements, infrastructure will be improved or expanded to provide required capacities and enhance services as warranted. The long-term development time frame will allow for continued planning and coordination for development and expansion of community facilities and services.

Standard: (D) Sufficient reserve areas for urban growth in appropriate locations based on a ten (10) year projection.

Discussion: The proposed development is in an appropriate location for urban growth as it is contiguous to existing urban areas and located adjacent to major transportation systems. Approximately 80 to 90 percent of the internal roadways and associated infrastructure is anticipated to be in place during the first ten years of project development. The market study for the Lihue-Hanamaulu Master Plan showed a demand for the proposed multi-family and single family residential product over a 15 to 20 year absorption period. The project area serves as an appropriate expansion area for urban growth adjacent to Lihue.

Standard: (3) Lands included (within the urban district) shall be those with satisfactory topography and drainage and reasonably free from the danger of floods, tsunami, and unstable soil conditions and other adverse environmental effects.

Discussion: The topography of the proposed development area is suitable for urban development, having an overall slope of less than 8 percent. Existing drainage patterns would remain largely intact and additional drainage system improvements would be installed. With the proposed storm water drainage system, the quantities and quality of surface runoff will be better controlled and managed.

Three years after initiation of the project, sediment loss should be less than currently experienced under sugar cultivation. The project area is located outside the 100 year storm and tsunami area.

Standard: (4) In determining urban growth for the next ten years, or in amending the boundary, lands contiguous with existing urban areas shall be given more consideration than non-contiguous lands, and particularly when indicated for future urban use on County General Plans.

Discussion: The project area is contiguous to existing urban areas and, therefore, merits more consideration than non-contiguous lands. The OSP has identified the project area as appropriate for urbanization in their 5-year State Land Use District Boundary review.

Standard: (5) It shall include lands in appropriate locations for new urban concentrations and shall give consideration to areas of urban growth as shown on the state and county general plans.

Discussion: The proposed land uses are consistent with policy provisions of the County of Kauai General Plan. An amendment to the General Plan land use maps will be required and is under review by the County, however, a portion of the project area is designated as Project District 1 in the Lihue Development Plan. This "Project District" calls for the development of single-family and multi-family housing and a community center. The site is adjacent to existing urbanized lands and consistent with all applicable provisions of the Hawaii State Plan.

Standard: (7) It shall not include lands, the urbanization of which will contribute toward scattered, spot urban development, necessitating unreasonable investment in public infrastructure or support services.

Discussion: The proposed Lihue-Hanamaulu Master Planned development does not constitute scattered, spot development due to the urban nature of the surrounding land uses. The Lihue-Hanamaulu Master Plan is better characterized as an "in-fill" project between the town of Lihue, Lihue Airport and Hanamaulu.

Section 15-15-19

In determining the boundaries for the "A" agricultural district, the following standard is applicable:

Standard: Lands in intensive agricultural use for two years prior to date of filing of a petition or lands with a high capacity for intensive agricultural use shall not be taken out of this district unless the commission finds either that the action:

(A) Will not substantially impair actual or potential agricultural production in the vicinity of the lands or in the county or state; or

(B) Is reasonably necessary for urban growth.

Discussion: Presently, the project area is surrounded by urban land uses, Lihue Airport, or the Hanamaulu Stream Valley. As such, continued agricultural use of the project area is not desirable due to the dust, smoke, and other factors associated with sugar production. Harvesting can be especially difficult due to FAA restrictions associated with Lihue Airport operations. Total agricultural production will not be impacted since replacement lands are being readied in Kealia. The inclusion of the Fruit Disinfestation Facility in the project area will have the effect of increasing agricultural acreage elsewhere on Kauai.

Clearly, urban development that can more efficiently utilize existing infrastructure and generate more employment proximate to existing and proposed housing, "[i]s reasonably necessary for urban growth." Additionally, the OSP has reaffirmed that more urban land is necessary on Kauai (proximate to Lihue) to allow for urban growth in the future. Consequently, the project area has been recommended by OSP for reclassification to the State Urban district and the Kauai General Plan (Project District 1) to permit future urban development of the project area.

7.6 ENVIRONMENTAL IMPACT STATEMENTS (CHAPTER 343, HRS)

In accordance with the State of Hawaii's Environmental Impact Statement Law, Chapter 343, HRS, there are eight conditions which trigger the environmental review process. If "significant environmental effects" are not identified by an Environmental Assessment, preparation of a full Environmental Impact Statement is exempted, otherwise preparation and processing of a full Environmental Impact Statement is required.

Of the eight conditions which trigger the environmental review process, the reclassification of State Conservation District Lands and amendment to the County of Kauai General Plan are applicable. In addition, the OSP has recommended in the State Land Use District Boundary Review (1992) that the State Land Use District boundaries be amended for approximately 792 acres which includes the project area from the Agricultural District to the Urban District. Both the Office of State Planning and County of Kauai have been consulted and involved in the preparation of the environmental assessment and this Environmental Impact Statement.

Because the Lihue-Hanamaulu Master Plan initially involves reclassification of State Conservation District Lands, the Accepting Agency responsible for the environmental review process of the Environmental Assessment (already reviewed by the LUC) and this Environmental Impact Statement will be the State Land Use Commission.

The Final EIS document will be submitted to the State Land Use Commission for acceptance and as an exhibit at the appropriate time in the State Land Use District Boundary Amendment process.

7.7 GENERAL PLAN FOR THE COUNTY OF KAUAI

The proposed Lihue-Hanamaulu Master Plan implements the objectives and policies of the County General Plan in areas of land use, environment, economic, urban design, public utilities and facilities, and recreation and culture. The specific applicable General Plan Goals and Policies and their applicability to the proposed Lihue-Hanamaulu Master Plan are discussed below.

According to Section 7-2.1 Goals of the County of Kauai General Plan, physical growth on Kauai must recognize the unique landscape and environmental character of the island. In doing so, opportunities for greater fulfillment of life, diversity and stability of employment, provisions for suitable living quarters for all residents in all income levels, and improvement and expansion of the island's economy must also be provided in concert with affected environmental resources. Other goals call for activities intended to provide opportunities for the youth of Kauai, thus encouraging them to remain in the County and contribute to its future.

Each of these goals recognize the importance of the quality of life associated with expansion of economic and housing opportunities. However, these must be implemented in a manner sensitive to Kauai's unique environment. The goals expressed by the General Plan will be implemented through the development under the proposed Lihue-Hanamaulu Master Plan. The following specific goals will be implemented as follows:

Goal

(5) To create opportunities for a greater diversity and stability of employment for residents of Kauai.

<u>Discussion:</u> The proposed Lihue-Hanamaulu Master Plan will greatly expand short-term employment in the construction industry and long-term employment in the proposed industrial areas. Indirect employment in a wide range of service related industries will also be created.

(7) To provide opportunities for suitable living quarters for all residents in all income levels.

<u>Discussion:</u> A central component of the Lihue-Hanamaulu Master Plan calls for development of affordable housing to be provided in accordance with State and County adopted policies. New housing will potentially mitigate the dramatic rise in housing prices experienced over the last 10 years.

(10) To promote the improvement and expansion of the island's economy, by recognizing and carefully utilizing land and water resources.

<u>Discussion:</u> The proposed development area contains significant constraints for feasible agriculture due to the existing surrounding land uses. By developing lands adjacent to existing infrastructure for urban land uses, more efficient use of land and water resources will ultimately result, while also expanding the island's economy through efficient use of fees paid by residents for water and sewer services.

(11) To guide and control development to take full advantage of the island's form, beauty and climate and preserve the opportunity for an improved quality of life.

<u>Discussion:</u> By providing new housing proximate to existing and future employment centers, implementation of the Lihue-Hanamaulu Master Plan will enhance the local economy and quality of life for residents living in the project area through reduced commuting times and less crowded housing.

(15) *To create, develop and sustain an economy and a population composition that will encourage the youth of Kauai to live in the County and contribute to society.*

Discussion: Presently, many of Kauai's youth leave Kauai in search of better employment and housing opportunities. By providing higher quality jobs and housing, Kauai's youth would be more likely to remain in Kauai and contribute to society over the 15 to 20 year development period.

7.8 LIHUE DEVELOPMENT PLAN

The Lihue Development Plan has designated a portion of the project area as "Project District 1" and the balance as "Agriculture" (Figure 7-1).

Within Project District 1, recommended land uses consist of 238 units of single family housing and 425 units of multi-family. A park/community center is also recommended to include facilities for active and passive recreation. The community center is recommended to provide facilities for indoor sports and meeting rooms. Although the balance of the project area is designated as "Agriculture" by the Lihue Development Plan, no specific actions or programs are recommended to encourage continued use of the project area for agricultural purposes. Circulation improvements are also planned for Kapule Highway and Ahukini.

The purpose of the Lihue Development Plan, is to extend governmental design responsibilities for areas of multiple ownership. However, the Lihue Development Plan states; *"[t]he development plans should not be restricted in their design intent to public property, but should form the framework of a public/private dialogue toward a common objective."* Consequently, the development plans establish guidelines and recommendations for the future growth of Kauai. These Development Plan recommendations are implemented through the Policies of the General Plan and the more specific land use control mechanism of the Comprehensive Zoning Ordinance.

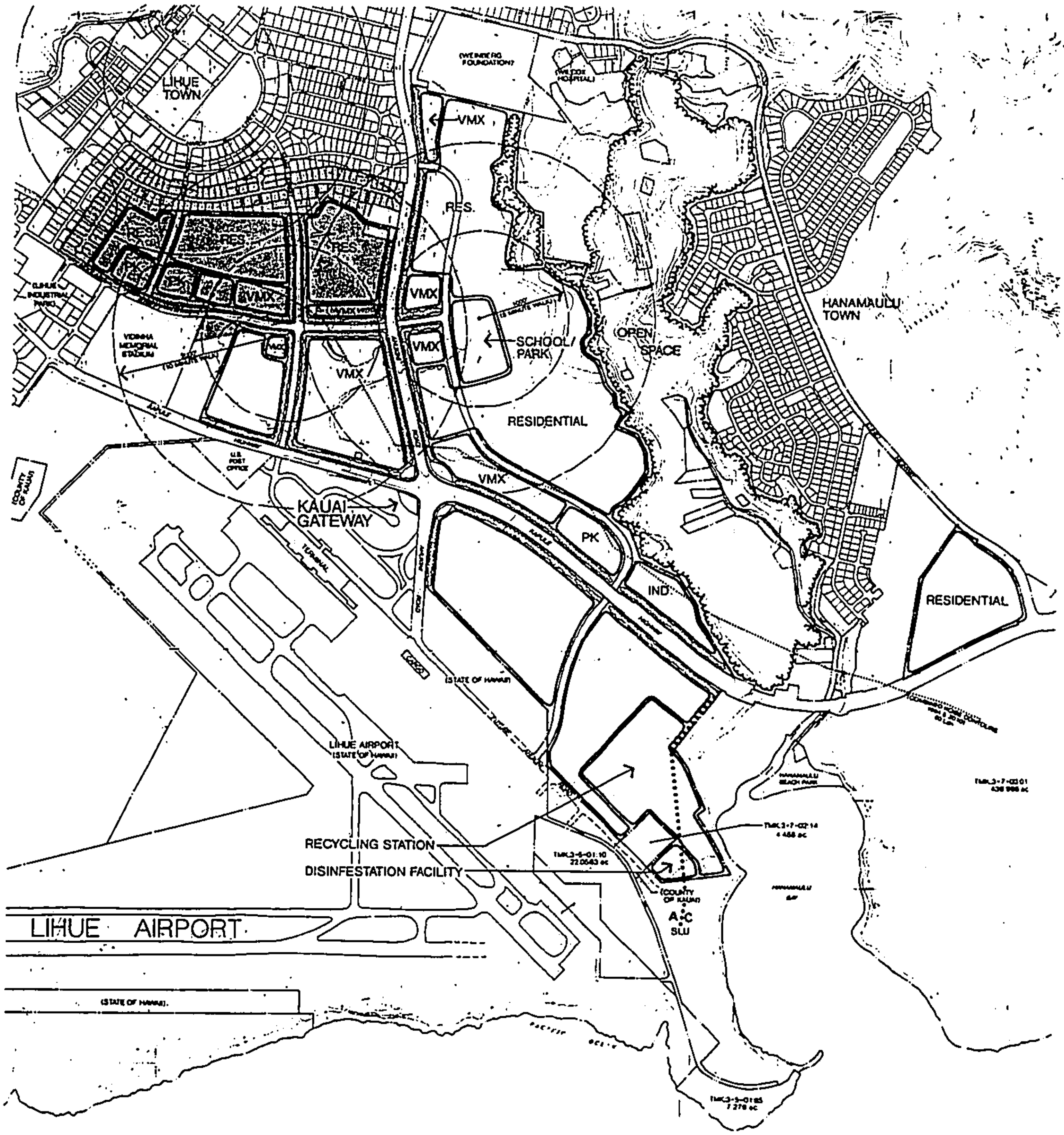
7.9 COMPREHENSIVE ZONING ORDINANCE

According to the Comprehensive Zoning Ordinance, the project area is zoned as Agriculture and small portions along Hanamaulu Stream valley as Open.

Within both the Agricultural and Open zoning districts, permitted uses do not include the residential, mixed use, or industrial land uses envisioned by the Lihue-Hanamaulu Master Plan. As such, implementation of the Lihue-Hanamaulu Master Plan will require a change of zone to the uses described in addition to a General Plan Amendment. The change of zone application will be submitted to the County of Kauai at the appropriate time in the land use approval process.

7.10 CONFORMANCE WITH COASTAL ZONE MANAGEMENT OBJECTIVES AND POLICIES

The objectives of the Hawaii Coastal Zone Management (CZM) Program, as set forth in Chapter 205A, Hawaii Revised Statutes, apply to the protection and maintenance of valuable coastal resources. In Hawaii, essentially no land areas are excluded from the CZM program. The proposed boundary amendment request conforms to applicable CZM objectives as follows:



LEGEND

PROJECT DISTRICT 1

FIGURE 7-1
DEVELOPMENT PLAN-
PROJECT DISTRICT 1
LIHUE-HANAMAULU
AMFAC/JMB HAWAII — LIHUE DISTRICT, ISLAND OF KAUAI
NORTH — LINEAL SCALE 375 0 375 750 1500 FEET
PBR HAWAII

Objective for Historic Resources - Protect, preserve, and where desirable, restore those natural and man made historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

Discussion: As previously noted, no significant archaeological or historical sites requiring preservation were identified in the archaeological survey conducted for the proposed development. Should any archaeologically significant artifacts, bones, or other indicators of previous on-site activity be uncovered during the construction phases of development, their treatment will be conducted in strict compliance with the requirements of the Department of Land and Natural Resources.

Objective for Scenic and Open Space Resources - Protect, preserve, and where desirable, restore or improve the quality of coastal scenic and open space resources.

Discussion: The proposed residential, mixed use and industrial development on the project area will replace the existing sugar cane and scrub vegetation. The addition of extensive landscaping will mitigate the visual impact as viewed from outside the site while the design of single family and multi-family housing units will complement the background vistas. As a master planned development, the proposed project will protect and preserve open space resources in a more carefully controlled manner. Scenic areas which includes the Hanamaulu Valley will remain as open space.

Objective of Coastal Ecosystems - Protect the valuable coastal ecosystem from disruption and minimize adverse impacts on all coastal ecosystems.

Discussion: Most of the project area is located mauka of the State Conservation District and inland from shoreline areas. Any possible impact to near-shore ecosystems resulting from surface runoff, will be mitigated by the establishment of on-site detention basins during the construction phases of development. Protection of groundwater resources will be enhanced by a centralized sewage collection, treatment, and disposal system.

Objective for Coastal Hazards - Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, and subsidence.

Discussion: The project area is not subject to coastal-related flooding. Development of Lihue-Hanamaulu Master Plan drainage systems will follow design standards of the County of Kauai to ensure the safe conveyance and discharge of storm runoff.

In addition, the proposed Lihue-Hanamaulu Master Plan is located outside of the County's Special Management Area (SMA) except for a small portion of the proposed County Recycling Station site. These portions of the Lihue-Hanamaulu Master Plan area are also located well outside of any coastal hazard areas.

7.11 CONCLUSIONS

The location of the project area, adjacent to Lihue, creates a logical opportunity for urban expansion into an area with little potential for continued or longer-term productive agriculture, but very high potential for viable urban development. The proposed reclassification from Agriculture and Conservation to Urban is supported by the following conclusions:

a. The Office of State Planning (OSP) recommended amending the State Land Use District boundaries of the project area from the existing Agricultural District to the Urban District in their OSP Five Year Boundary Review:

b. The need for employment opportunities, economic development and provisions for expanded housing opportunities as described in the State Land Use and General Plan Amendment petitions. Consequently, the housing component of the Lihue-Hanamaulu Master Plan has been designed to address a wide range of housing needs of Kauai residents.

c. The Project area is located adjacent to Kauai's major urban area. The proximity of the Lihue-Hanamaulu Master Plan to existing utilities and transportation infrastructure will greatly enhance the efficient use of existing public facilities and services. The developer will fund its fair share of the necessary infrastructure improvements, as required, resulting from development of the Lihue-Hanamaulu Master Plan.

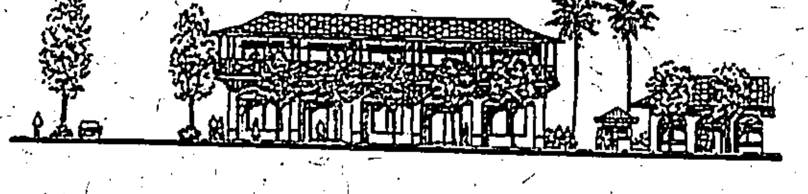
d. The agricultural economy of the County of Kauai will be impacted minimally by the inclusion of new area at Kealia. Although the site is located within the State Agricultural District, the project area has limited agricultural potential due to the relatively small size of the project area and proximity to urban areas. The Fruit Disinfestation Facility promises to spur diversified agricultural activity.

e. No unique habitats are known to exist on the project area although the diversity of habitat will expand with the project area.

f. Generally positive socio-economic impacts will result on a short-term and long-term basis by providing: 1) expanded opportunities for all housing types, 2) additional employment opportunities for Kauai residents, 3) use of land with little potential for continued or longer-term productive agriculture adjacent Lihue Town for urban purposes (thereby reducing pressure to develop prime agricultural land elsewhere on Kauai), and; 4) by implementation of the County of Kauai General Plan.

8.0

ALTERNATIVES TO THE PROPOSED ACTION



8.0 ALTERNATIVES TO THE PROPOSED ACTION

In compliance with the provisions of Title 11, Department of Health, Chapter 200, Environmental Impact Statement Rules, Section 11-200-17(f), the "known feasible" alternatives to the proposed Conceptual Master Plan are limited to those that would allow the objectives of the Conceptual Master Plan to be met, while minimizing potential adverse environmental impacts. The proposed Conceptual Master Plan has been prepared to address the growing demand for housing, other needed land uses and new employment opportunities on Kauai. Other possible alternatives to the proposed Conceptual Master Plan, including the "no-action" alternative, have also been investigated to identify other potential land uses which might be more appropriate on the property relative to existing environmental and social/economic conditions.

The alternatives rejected do not meet the stated objectives of the State's and County's plans and goals as effectively as the proposed Conceptual Master Plan, would result in greater environmental impacts than the preferred alternative, or they are not economically feasible. Some of the alternatives considered include golf course layouts, various combinations of single and multi-family units, combinations of golf course layouts and residential units, and the alternative of "no-action".

8.1 THE PREFERRED ALTERNATIVE

Under the preferred alternative, the petition area would be developed for residential, commercial, industrial, and public facility purposes. As a result, the open space character of the current plantation agriculture would be diminished or lost. This alternative would respond to the population growth projected for the Lihue District, but also generate new demands on existing infrastructure, including increased use of potable water, intensified generation of wastewater and solid wastes, and greater demand for public facilities and services. However, by using master planned communities to comprehensively plan for the projected population growth that will occur, the environmental and social impacts of population growth will be mitigated as compared to scattered unplanned growth or over crowding that could be expected with the "no-action" alternative.

Although the final layout and configuration of the proposed Conceptual Master Plan will be refined through the engineering design process and preparation of site plans, the proposed Conceptual Master Plan is considered to be the "best" from land use, infrastructure, traffic, and economic perspectives. This alternative has also been judged as the preferred alternative because the overall planning objective of providing new housing and employment opportunities on Kauai will have been achieved. By incorporating existing site features, the preferred alternative provides adequate open spaces and establishes a logical land use pattern relative to the adjoining Lihue Airport, Hanamaulu Stream, and the urban land uses of Lihue town.

Because the project area lies adjacent to existing urban areas, the relative impact to Kauai's agricultural industry will also be minimized by "in-filling" these relatively small agricultural parcels with urban land uses rather than have urban land uses spread out over larger agricultural areas outside of Lihue. By providing replacement land for sugar cane production in other areas and through the establishment of new agricultural infrastructure (disinfestation facility), existing agriculture will continue and viable forms of diversified agriculture on Kauai will be encouraged. Similarly, infrastructural impacts associated with urban development would also be minimized due to the efficient use of existing infrastructure and by providing necessary improvements to existing infrastructure, public services and facilities.

8.2 "NO-ACTION ALTERNATIVE"

The "no-action" alternative would not be consistent with stated governmental policies of establishing new housing and employment opportunities and would not create the overall positive economic impacts to the residents of the area, County, and State. New tax revenues would not be generated and the infrastructure improvements to be provided in support of the conceptual master plan would not be constructed by the developer.

This alternative would likely maintain the site as unimproved agricultural land. However, because of its close proximity to existing urban areas and the Lihue Airport, it is not generally well suited for sugar production. Existing environmental impacts to the area would continue which are related to the application of agricultural pesticides, fertilizers, agricultural burning during harvest, and relatively higher soil erosion (compared to the preferred alternative) would continue when soils are exposed after harvest.

These impacts would continue to occur adjacent to (and upwind of) Lihue, Kauai's primary population center. In addition, the site would continue to be under-utilized in terms of implementing the project objective of addressing the existing and future demand for new housing, civic, and employment opportunties. Therefore, this alternative was rejected.

8.3 RESIDENTIAL LAND USE/GOLF COURSE

The project area is also physically suited for golf course development which could be master planned with residential development. Residential land uses could easily be incorporated into a master plan to gain increased values for those lots fronting the golf course. Other benefits of golf development include enhanced opportunities for increased: 1) on-site retention of surface runoff, 2) open space 3) recreational opportunities, 4) less demand for infrastructure improvements including roadway and public services, and 5) disposal opportunties for treated wastewater. However, at the present time, the market demand for golf and increased real estate values for lots with golf frontage, does not economically offset the corresponding loss of new housing units and increased employment opportunities afforded by the preferred alternative.

Consequently, golf course development is not included in the conceptual development plan, even though the site is physically suited for golf course development. Should market conditions change in the future, or should the County require an alternative method to dispose of treated wastewater, the golf course alternative may be re-evaluated.

8.4 AGRICULTURAL SUBDIVISION

Assuming that the existing TMK parcels could be subdivided under the existing agricultural zoning to the maximum allowable density, approximately 100 agricultural lots with a maximum of 280 farm dwelling units could be developed within the project area.

According to the County of Kauai Zoning Ordinance, the purpose of permitting the subdivision of agricultural land is to: *"establish a relationship between the size of the parcel to be subdivided and the size of the smaller parcels created by the subdivision, in order to maintain large parcels for agricultural uses and activities best carried out on large parcels and to maintain and provide smaller parcels of various sizes for agricultural uses that can be carried out most efficiently on smaller parcels."* As such, the purpose of the agricultural zoning ordinance is to promote and protect smaller diversified agricultural operations where appropriate.

Given the close proximity of the project area to the existing urban land uses of Lihue, the establishment of small agricultural lots may not be appropriate. As described in Appendix G, two important factors must be present to establish viable diversified agriculture; 1) viable markets must exist for the crops produced, and 2) the land must have unique qualities that make it more appropriate for diversified agriculture than other less expensive lands not located adjacent to urban areas.

Because the project area is located adjacent to urban areas and other lands suitable for diversified agriculture are available elsewhere on Kauai and throughout the State, the alternative of subdividing the project area for diversified agriculture was rejected.

8.5 SUMMARY OF MAJOR IMPACTS

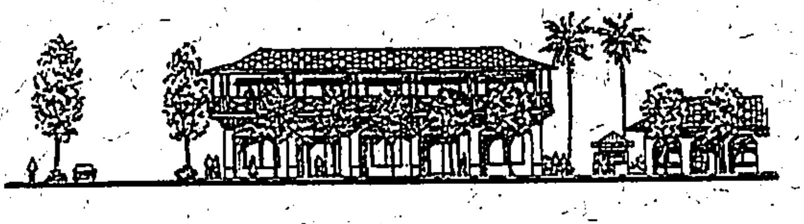
The major impacts associated with development of the Conceptual Master Plan are not unique to this project, but are typical of most residential, commercial, and industrial development. Traffic patterns will be altered, air and noise impacts will occur, and additional demands on existing water and wastewater infrastructure systems will result from the Lihue-Hanamaulu Master Plan. Although the proposed development will replace the open space character of the sugar cane lands, these lands do not provide any habitats for rare, threatened or endangered flora and fauna, and are not accessible to the public under the current agricultural land use. Additionally, there are no significant archaeological or historical resources.

Public services will also be impacted, especially education, and police and fire protection. However, social service costs may be reduced as new housing and employment opportunities are made available to Kauai residents. Additionally, new tax revenues will be generated which will largely mitigate the costs of most services provided by government. The net fiscal impact of the Conceptual Master Plan is expected to be positive.

It should be noted that all of the major Conceptual Master Plan related impacts identified can be mitigated by the development of new infrastructure and public service facilities. These improvements will be directly implemented in the conceptual master plan either from the collection of impact fees and/or new tax revenues generated by increased employment and construction. Consequently, no significant environmental effects will result from the Conceptual Master Plan provided appropriate mitigation measures are developed and implemented.

9.0

SUMMARY OF UNRESOLVED ISSUES



9.0 SUMMARY OF UNRESOLVED ISSUES

According to the Content Requirements, Section 11-200-17(n), of the Department of Health Environmental Impact Statement Administrative Rules, a summary of "unresolved issues" must be provided in the Draft EIS describing how such issues will be resolved and what overriding reasons there are for proceeding without resolving the issues. As herein described, the unresolved issues applicable to the Lihue-Hanamaulu Master Plan deal primarily with future actions and decisions of governmental bodies that cannot be determined at this time.

9.1 OVERVIEW

The Lihue-Hanamaulu Master Plan is conceptual at this stage of the land use approval process. Requests for State Land Use District Boundary and County General Plan amendments will provide broad urban classification of the property to allow detailed, site specific planning for the next levels of the approval process. As such, a number of issues remain unresolved.

Identified below are several issues discussed in this report that are presently unresolved but are in process of resolution. Resolution of these issues will occur over time for the following master plan land use components and the need for regional infrastructure and public facility improvements.

The unresolved issues include: 1) land use entitlements and development of the Lihue Debris Recycling Station by the County of Kauai, 2) completion of negotiations for the new police station and State Judiciary facilities, 3) development of the Tropical Fruit Disinfestation Facility by the University of Hawaii, 4) implementation of regional traffic "base" improvements by the State and County, 5) selection of appropriate treatment facilities for wastewater by the applicant and the County of Kauai, and 6) selection of a school site by the State Department of Education.

(1) Lihue Debris Recycling Station

The County of Kauai is presently seeking the necessary approvals for this project, which would recycle much of the debris remaining from Hurricane Iniki. Because this is a County of Kauai project to be located within the Lihue-Hanamaulu Master Plan area, LPCo, the current landowner, has little control over the ultimate design and development schedule of the facility. Consequently, environmental impacts such as litter, bird and vector animal control, and visual impact will ultimately be addressed by the County of Kauai.

(2) University of Hawaii Tropical Fruit Disinfestation Facility

This facility is presently located within that portion of the Lihue-Hanamaulu Master Plan presently designated as State Agricultural and Conservation District land. The University of Hawaii will design and seek land use entitlements separately from the permitting process for the Lihue-Hanamaulu Master Plan. Therefore, the environmental impacts associated with the disinfestation facility will ultimately be addressed by the University of Hawaii, through the approval of the Board of Land and Natural Resources.

Because these two elements of the Lihue-Hanamaulu Master Plan, the Recycling Station and Disinfestation Facility, are relatively independent components of the entitlement process, their status is "unresolved". However, it is assumed that the County of Kauai and the University of Hawaii will implement appropriate mitigative measures to successfully integrate their respective projects into the Lihue-Hanamaulu Master Plan. Both projects are urgently needed to mitigate the harmful impacts of Hurricane Iniki and economic damage of fruit fly infestation to agricultural products in Hawaii.

(3) Base Transportation Improvements

A third unresolved issue concerns the implementation of the "base" transportation improvements needed to accommodate future population growth with or without development of the proposed project. Two of the major base transportation improvements include the widening of Kapule Highway and Kuhio Highway as described in the Traffic Impact Assessment (Appendix E). Future transportation levels of service and overall traffic congestion will depend almost entirely on the State of Hawaii and County of Kauai providing transportation improvements that will be needed. Since these transportation improvements are required even without the project, they will likely be funded and implemented independently of the project.

(4) Wastewater Treatment and Disposal

Three options have been identified for the collection, treatment, and disposal of wastewater effluent to serve project requirements with the eventual dedication of the system to the County Department of Public Works. The options include; 1) expansion of the Lihue WWTP, 2) development of a new WWTP on the project site, and 3) a combination of these alternatives. Discussions between LPCo, Amfac/JMB, the County of Kauai, and the State Department of Transportation Airports Division are currently underway to determine the most efficient and feasible design for the system which could be beneficial to all parties. Consequently, the ultimate design of the wastewater system is presently being resolved.

(5) School Site

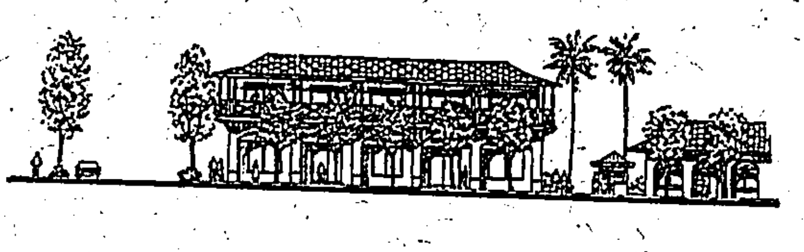
The Lihue-Hanamaulu Master Plan provides a 12-acre school site (of which four acres will serve as a community park) anticipating that school aged children will be generated by the new residential development. In their review of the project, the Department of Education has indicated an interest in other lands owned by Amfac/JMB located outside of the project area, specifically in Puhi. Amfac/JMB has provided the Department of Education with maps of other potential properties in the Puhi area for their review. Discussions and negotiations on a final site are pending and the final site selection remains unresolved.

9.2 CONCLUSION

All of the unresolved issues described will ultimately depend on close cooperation between the developer and various governmental bodies. Discussions between the parties are underway to resolve these issues by integrating their development into the Lihue-Hanamaulu Master Plan. If any of the public facilities or infrastructure cannot be implemented as planned by the State or County, the Lihue-Hanamaulu Master Plan can continue independently by planning for other compatible land uses in those areas. Over the 15 to 20 year development period, the Lihue-Hanamaulu Master Plan will evolve and change in accordance with the needs of the community and future population. The significant range of community and socio-economic benefits provided by the project warrants its immediate undertaking while simultaneously working with government agencies on the unresolved issues.

10.0

REFERENCES AND LIST OF PREPARERS



10.0 REFERENCES AND LIST OF PREPARERS

10.1 REFERENCES

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Wilson Okamoto & Associates. (1991). *Urban Land Requirements Study.* Honolulu, Hawaii.

10.2 PREPARERS OF THE ENVIRONMENTAL IMPACT STATEMENT

This Final EIS has been prepared by PBR HAWAII, Pacific Tower, Suite 650, 1001, Bishop Street, Honolulu, Hawaii 96813. The staff involved in the preparation of this document included:

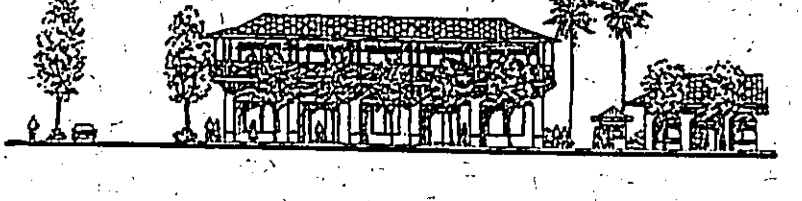
Thomas. S. Witten, ASLA	Executive Vice President
Yukie Y. Ohashi	Project Planner
David Hulse, AICP	Associate
Vincent Shigekuni	Associate
Toshiko Matsushita	Graphics
Guy Tsutsui	Graphics
Nadine Matsunaga	Production
Anne Furukawa	Production

Several key technical consultants were employed to provide specific assessments of environmental factors for this project. These consultants, their company affiliation, and their specialty are listed below:

Clyde Kodani, P.E.	Kodani & Associates	Civil Engineering
Stanford Iwamoto, P.E.	Kodani & Associates	Civil Engineering
Ted Kawahigashi, P.E.	Austin, Tsutsumi & Associates	Civil and Traffic
Lambert Yamashita, P.E.	Austin, Tsutsumi & Associates	Civil Engineering
Bob Cheung	Austin, Tsutsumi & Associates	Traffic Engineering
Yoichi Ebisu	Y. Ebisu and Associates	Noise Impact Assessment
Greg McCartney	Ogden Environmental	Air Quality Assessment
Dan Lum	Water Resource Engineering	Hydrology
Brad Mossman	Arthur Andersen Company	Market Study, Economic/Fiscal Study
Berna Cabacungan	Earthplan	Social Impact Assessment
Peter Garrod, Ph.D.	Evaluation Research Consultants	Agricultural Assessment
Paul H. Rosendahl, Ph.D.	Paul H. Rosendahl, Inc.	Archaeology Assessment
Richard Brock. Ph.D.	Environmental Assessment Co.	Marine Assessment
Ron Englund	Pacific Aquatic Environmental	Stream Assessment
Winona P. Char	Char and Associates	Botanical Assessment
Phil Bruner		Wildlife Assessment
Pat Hart	Pacific Aquatic Environmental	Wildlife Assessment

11.0

CONSULTED PARTIES AND PARTICIPANTS IN THE EIS PROCESS



11.0 CONSULTED PARTIES AND PARTICIPANTS IN THE EIS PROCESS

11.1 LIST OF GOVERNMENT AGENCIES CONSULTED IN THE PREPARATION OF THE EIS

The following list includes governmental agencies who have been contacted as part of the pre-consultation process for the preparation of the Environmental Assessment and the Draft and Final EIS.

COUNTY OF KAUAI
Planning Department
Department of Public Works
Department of Water
Kauai Historic Preservation Review Committee
Office of Economic Development
Fire Department
Police Department
Former Mayor Jo Ann Yukimura
Mayor Maryanne Kusaka
Councilmembers:
- William "Kaipo" Asing
- Maxine Correa
- Jessie Fukushima
- Ronald Kouchi
- Richard Minatoya
- Nelson Secretario
- Randal Valenciano

Former Councilmembers:
- Joe Munechika
- Jimmy Tehada

State Legislators:
- Lehua Fernandez-Salling
- Bertha Kawakami
- Ezra Kahoho

STATE AGENCIES
Department of Accounting and General Services
Department of Agriculture
Department of Business, Economic Development and Tourism
DBEDT State Energy Office
Department of Defense

Department of Education
Department of Hawaiian Home Lands
Department of Health
Department of Land and Natural Resources
- Division of Aquatic Resources
- Commission of Water Resource Management
- State Historic Preservation Division

Department of Transportation - Airports Division
Department of Transportation - Highways Division
Housing Finance and Development Corporation
Office of Environmental Quality Control
Office of Hawaiian Affairs
Office of State Planning

STATE OF HAWAII- KAUAI BRANCHES
Department of Transportation - Highways Division
Department of Transportation - Airports Division (Lihue Airport)
Judiciary - Fifth Circuit Court
Department of Health
Department of Education

FEDERAL AGENCIES
Federal Aviation Administration
U.S. Army Corps of Engineers
U.S. Department of Agriculture, Animal Damage Control
U.S. Department of Agriculture, Natural Resources Conservation Service
U.S. Department of the Interior - Fish and Wildlife Service
U.S. Geological Survey

PUBLIC UTILITIES
Hawaiian Telephone Company
Kauai Electric Company

11.2 LIST OF ORGANIZATIONS AND INDIVIDUALS CONTACTED IN PREPARATION OF THE EIS

As part of its community involvement process, staff of Amfac/JMB met with numerous individuals and representatives of organizations to discuss the project and to solicit their input to the planning process. In addition, the project's social impact consultant surveyed 61 individuals with diverse personal and professional backgrounds; a list is provided in the Social Impact Asessment in Appendix P. Listed below are organizations and individuals which have been contacted and consulted in the planning process.

ORGANIZATIONS

Catholic Charities of Hawaii
Contractors Association of Kauai
Grove Farm
Hanamaulu Community Association
Hawaii Visitors Bureau
ILWU
Kauai Economic Development Board
Kauai Realty
Kauai Chamber of Commerce
Kauai Veterans Association
Kikiaola Land Co.
Molokoa Community Association
Rotary Club of Kauai
Teen 4 Teens
Wilcox Memorial Hospital
YMCA

INDIVIDUALS

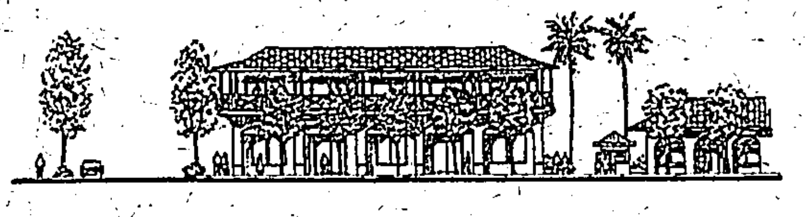
Clayton Arinaga - Kauai Police SHOPO Union
Gary Baldwin - National Rent A Car
Hartwell Blake - County Attorney
Hilda Cannon - Catholic Charities of Hawaii
Connie Clausen - Greenstar Recycling Program
Manuel Corregador - Kauai Veteran's Association
Hollis Crozier - Cybertel Cellular
Carol Cummings - Kauai Realty
Clayton Dela Cruz -ILWU
Tom Dinnell - Catholic Charities of Hawaii
Billy Fernandes - Kauai Veteran's Association
Ralph Fujinaka - Lihue Credit Union
Calvin Fujita - KPD Police Chief
Brian Fujiuchi - KPD Deputy Police Chief
Charlene Garcia - Lihue Credit Union
Bob Girald - ILWU
Hoby Goodale - Garden Island Motors
Wynnis Grow - Public Relations Consultant
Fr. Clyde Guerrero - Immaculate Conception Church
Jack and Beverly Harter - Jack Harter Helicoptors
Bradley Hirano - Postmaster, Lihue Post Office
Ted Inouye - Hanamaulu Resident
John Iwamoto - Kauai Veterans Association
Bill Jessup - Moloa'a Farmers Coop
Lynn and Sarah Joseph - Teens 4 Teens

Aaron Kakinami - Attorney at Law
Michael Kano - Kauai Fire Department
Sue Kanoho - Kauai Economic Development Board
Bobby Keao - Niu Construction
Willie Keao - Niu Construction
Melvin Kihara - Kauai Chamber of Commerce
Maurice Lardizabal - Filipino Community
Ann Leighton - Bicycling and Fitness Community
Don Lindsey - Young Brothers
Cheryl Lovell-Obatake - Kauai Burial Council
Richard Maeda - Kauai Builders
Russell Maeda - Kauai Builders
Christine Matsumoto - Hawaii Visitors Bureau
Jim Mayfield - Bank of Hawaii
Tad Miura, Jr. - M. Miura Store
Tad Miura, Sr. - Kauai Realty
Garrett Miyake - Honsador Co.
Mel Morris - KPD Police Captain
Debbie Mullen - Fitness Trainer
Conrad Murashige, Shioi Construction Inc.
Haruo "Dyna" Nakamoto - Retired, ILWU
Brian Nishimoto - Molokoa Resident
Randall Nishimura - Ron's Electric
Ken Ono - Wilcox Hospital Board
Jonathan Ota - Tip Top Bakery
Jim Pappas - Honsador Co.
Warren Perry - Attorney at Law
Cesar Portugal - Engineer
David Proudfoot - Attorney at Law
W. Neil Rapozo - Lihue Chevron Service Station
Robbie Rask - R. Electric Co.
Wayne Richardson - RHK Enterprise
Eddie Sarita - Hanamaulu Community Association
Dee Schultz - Kauai YMCA
Paul Shinseki - Molokoa Community Association
Conrad Murashige - Shioi Construction, Inc.
Walter "Freckles" Smith - Smith Boat Tours
Karen Taketa - Kauai Contractors Association of Kauai
Mark Tanaka - Kauai Realty
Tom Tannery - Kauai YMCA
Florence Tazaki - Lihue Credit Union
George Toyofuku - Mokihana Insurance Co.
Leroy Wadahara - Seiwa Massage
Tom Warling - Wong Care Home

Steve Williams - First Hawaiian Bank
Noboru Yamane - Hawaiian Airlines
Tom Yano - Attorney at Law
Barry Yap - Hawaii Visitors Bureau
Darcie Yukimura - Teens 4 Teens
Lani Yukimura - Wilcox Hospital

12.0

COMMENTS AND RESPONSES



12.0 COMMENTS AND RESPONSES

The public comment period as required by Chapter 343, Hawaii Revised Statutes, on the Draft EIS and the EA/NOP for the Lihue-Hanamaulu Master Plan resulted in the following responses from governmental agencies. The agency letters and responses prepared by the planning consultant are also included in this section.

12.1 COMMENTS RECEIVED ON THE DRAFT EIS

<u>COUNTY OF KAUAI</u>
Department of Public Works
Department of Water
Kauai Historic Preservation Commission
Police Department

<u>STATE AGENCIES</u>
Department of Accounting and General Services
Department of Business and Economic Development & Tourism - Energy Division
Department of Business and Economic Development & Tourism - Land Use Commission
Department of Defense - Civil Defense
Department of Education
Department of Health
Department of Land and Natural Resources
Department of Land and Natural Resources - Historic Preservation Division
Housing Finance Development Corporation
Office of State Planning
University of Hawaii Environmental Center

<u>FEDERAL AGENCIES</u>
Department of the Navy

<u>COMMUNITY INDIVIDUALS</u>
Cheryl Lovell-Obatake

12.2 DRAFT EIS COMMENT LETTERS AND THE APPLICANT'S RESPONSES

The following section includes letters sent to the Land Use Commission in response to the Draft EIS for the Lihue-Hanamaulu Master Plan. Responses to the comments have been prepared by PBR HAWAII on behalf of The Lihue Plantation Company and Amfac/JMB, Inc.

JOANN A. YUKIMURA
MAYOR

DEC - 1 [illegible]

ELDON FRANKLIN
COUNTY ENGINEER
TELEPHONE 241-6600

EDMOND P.K. RENAUD
DEP. COUNTY ENGINEER
TELEPHONE 241-6600

AN EQUAL OPPORTUNITY EMPLOYER
COUNTY OF KAUAI
DEPARTMENT OF PUBLIC WORKS
3021 UMI STREET
LIHUE, KAUAI, HAWAII 96766

November 28, 1994

Ms. Esther Ueda, Executive Officer
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

RE: DRAFT EIS LIHUE-HANAMAULU MASTERPLAN

Reference is made to your letter dated October 14, 1994 regarding the draft EIS for the Lihue-Hanamaulu Masterplan. We would like to offer the following comments.

1. <u>DRAINAGE</u>

We are in favor of providing retention and/or detention basins to keep storm runoff to predevelopment rates as proposed in the drainage masterplan. We also like the combination park/detention basin concept. However, we have some concerns which are as follows:

a. We have accepted the idea of developing park sites which can also serve as a detention basin. This idea eliminates the need to develop costly downstream structural improvements. However, a combination park/detention basin must first serve as a park with the detention basin secondary to the park. A combination park/detention should not become totally inundated by the more frequent storms causing active recreational activities such as soccer, football and even baseball to be curtailed until the ponds recedes and the field dries out. Comfort stations and other structures built on fills will reduce ponding capacities. Consequently, if there is a County requirement to dedicate lands for recreational uses, we believe that the required lands for active recreational purposes should be in addition to that required for detention basin purposes.

We are suggesting that the drainage detention basin proposals with the ponding of flood waters for various storms be presented and discussed with "County Decision Makers" and decisions on additional lands for recreational purposes be obtained.

b. A 10 acre park/detention basin is proposed in Ahukini Mauka area. Flow depths in the park will vary in depth from 2 feet, 3 feet, and 5 feet depending upon the storm frequency. (The park is proposed to have 3 levels of flooding). We are concerned with safety due to the deep flood depths. We're also concerned with the usage of the park for recreational uses since the park is expected to be graded at three levels. Recreational needs of the park will also need to be considered and addressed as noted above.

c. Storm water will be directed into the cane lands at the Hanamaulu site. The report mentions that there are no buildings and that the lower lands are in cane production; therefore, no adverse drainage impacts are expected. We have dealt with Lihue Plantation who have in the past informed us of cane and cane land damages as a result of drainage discharges into their lands from residential development. If no adverse drainage impacts are expected, then Lihue Plantation must accept flowages and it's consequences from the development of the Hanamaulu site and these rights should be extended to any developer who develops the Hanamaulu site. If there is adverse drainage impacts, the drainage masterplan must incorporate drainage improvements to handle the storm runoffs from the development of the Hanamaulu site which we believe should also consist of detention basins.

d. The report mentions that AMFAC/JMB will work with the State to develop the drainage system through the State of Hawaii, Airports property when developing the Ahukini Makai site. We are presuming that AMFAC/JMB will extend these commitments to any party who develops the Ahukini Makai site.

e. Molokoa II drains through an existing 36 inch culvert under Kapule Highway. The 36 inch culvert will be replaced by a new 60 inch culvert. Will additional storm flowages be directed to the downstream lands?

f. The Ahukini Mauka site will be drained through an existing ditch to the Hanamaulu Stream. We are concerned with ownership and maintenance of the ditch. We do not believe that Lihue Plantation would agree to own and maintain the ditch system that serves as the drainage system for the residential development. Flows to natural valleys or ditches that drains into the Hanamaulu Stream should be kept to predevelopment rates.

2. <u>TRAFFIC</u>

The report cites the recommended traffic improvements required in year 2006 and 2016 with and without the project. We would like to offer the following comments.

a. The report calls for the development of additional traffic lanes at the Rice Street/Hoolako Street and at the Kuhio Highway/Ahukini Road intersections. Acquisition of additional right-of-ways to facilitate the additional lanes may be prohibitive due to the already built up frontages along both roadways.

We concur with the report that traffic improvements need to be implemented with or without the project but moreso, with the project. Otherwise, there will be increased delay and congestion during the peak morning and afternoon traffic periods as well as the increased usage of existing streets such as Umi, Hardy, Malae and Kaana Streets.

Due to the limitation of Kuhio Highway and Rice Street to accommodate additional lanes, consideration should be given to an additional roadway through Amfac's proposal development paralleling Ahukini Road and connecting to Kuhio Highway between the Wilcox Hospital and Ahukini Road. Also, an extension of Poinciana Street, if possible, mauka to the future mauka bypass road should be looked at as another alternative to the additional lanes.

b. We believe that traffic will also be generated on County roadways such as Umi Street, Malae Street, Kaana Street and Hardy Street. The existing County roadways needs to be upgraded to current roadway standards since they provide a direct access linkage between the development and to the various major roadways and the Lihue Civic Center Complex.

c. The access to the Ahukini Makai lands will be through Ahukini Road and a "future Ahukini Road and the "Mauka-Makai Road." The tax map show that the State, Airport Division have eliminated a section of Ahukini Road right of way that traverses through the airport's lot. A replacement interior roadway has been developed by the State Airports Division. We re not sure if the State can legally remove an existing roadway access and there may not be any problems as long as public access is permitted. However, for the development of the industrial park as well as the recycling station, disinfestation facility and the County's refuse transfer station the Mauka-Makai Roadway as well as the frontage road to service these developments need to be planned and constructed so that the lots are not landlocked and will have a legal access roadway.

3. <u>WASTEWATER</u>

While the draft EIS states that all wastewater treatment alternatives are currently being evaluated, and are being closely coordinated with the County, we offer the following comments.

a. A fourth alternative (an offshoot to alternative 3 of a new WWTP and expansion of the Lihue WWTP) should also be evaluated. This alternative would be to have all of the liquid treatment processes be located at the Lihue WWTP and all of the solids handling facilities at the site of the proposed new WWTP. It may be that the physical separation and operation of the liquid and solids treatment facilities respectively may be more cost effective that operating two entirely separate and independent treatment plants.

b. The owner/management aspects of the treatment alternatives involving a new WWTP should be addressed.

c. Effluent disposal from the new and/or expanded facilities is of major concern. The draft EIS proposes a near term solution of pumping treated effluent to be mixed with mill wash water and eventually reused to irrigate Lihue Plantation fields. Given the tenuous nature of the sugar industry, a more permanent means of effluent disposal should be implemented or at least fall back, alternative systems be provided.

The draft EIS address long term solutions for effluent disposal. These solutions should be implemented immediately in conjunction and concurrently with build out of the subject plan. In addition to those long term alternatives listed, the developer should, in consultation with the State Department of Health, consider planning for and facilitating the implementation of the use of effluent for other non-domestic uses such as flushing toilets etc. The effluent reuse infrastructure should be installed with the various development projects.

Please contact Kenneth Kitabayashi at 241-6620 or Harry Funamura at 241-6610 if there are questions on the comments.

Very truly yours,

for ELDON FRANKLIN
County Engineer

KK/HF/mc

cc: Planning Dept.
PBR Hawaii

PBR
HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

Mr. Steve Oliver, County Engineer
County of Kauai
Department of Public Works
3021 Umi Street
Lihue, Hawaii 96766

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Dear Mr. Oliver:

We have reviewed your Department's letter of November 28, 1994 regarding the Draft EIS for the Lihue-Hanamaulu Master Plan. The developer, Amfac/JMB Hawaii, Inc. ("Amfac"), PBR Hawaii, and civil engineers for the project, Kodani & Associates and Austin, Tsutsumi & Associates ("ATA") have met with several of your staff at the Department of Public Works ("DPW") in the review process of the Draft EIS; we appreciate the consultation which have been provided. We offer the following responses to the issues and comments which have been raised.

1. DRAINAGE

a. Combination Park/Detention Basin: We note that the DPW staff favors the dual use concept of park and stormwater detention basin, however, you express some concern about the park's ability to function for recreational purposes during periods of inundation.

As described in the Section 5.8.5 and Appendix D of the Final EIS, active recreational areas will be located above the base 100-year flood elevation. All other park areas will be located above the 2-year 24-hour flood elevation to ensure that the more heavily used portions of the park does not become flooded during the more frequent storm event. Depth of standing water, except the area directly adjacent to the outlet, shall be kept relatively shallow for liability and safety purposes. Where appropriate, the area near the outlet will be fenced off. The project has been planned to provide adequate land area to meet park dedication requirements and the detention basin needs of the project.

The Drainage Master Plan by Kodani & Associates which is published in the Final EIS as Appendix D described the use of shallow park/detention basins to mitigate the effects of increased runoff on downstream areas. The storm drainage system will be designed to County of Kauai and State Department of Health standards with the intent that the infrastructure improvements will be dedicated to the County. In developing this project, Amfac intends to incorporate Best Management Practices, such as detention basins, buffer strips, and biofiltration channels to ensure that no adverse impacts occur to downstream areas.

b. Ahukini Mauka Park Peak Discharge: In response to your comments, Kodani and Associates has recalculated peak discharges for the 100-year 24-hour storm and revised the planned park/detention basins in Ahukini Mauka to comply with the "shallow detention guidelines" discussed above. In order to accomplish this the peak discharges increase from 850 cfs before the development to 1,160 cfs after development even with the use of park/detention facilities. However, because this increase in discharge represents less than one percent of the total peak discharge of Hanamaulu Stream, the rise in the base flood elevation downstream of the outlet was less than 0.1 foot and will not have an adverse impact on downstream properties.

This change has been evaluated by the stream and marine biological consultants as described in Sections 4.6 and 4.7. Their conclusions as to the impact to Hanamaulu Stream and Hanamaulu Bay were based on the relative small size of the Project Area (three percent) compared to the overall watershed which drains to the stream and ultimately to the bay. Consequently, no significant drainage related impacts are anticipated relative to Hanamaulu Stream or Hanamaulu Bay.

c. Impact to Sugar Land From Hanamaulu Drainage: Increased runoff from the Hanamaulu area to the cane field makai of Kapule Highway can be expected with the development of the Hanamaulu site. Lihue Plantation Company will accept these additional flows and will provide measures as necessary to mitigate any adverse drainage impacts to their cane fields. The acceptance of these additional flows will be extended to any developer that develops these sites.

d. Drainage Improvements Through Lihue Airport Property: The development of drainage facilities through the Ahukini Makai parcel of the project will also pass over Lihue Airport property. Discussions about infrastructure development for the project and as potential shared development between Amfac and the State Department of Transportation Airports Division have been on-going. Any negotiated commitments with the Master Developer and accepted by the State will be extended to any third party builder and/or sub-developer.

e. Runoff Levels from Molokoa II: Additional runoff from Molokoa II will flow through a short stretch of swale area on Kauai Lagoons property before it combines with flows from the Molokoa I area and other upstream areas. An evaluation of the swale area was done as part of the Preliminary Engineering Report on Drainage and it was determined that sufficient capacity to accommodate this runoff was available and no adverse impacts are anticipated.

The combined flows from Molokoa I and Molokoa II will be kept at pre-development levels through the use of detention facilities and other best management practices.

f. Ahukini Mauka Flows to Hanamaulu Stream: With the development of the Ahukini Mauka area, the existing agricultural irrigation ditches in that area that are currently owned by Lihue Plantation will no longer be required or maintained. Since some of the irrigation ditches also serve as drainage ditches, flows to these ditches will be evaluated and mitigative measures taken as necessary to ensure that these conveyance systems can accommodate the developed condition flows with no adverse impact. Flows to natural gullies and swales will be similarly evaluated.

Kodani has re-calculated the flows at project buildout to address the County's park/detention basin dual use concern and has determined that the flows will be increased by approximately 25 percent at peak periods (100-year 24-hour storm events). This issue has been evaluated by the marine and stream consultants for its impact to the receiving waters and it has been determined that no overall impact to the aquatic biota is expected since the project area represents only three percent of the total watershed draining to Hanamaulu Stream and Bay. References to these studies are included in Sections 4.6 and 4.7 and Appendices H, H-1, I, and I-1.

2. TRAFFIC

a. Additional Traffic Lanes: We concur with the County that acquisition of rights-of-way for roadway widening may be difficult due to existing build-out conditions along Rice Street and along Kuhio Highway. However, when Lihue Town, between Rice Street and Ahukini Road, is studied relative to location for a new mauka/makai and new north/south streets, Austin Tsutsumi Associates, Inc. (ATA) determined that there are no other options. Therefore, based upon current studies for long-term and short-term roadway requirements, with or without this project, Rice Street and Ahukini Road are the only roadways that can provide for the mauka/makai movement of traffic. In the north/south direction, Hoolako Street and Kapule Highway are the primary existing roadways. A bypass road mauka of Lihue would provide relief for Kuhio Highway. Therefore, ATA still recommends that Rice Street be widened to provide for four through lanes and separate turning lanes at each intersection, including the Hoolako Street intersection.

If widening does not occur, additional traffic congestion would be expected. However, at the Kuhio Highway and Ahukini Road intersection, ATA will reassess its recommendation for double turning lanes. It may be that this intersection may have to operate at less than desirable conditions during the peak periods of traffic.

Regarding a new mauka/makai road paralleling Ahukini Road through Amfac's proposed development area between Kapule Highway and Kuhio Highway at Wilcox Hospital, it would not be possible since the area between Weinberg's property and Wilcox Hospital is not owned by either Amfac or the County. Further, ATA's assessment indicates that this roadway would not attract enough traffic to warrant its construction.

At this time, extending Poinciana Street mauka to a future Lihue Bypass Road will be considered under the State Department of Transportation's Update of the Kauai Land Transportation Master Plan Project. It certainly could provide some relief to the future Kuhio Highway/Ahukini Road intersection when Ahukini Road is realigned and extended to the future bypass road.

b. Roadway Circulation System: We concur that the existing internal Lihue roads, such as Kaana Street, Umi Street, Hardy Street and Malae Street will receive increased traffic volumes. However the users of these streets will most likely be primarily motorists who already live in this general area. The roadway improvements recommended in the traffic report encourage through traffic from outside the area to use the major collector roads and not the internal roads. The intent is to keep the internal roadway's rights-of-way as they exist in order to discourage through traffic from using these roads. However, we concur that where the existing pavement widths are narrow, say 18 feet or less, the pavement should be widened to a minimum of 20 feet and, preferably, to 22 feet in width.

c. Access Considerations Along Ahukini Road: We concur with your comments on the need to jointly plan access to the proposed Ahukini Makai industrial area, County refuse transfer station and recycling station, and the disinfestation facility. We have had several meetings with the State Airports Division to address issues such as this one and coordinated infrastructure development. These discussions will continue.

3. WASTEWATER

a. Fourth Alternative: A fourth alternative of splitting the liquid treatment process and solids handling facility will be evaluated in the Final EIS document. This alternative would involve the expansion of the existing Lihue WWTP to accept the liquid stream portion of the net estimated 1.51 mgd of wastewater generated flows from the proposed development. Under this alternative, however, the solids stream portion of the new and old flows, would be pumped to an alternate site approximately two miles away in Ahukini Makai. Here, the solids stream would be processed and disposed off site, with the liquid stream being returned back to the existing WWTP. See Section 5.8.3 and Appendix A of the Final EIS.

b. Ownership/Management Aspects of the Treatment Alternatives: Depending on the alternative selected, the Owner/Management aspects of the treatment may be either Developer-owned and -operated or dedicated to the County. Alternative Nos. 1, 2, and 4 would be dedicated to the County. Alternative No. 3 would be a combination of Developer-owned and -operated and dedicated to the County. Under this third alternative, approximately 0.7 mgd of the estimated total flow would be directed to an expanded existing WWTP. This expansion would be dedicated to the County. The balance of the flow, approximately 0.8 mgd, would be directed to a private WWTP situated within Ahukini Makai. This plant would be owned and operated by Amfac and/or the Association. See Appendix A of the Final EIS.

c. Long-term Solution for Effluent Disposal: The use of treated effluent, mixed with mill wash water and reused to irrigate Lihue plantation fields, can be considered both a near-term as well as a long-term solution. Should the sugar industry become a non-viable alternative, Amfac will work with the county to develop a permanent disposal system. One alternative may be granting easements to allow the County to dispose of effluent on pasture land previously used to grow sugar cane. In the future, other long-term solutions for effluent disposal may become available, including re-use on pastureland, roadway and public landscape irrigation, and use on golf courses. These alternatives may be reviewed in the future and as the demand for irrigation water increases, the disposal of the effluent may be shifted from "previous sugar cane land" to more productive use.

We appreciate your review and comments on the Draft EIS; your concerns are addressed in the Final EIS. Please contact us if you have any questions or require additional information.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi

Yukie Y. Ohashi
Project Planner

cc: Ms. Esther Ueda, Land Use Commission

1144.01\rl-dpw.w60

DEPARTMENT OF WATER
COUNTY OF KAUAI
P.O. BOX 1706
LIHUE, HAWAII 96766-5706
PHONE NO: (808) 245-6986 FAX NO. 245-5813

DEC 1 ?

December 7, 1994

Ms. Ester Ueda
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, HI 96813

RE: Petition for Amendment to the State Land Use District Boundaries, A94-703/The Lihue Plantation Co., Ltd. Agricultural and Conservation to Urban. Hanamaulu and Kalapaki, Kauai. TMK: 3-6-2: Por. 1, Por. 4, and 17, 3-7-1: Por. 1; 3-7-2: Por. 1 and Por. 12, and 3-7-3: Por 20.

We have no objections to this General Plan Amendment. However, any actual subdivision or development will be dependent on the adequacy of the Source, Storage and Transmission facilities existing at that time. At the present time, the proposed development is outside of the Department of Water, County of Kauai's full-growth service area. The existing Source, Storage and Transmission facilities are not adequate to handle the proposed demands of this development.

Prior to granting approval for any actual subdivision or development of the area, the applicant must:

1. Prepare and receive Department of Water's approval of a Water Master Plan for full development of this area, along with hydraulic calculations and details of the proposed water system improvements.

2. Develop additional Source, Storage and Transmission facilities which are required as part of the approved water master plan for the proposed development.

Murl T. Nielsen
Manager and Chief Engineer

ED:dc
cc: Timothy Johns, Amfac/JMB Hawaii
Yukie Ohashi, PBR Hawaii

PBR HAWAII

LANDSCAPE ARCHITECTURE
PLANNING
ENVIRONMENTAL STUDIES

January 12, 1995

Mr. Murl T. Nielsen, Manager and Chief Engineer
Department of Water
County of Kauai
P.O. Box 1706
Lihue, Hawaii 96766-5706

**SUBJECT: LIHUE-HANAMAULU MASTER PLAN
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)**

Dear Mr. Nielsen:

We have reviewed your letter of December 7, 1994 regarding the Petition for Amendment to the State Land Use District Boundaries for the Lihue-Hanamaulu Master Plan and offer the following clarification and responses to your comments.

1. Clarification of the Approvals Being Sought

The Lihue-Hanamaulu Master Plan project proposed by Amfac/JMB Hawaii, Inc.("Amfac") and The Lihue Plantation Company, Limited, is presently pursuing a State Land Use District Boundary Amendment through the Land Use Commission to reclassify approximately 555 acres of Agricultural and Conservation District land to the Urban District. Concurrently, we have filed a County of Kauai General Plan Amendment Petition request to amend the Lihue General Plan map to Urban Mixed Use to allow the project. Both of these actions require Chapter 343, Hawaii Revised Statutes compliance, hence, the Draft EIS has been prepared and is now in process of being finalized.

2. Development of Water Source, Storage and Transmission Facilities

We are aware that the County's water system presently does not serve the project area due to its agricultural land use. We are also aware that the County's existing water system infrastructure is inadequate to service the proposed project. We have, therefore, prepared engineering studies for the development of a water system to meet the requirements of the project. Water Resource Associates has prepared a hydrological study and identified two areas for exploratory well sites on Amfac land several miles mauka of the project boundaries. The study, including hydraulic calculations, is discussed in Section 5.8.2 and in Appendix C of the Final EIS. Kodani and Associates, civil engineer for water supply facilities, has calculated the potable water demand for the project and planned the storage and transmission system. In summary, at full buildout, the project will require approximately 1.78 million gallons per day ("MGD") of the 40 MGD sustainable yield within the Lihue sector, Hanamaulu Aquifer. Nine new wells and two new storage reservoirs, as well as transmission lines

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung

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BRANCH OFFICE: HILO LAGOON CENTER 101 AUPUNI STREET, SUITE 310 HILO, HAWAII 96720 TELEPHONE 808 961-3333 FAX 808 961-4989

are proposed. The water system is being designed to County standards with the anticipation that it will tie into the County's system and ultimately be dedicated to the County. Amfac and its representatives will be continuing discussions with the County Department of Water.

3. Development of a Water Master Plan

A Preliminary Engineering Report for Water Requirements, including the information cited above, has been prepared by Kodani & Associates and is included in the EIS as Appendix B. At the appropriate time in the development process, water source development and pumping permits will be requested from the State Commission on Water Resource Management. In addition, Amfac and its civil engineering consultant, Kodani & Associates, Inc. and hydrologist, Water Resource Associates, will prepare and seek your Department's approval of a Water Master Plan for full development of this area.

We appreciate your review and comments on the Draft EIS; your concerns are addressed in the Final EIS. Please contact us if you have any questions or require additional information.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi

Yukie Y. Ohashi
Project Planner

cc: Ms. Esther Ueda, Land Use Commission

1144.01\rl-15.w60

JOANN A. YUKIMURA
MAYOR

COUNTY OF KAUAI
PLANNING DEPARTMENT
4444 RICE STREET, SUITE 473
LIHUE, KAUAI, HAWAII 96766

DEE M. CROWELL
PLANNING DIRECTOR

NEIL L. AALAND
DEPUTY PLANNING DIRECTOR

TELEPHONE (808) 241-6677
FAX (808) 241-6699

November 4, 1994

Mr. Michael Machado, Chairman
Kauai Planning Commission
4444 Rice Street, Suite 473
Lihue, HI 96766

SUBJECT: JMB-AMFAC
LIHUE-HANAMAULU MASTER PLAN
TMK Nos. 3-6-2:01 and 4 (pors.); 3-6-2:17; 3-6-2:20 (por.); 3-7-1:01 (por.); 3-7-2:01 and 12 (pors.); 3-7-3:20 (por.), Kalapaki & Hanamaulu, Lihue District

The Kauai Historic Preservation Review Commission (KHPRC), at its meeting held on November 3, 1994, reviewed the Draft Environmental Impact Statement for the above referenced.

The KHPRC accepted the archaeological report with the condition that if any archaeological finds occur during construction, the applicant shall stop work immediately and notify the State Historic Preservation Division of the Department of Land & Natural Resources (1-808-587-0047) and the County Planning Department (241-6677).

The KHPRC also recommended that incorporating the radio station building into the plans be considered and that further study of the building by a preservation architect for rehabilitation costs and a preservation plan, including but not limited to, measured drawings and black & white photographs be made.

Danita Aiu

DANITA AIU
Chairperson
KAUAI HISTORIC PRESERVATION REVIEW COMMISSION

cc: Applicant

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

Ms. Danita Aiu, Chairperson
Kauai Historic Preservation Review Commission
County of Kauai
Planning Department
4444 Rice Street, Suite 473
Lihue, Kauai, Hawaii 96766

**SUBJECT: LIHUE-HANAMAULU MASTER PLAN
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)**

Dear Ms. Aiu:

We are in receipt of your letter dated November 4, 1994 regarding the Draft EIS for the Lihue-Hanamaulu Master Plan and offer the following responses to your comments.

1. Acceptance of the Archaeological Report

We note Kauai Historic Preservation Review Commission's (KHPRC) acceptance of the archaeological report that was prepared for the project and the condition noted in your letter. We are revising Section 5.1 Archaeological and Historic Resources to read as follows (additions are underlined):

> *"However, in accordance with DLNR's and the Kauai Historic Preservation Review Commission's recommendation, should subsurface remains, artifacts, deposits of charcoal or shells be found during construction activities, work in the area will be stopped immediately and the Department of Land and Natural Resources and the County Planning Department will be contacted to determine the significance of the site and to identify appropriate mitigation measures."*

2. Site 9402

In response to comments from DLNR-State Historic Preservation Division, the project archaeologist has obtained information on the historic building which was constructed in 1930 to house Kauai's first radio station. It has been determined by SHPD that the site is important for informational content.

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung
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With regard to KHPRC's request, Amfac/JMB Hawaii Inc. is presently in the process of retaining a preservation architect to study the radio station building to determine the feasibility of rehabilitation and, if appropriate, to prepare a preservation plan, including estimating rehabilitation costs. At the very least, the architect selected will gather historical information about the building, including measured drawings and black and white photographs. When a preliminary report and recommendations are available from the architect, Amfac would appreciate the opportunity to present this information to the KHPRC.

We appreciate your review and comments on the Draft EIS; your concerns are addressed in the Final EIS. Please contact us if you have any questions or require additional information.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi
Project Planner

cc: Ms. Esther Ueda, Land Use Commission

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AN EQUAL OPPORTUNITY EMPLOYER

OUR REFERENCE

YOUR REFERENCE

POLICE DEPARTMENT

COUNTY OF KAUAI

3060 UMI STREET
LIHUE, HAWAII 96766
TELEPHONE 241-6711
FAX 241-6776

ADDRESS ALL COMMUNICATIONS TO

CALVIN C. FUJITA
CHIEF OF POLICE

December 12 1994

Ms. Esther Ueda
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, HI 96813

Dear Ms. Ueda:

Re: AMFAC/JMB Hawaii Lihue-Hanamaulu Master Plan Draft Environmental Impact Statement.

As Deputy Chief of the Kauai Police Department, on behalf of Police Chief Calvin C. Fujita, I wish to provide the following comments on the Draft Environmental Statement for the Amfac/JMB Hawaii Lihue-Hanamaulu Master Plan.

Several public facilities are planned to be located within the Amfac project. The Draft EIS states on page 2 - 7 that "the project Master Plan has identified a new police headquarters site adjacent to the planned Judiciary complex at Molokoa."

The Kauai Police Department is in dire need of a new headquarters building. The current station in Lihue was built in 1953 and is very outdated and overcrowded. There is presently no room available to install a much needed computer room. There is no space available to accommodate our crime lab and accompanying equipment. There is no space or drainage for showers.

In order to keep Kauai safe and secure for our residents, priority must be placed on building a new police headquarters.

The Kauai County Police Department, consisting of 139 sworn officers and 28 civilian support staff, strongly recommends approval of the Amfac/JMB Hawaii Lihue-Hanamaulu

Ms. Esther Ueda
December 12,1994
Page 2

Master Plan, which would provide for a new Police Headquarters and help us in our efforts to protect the people of Kauai and enhance the quality of life for our island.

Sincerely yours,

CALVIN C. FUJITA
Chief of Police

BRIAN S. FUJIUCHI
Deputy Chief of Police

cc: *Mr. Tim Johns, Amfac/JMB Hawaii*
Ms. Yukie Ohashi, PBR Hawaii

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

Mr. Calvin C. Fujita, Chief of Police
Mr. Brian S. Fujiuchi, Deputy Chief of Police
Police Department
County of Kauai
3060 Umi Street
Lihue, Kauai, Hawaii 96766

SUBJECT: LIHUE-HANAMAULU MASTER PLAN DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Dear Messrs. Fujita and Fujiuchi:

We have reviewed your letter of December 12, 1994 regarding the Draft EIS for the Lihue-Hanamaulu Master Plan. We note that your agency has reviewed the subject EIS and that the Kauai County Police Department recommends approval of the proposed project.

We appreciate your review of the Draft EIS. Please contact us if you have any questions or require additional information.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi
Project Planner

cc: Ms. Esther Ueda, Land Use Commission

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W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y.J. Chung

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Ms. Esther Ueda, Executive Officer
State Land Use Commission
335 Merchant Street
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Subject: Lihue-Hanamaulu Master Plan
Lihue, Kauai, Hawaii
DEIS

Thank you for the opportunity to review the subject document. We have no comments to offer.

If there are any questions, please have your staff contact Mr. Ralph Yukumoto of the Planning Branch at 586-0488.

Very truly yours,

Gordon Matsuoka

GORDON MATSUOKA
State Public Works Engineer

RY:jy
cc: Amfac/JMB Hawaii, Inc.
PBR Hawaii, Inc.
OEQC

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

Mr. Gordon Matsuoka, State Public Works Engineer
State of Hawaii
Department of Accounting and General Services
State Public Works Division
Kalanimoku Building
1151 Punchbowl Street
Honolulu, Hawaii 96813

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Dear Mr. Matsuoka:

We have reviewed your letter of November 28, 1994 regarding the Draft EIS for the Lihue-Hanamaulu Master Plan. We note that your agency has reviewed the subject EIS and has no comments to offer at this time.

Thank you for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi

Yukie Y. Ohashi
Project Planner

cc: Ms. Esther Ueda, Land Use Commission

1144.01\r1-09.w60

JOHN WAIHE
Governor
JEANNE K. SCHULTZ
Director
RICK EGGE
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE: (808) 587-3800 FAX: (808) 587-382.

October 19, 1994

Ms. Esther Ueda
Executive Officer
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Subject: Lihue Hanamaulu Master Plan
Draft Environmental Impact Statement
TMK: 3-6-2:01 and 4 (pors.); 3-6-2:17;
3-6-2:20 (por.); 3-7-1:01 (por.);
3-7-2:01 and 12 (pors.); 3-7-3:20 (por.)
Kalapaki and Hanamaulu, Lihue District, County of Kauai, Hawaii

This is to inform you that we have no comments on the subject Draft Environmental Impact Statement (DEIS).

Thank you for the opportunity to comment on the subject Draft EIS.

Sincerely,

Maurice H. Kaya
Energy Program Administrator

MHK/hkeis116

c: OEQC-Mr. Bruce Anderson
Amfac/JMB Hawaii, Inc.,-Mr. Timothy Johns
✓PBR Hawaii-Ms. Yukie Ohashi

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

Mr. Maurice H. Kaya, Administrator
Department of Business, Economic Development, and Tourism
Energy Division
335 Merchant Street, Room 110
Honolulu, Hawaii 96813

SUBJECT: LIHUE-HANAMAULU MASTER PLAN DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Dear Mr. Kaya:

We have reviewed your letter of October 19, 1994 regarding the Draft EIS for the Lihue-Hanamaulu Master Plan. We note that your agency has reviewed the subject EIS and has no comments to offer.

Thank you for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Yo Ohashi

Yukie Y. Ohashi
Project Planner

cc: Ms. Esther Ueda, Land Use Commission

1144.01\t1-01.w60

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung
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BRANCH OFFICE: HILO LAGOON CENTER 101 AUPUNI STREET, SUITE 310 HILO, HAWAII 96720 TELEPHONE: (808) 961-3333 FAX: (808) 961-1989

JOHN WAIHEE
GOVERNOR

ESTHER UEDA
EXECUTIVE OFFICER

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 587-3822

November 14, 1994

Ms. Yukie Ohashi
PBR Hawaii
Pacific Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Ms. Ohashi:

Subject: LUC Docket No. A94-703/Lihue Plantation Company, <u>Inc.: Draft Environmental Impact Statement (DEIS)</u>

We have reviewed the DEIS prepared for the subject docket and have the following comments:

1) On page 1-5, section 1.4, of the DEIS, there appears to be a discrepancy with the list of TMKs comprising the petition area. Specifically, TMK No.: 3-7-02: 1 (por.) and 12 (por.) are not included within the petition area as they are on page 1-3 while TMK No.: 3-7-01: 12 (por.), which is not part of the petition area, is listed. Also, TMK No.: 3-6-02: 17 is listed as a portion of when in fact the whole parcel is involved.

   Additionally, Figure 1-2 on page 1-6 of the DEIS does not include TMK No.: 3-6-02: 20 (por.) and does not identify TMK No.: 3-6-02: 4 as a portion of in the Molokoa planning area. This map also appears in Appendices D, E, and K.

2) Figures 1-2, 1-2C, 2-2, and 4-5 of the DEIS appear to incorrectly delineate the western boundary of the Ahukini Mauka planning area. This representation also appears in several of the maps in Appendices A, E, E-1, and K. Said representation does not reflect the boundary as amended by the First Amended Petition filed on October 11, 1994.

3) Based on LUC Boundary Interpretation No. 93-56 and the revised Exhibit 1 of the First Amended Petition (metes and bounds map), Figure 3-1 of the DEIS appears to inaccurately represent the project area boundary to exclude a portion of Conservation District lands within

parcel C of Ahukini Makai near the Hanamaulu-Ahukini Cutoff Road.

4) Appendix F (Market Analysis) does not include TMK No.: 3-6-02: 20 (por.) in its description of the petition area and does not reflect the new acreage as amended by the First Amended Petition. Additionally, Appendix M (Archaeological Inventory Survey) appears to leave out the approximately 12.873 acres of Conservation District lands in its description of the Ahukini Makai portion of the petition area on pages ii and 5. Also, this area does not appear to be included in Figure 1. Please clarify whether this area was included in the survey.

5) A projected breakdown of the 1,400-1,800 single and multi-family residential units by each price range shown on page 5-27 and Appendix F of the DEIS should be provided.

6) Appendices B and D provide cost estimates for the water system and drainage improvements, respectively, that are necessitated by the project. However, no on-site and off-site costs are provided for the project's wastewater collection, treatment, and disposal options; roadway improvements; and construction of the residential, commercial, and industrial units. A breakdown of the estimated $55 to 65 million on-site and off-site costs of the development cited on page 2-20 of the DEIS should be provided.

7) Section 6.1 of the DEIS contains a general discussion of cumulative and secondary environmental impacts. A more thorough discussion on the cumulative impacts from the project and other related developments in the region as it pertains to the provision of public services and facilities should be provided.

8) By letter dated October 26, 1994 from Timothy E. Johns, Vice-President and General Manager, Real Estate Division, Oahu/Kauai Development, we were informed that the metes and bounds description for parcel D (Hanamaulu Triangle) of the petition area may change. Should the lengths, coordinates, or acreage change as a result of the field surveying and research, the appropriate maps and text in the DEIS as well as the metes and bounds map and description filed with the petition should be amended accordingly.

We have no other comments to offer at this time.

Should you have any questions on this matter, please feel free to call me or Bert Saruwatari of our office at 587-3822.

Sincerely,

ESTHER UEDA
Executive Officer

cc: Amfac/JMB Hawaii
Attn: Timothy Johns
OEQC

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

Ms. Esther Ueda, Executive Officer
Land Use Commission
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
LUC DOCKET NO. A94-703/LIHUE PLANTATION COMPANY
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Dear Ms. Ueda:

We have reviewed your letter of November 14, 1994 regarding the Draft EIS for the Lihue-Hanamaulu Master Plan. We have met with Mr. Bert Saruwatari of your staff to review your comments on the Draft EIS. We appreciate the consultation which has been provided. This letter addresses the questions and comments raised in your letter.

1. Clarification on TMK Numbers

We have reviewed the TMK numbers and corrected the text in Section 1.4 of the Draft EIS as follows:

The subject land is owned in fee in part by The Lihue Plantation Company, Limited ("LPCo"), in part by Amfac Property Development Corp., a Hawaii corporation ("APDC") and in part by Okada Trucking co., Ltd. ("Okada"). We have corrected the TMKs in the Final EIS:

TMK 3-6-2: 01, 4 & 20 (portions)
TMK 3-6-2: 17
TMK 3-7-1: 01 (portion)
TMK 3-7-2: 01 & 12 (portions)
TMK 3-7-3: 20 (portion)

We have revised the figures to include TMKs 3-6-02: 20 and 3-6-02:4 as portions of the planning area.

2. Figures Depicting Project Boundary

Figures 1-2, 1-2C, 2-2, and 4-5 as well as the figures in Appendices A, E, E-1 and K have been revised to be consistent with the First Amended Petition.

3. LUC Boundary Interpretation/First Amended Petition

We have reviewed the State Land Use Boundary map, the Revised Exhibit 1 survey map and the project boundary map and have adjusted the Conservation District line in Parcel C as shown in Figure 3-1. The corrected line does not change the Conservation District land area of 12.873 acres.

4. Market Analysis (Appendix F) - 3-6-02: 20 and Archaeological Report (Appendix M)

Market Analysis (Appendix F) - TMK: 3-6-02: 20

Parcel 3-6-02: 20 is owned and will be developed by Okada Trucking Company. Although it is included in the Petition Area, it is not planned for any land use as proposed by the Lihue-Hanamaulu Master Plan. Consequently, Amfac's Market Study does not include this parcel.

As stated in the First Amended Petition for Land Use Boundary Amendment (Dwyer Imanaka Schraff Kudo Meyer & Fujimoto), portions of Parcel 3-6-02: 20 that are within the Petition Area are currently owned by Okada Trucking Co., Ltd. Amfac conveyed this land to Okada in December 1992, together with lands included in the Molokoa Subdivision - Unit III. The conveyed lands were contained in one existing lot, the boundaries of which did not conform to the existing Agricultural-Urban district boundary. Amfac and Okada have agreed to reconfigure the Okada Parcel after the conveyance to match the existing Agricultural-Urban district boundary. As such, Okada has agreed to convey to Amfac the portions of TMK: 3-6-02: 20 within the Petition Area once the Okada Parcel is legally resubdivided.

Archaeological Report (Appendix M)

We have confirmed with the project archaeologist, Paul H. Rosendahl, Ph.D. Inc. ("PHRI"), that the archaeological assessment survey included the Conservation District land. All lands on the flat plateau, including the Conservation District land, up to the edge of the Hanamaulu Gulch slope, were surveyed according to Alan Walker of PHRI. The reference to "c.131.0 acres" on page ii of the Archaeological Inventory Survey (Appendix M) refers to the Agricultural District portion of the Ahukini Makai project area. Reference to the 12.873-acre Conservation District portion was inadvertently omitted. The report in Appendix M has been corrected to reflect the full extent of the survey.

5. Projected Price Breakdown for Residential Units.

As the Master Developer for the Lihue-Hanamaulu Master Plan, Amfac's role is to develop the land and infrastructure, much like its successful Waikele Planned Development in Central Oahu. Amfac will similarly contract with third party builders and sub-developers to construct residential and commercial/industrial subdevelopments at Lihue-Hanamaulu. The specific apportioning of the types and quantities of product will be determined through the coordinated effort of Amfac and the third party developer(s). Moreover, it is our understanding that the Land Use Commission will specify a ratio of affordable and market priced residential units. Consequently, a detailed breakdown of the number of units for the different product types has not yet been determined and it is therefore, premature to provide a detailed breakdown of the number of units in the different price ranges. We have discussed this with Mr. Saruwatari and received his concurrence in this matter.

6. Approximate Infrastructure Costs

Infrastructure Cost Breakdown.

The costs for the development of the infrastructure improvements has been detailed in the Final EIS, Section 2.7. The total estimated construction cost for on-site and off-site infrastructure improvements is approximately $55 to $65 million. These costs are preliminary and based on the Conceptual Master Plan. Costs will be refined as more detailed development plans are prepared and alternatives are selected. The order of magnitude costs (1994 dollars) are broken down as follows:

INFRASTRUCTURE COST SUMMARY	TOTAL COST
Onsite Roads/Electricity	$10 million to $12 million
Onsite Water	$ 1 million to $ 2 million
Onsite Sewer	$ 2 million to $ 2.5 million
Onsite Drainage	$ 3 million to $ 3.5 million
Offsite Roads/Electricity	$ 8 million to $ 8.5 million
Offsite Water	$ 8 million to $10 million
Offsite Sewer	$22 million to $25 million
Offsite Drainage	$ 1 million to $ 1.5 million
TOTAL:	$55 million to $65 million

Residential and Commercial/Industrial Construction Costs.

As described above in item 5, Amfac, as the Master Developer, will contract with third party builders and developers to construct residential and commercial/industrial subdevelopments. At the present time Amfac is negotiating bulk land sales for the tropical fruit disinfestation facility, the recycling center and the State Judiciary. The buildings and facilities will be planned and constructed by separate owners at their own cost. Future sales of other parcels will be similarly handled. Amfac is therefore, unable to estimate the construction costs for the project (other than the infrastructure development costs).

7. Cumulative and Secondary Impacts on Public Services and Facilities

A discussion of the cumulative impacts on public services and faciities anticipated from the proposed project has been included in the EIS as Section 6.2. This includes the impact on the land use character of the project, traffic, potable water, and schools.

Other proposed projects which have received some or all required land use approvals, or are presently under construction, could generate impacts to the existing public services and facilities in the vicinity of the Lihue-Hanamaulu Master Plan project. To the extent practicable, the cumulative impacts of other related developments in the region are also evaluated.

8. Revised Metes and Bounds Map and Description

Verification and revisions to the surveyed map for the total Petition Area and the metes and bounds description have recently been completed and submitted to your office on December 23, 1994 as the Third Amended Petition. The Petition Area has been increased to 554.642 acres (formerly 551.692 acres) due to an earlier miscalculation within the Molokoa parcel; however, the boundaries of the Petition Area remain unchanged. This matter is described in Section 1.2 of the Final EIS.

We appreciate your review and comments on the Draft EIS as well as the guidance we have received from your staff. Please contact us if you have any questions or require additional information.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi

Yukie Y. Ohashi
Project Planner

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JOHN WAIHEE
GOVERNOR
MAJOR GENERAL EDWARD V. RICHARDSON
DIRECTOR OF CIVIL DEFENSE
ROY C. PRICE, SR.
VICE DIRECTOR OF CIVIL DEFENSE

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

PHONE (808) 734-2161

4

October 11, 1994

TO: Ms. Esther Ueda
State Land Use Commission

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

SUBJECT: ENVIRONMENTAL ASSESSMENT (EA) AND ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN); LIHUE-HANAMAULU MASTER PLAN, KALAPAKI AND HANAMAULU, KAUAI, HAWAII

State Civil Defense (SCD) appreciates this opportunity to comment on the EA and EISPN for Lihue-Hanamaulu Master Plan, Kalapaki, and Hanamaulu, Lihue, Kauai, Hawaii. Project area TMK: 3-6-2:01 and 04 pors.; 3-6-2:17; 3-7-1:01 por.; 3-7-2:01 and 12 pors.; and 3-7-3:20 por.

We do not have negative comments specifically directed at the EA and EISPN. However, the proposed project area is not presently covered by any existing siren warning device. SCD requests that the petitioner purchase and install a siren and the siren support infrastructure to alert residents and workers of an impending or actual event that threatens the area. The addition of one 121 dB solar powered siren at the makai Lihue corner of the new intersection of the Hanamaulu-Ahukini cutoff road is shown on the copy of the enclosed Figure 4, "Conceptual Master Plan." The proposed siren requires a 250-foot radius buffer zone in which there are no residential buildings. Existing siren locations with their approximate coverage areas are also marked in pencil.

SECTION 5.0, SUMMARY DESCRIPTION OF THE AFFECTED ENVIRONMENT, subsections 5.1, page 8, and 5.2, page 9, are entitled Climate and Geology/Topography, briefly discuss rainfall and slope and elevation (1 to 8 percent and 75 to 220 above mean sea level), respectively. The proposed sites must further be evaluated for the impact of the potentially destructive winds and torrential rainfall of tropical cyclones/hurricanes on any structures designed and constructed for use in the project area. Some of these structures may be surveyed in the future for use as public shelters.

If there are any further questions, please have your staff call Mr. Mel Nishihara of my staff at 734-2161.

Enc.

c: Mr. Tim Johns
AMFAC/JMB Hawaii, Inc.

✓Ms. Yukie Ohashi
PBR Hawaii, Inc.

Office of Environmental Quality Control

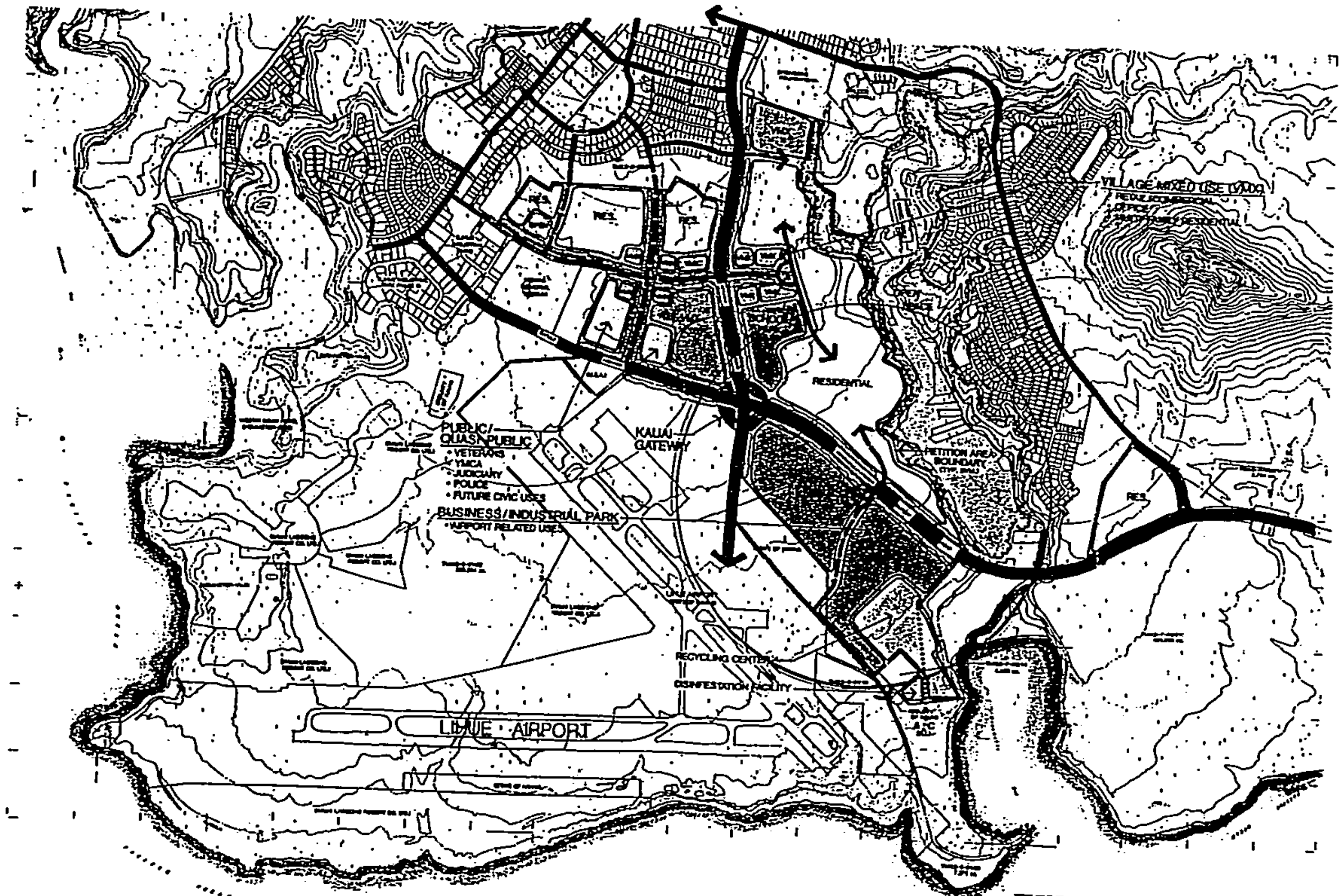


FIGURE 4
CONCEPTUAL MASTER PLAN
LIHUE-HANAMAULU
LIHUE DISTRICT, ISLAND OF KAUAI
PBR

BENJAMIN J. CAYETANO
GOVERNOR

MAJOR GENERAL EDWARD V. RICHARDSON
DIRECTOR OF CIVIL DEFENSE

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

PHONE (808) 734-2161

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

December 9, 1994

TO: The Honorable Norma Wong
Director, Office of State Planning

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

SUBJECT: FIRST AMENDED PETITION #A94-703/THE LIHUE PLANTATION CO., LTD: FOR AMENDMENT TO THE STATE LAND USE DISTRICT BOUNDARY; HANAMAULU AND KALAPAKI, KAUAI

We appreciate this opportunity to comment on the First Amended Petition by the Lihue Plantation Co., Inc., requesting a District Boundary change to reclassify approximately 552.026 acres from Agricultural and Conservation to the Urban District. The proposed reclassification is located at Hanamaulu and Kalapaki, island of Kauai, State of Hawaii; Tax Map Key: 3-6-2:01 (por.), 04 (por.), and 17; 3-7-1:01 (por.); 3-7-2:01 (por.) and 12 (por.); and 3-7-3:20 (por.) consisting of approximately 552.026 acres.

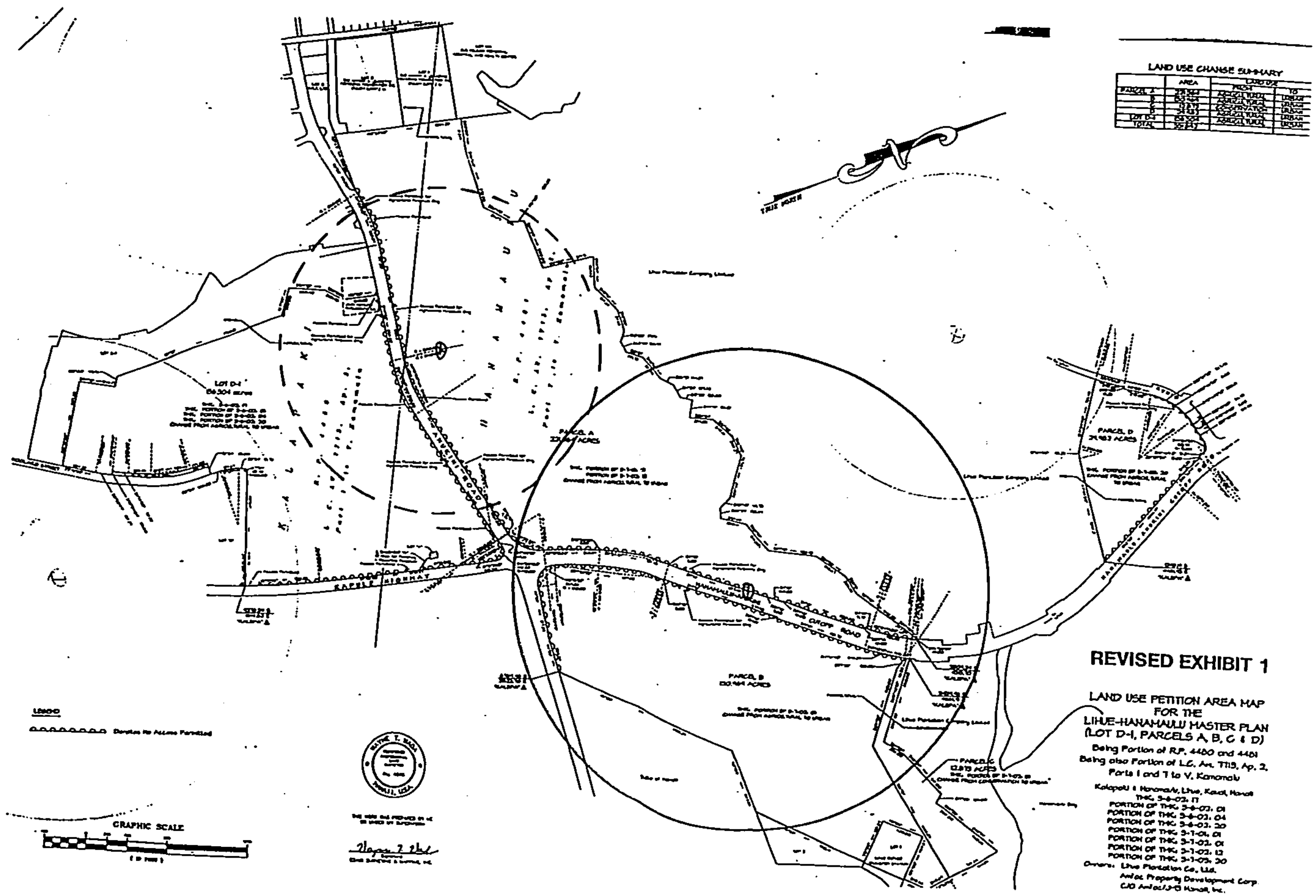
State Civil Defense (SCD) does not have negative comments specifically directed at the First Amended Petition requesting a District Boundary change. However, we would like to note that our specific needs and commentary were provided for the Environmental Assessment (EA) and the Environmental Impact Statement Preparation Notice (EISPN) for the Lihue-Hanamaulu Master Plan in a letter dated October 11, 1994 (enclosed). An additional infrastructure improvement is recommended for this amended petition. A second solar powered siren of 115 dB should be installed, in addition to the 121 dB solar powered siren (previously recommended) at the Mauka/Lihue corner of the new intersection of Hanamaulu-Ahukini cutoff road as shown on the copy of Revised Exhibit 1. There is insufficient information to select a suitable location for this siren at this time. Existing siren locations with their approximate coverage areas are marked in blue pencil.

12/12/94

If there are any further questions, please have your staff call Mr. Mel Nishihara of my staff at 734-2161.

Enc.

c: Mr. Benjamin Kudo
Ms. Darcie Yoshinaga
Dwyer Imanaka Schraff Kudo
Meyer & Fujimoto



LAND USE CHANGE SUMMARY
AREA
FROM
TO
TRUE NORTH
PARCEL A
PARCEL B
PARCEL C
PARCEL D
LOT D-1
KAPULE HIGHWAY
CUTOFF ROAD
LEGEND
GRAPHIC SCALE
REVISED EXHIBIT 1
LAND USE PETITION AREA MAP
FOR THE
LIHUE-HANAMAULU MASTER PLAN
(LOT D-1, PARCELS A, B, C & D)
Being Portion of R.P. 4400 and 4401
Being also Portion of L.C. Aw. 7713, Ap. 2,
Parts I and 7 to V, Kanamalu
Kalapaki & Hanamaulu, Lihue, Kauai, Hawaii
TMK: 3-6-02: 17
PORTION OF TMK: 3-6-02: 01
PORTION OF TMK: 3-6-02: 04
PORTION OF TMK: 3-6-02: 20
PORTION OF TMK: 3-7-01: 01
PORTION OF TMK: 3-7-02: 01
PORTION OF TMK: 3-7-02: 12
PORTION OF TMK: 3-7-03: 20
Owners: Lihue Plantation Co., Ltd.
Amfac Property Development Corp.
C/O Amfac/JMB Hawaii, Inc.

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

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

SUBJECT: **LIHUE-HANAMAULU MASTER PLAN**
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Dear Mr. Price:

We have reviewed your memorandum of October 11, 1994 regarding the Environmental Assessment (EA) and Environmental Impact Statement Preparation Notice (EISPN) and also your response to Ms. Norma Wong of the Office of State Planning on the First Amended Petition, and offer the following responses to your comments:

1. Siren Warning Device

Two sirens and siren warning infrastructure will be purchased and installed by Amfac/JMB Hawaii, Inc. ("Amfac") to help alert residents and workers of potential events that may threaten the area. The siren locations, as recommended by your staff, are at a minimum of 250 feet from the nearest planned residential development. The installation of the equipment will follow the necessary governmental approvals and will be coordinated with your office and the County of Kauai Civil Defense Agency.

2. Natural Hazards - Cyclones and Hurricanes

The potential impact of destructive winds and torrential rainfall of tropical cyclones/hurricanes on structures within the project will be mitigated by compliance with the Uniform Building Code as modified and adopted by the County. All structures will be constructed for protection from earthquakes and tropical cyclones/hurricanes in accordance with the requirements of the County.

Amfac understands that future structures within the project area may be surveyed by the Civil Defense Office for their potential use as public shelters and is supportive of any effort to ensure public health and safety.

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y.J. Chung
PACIFIC TOWER, SUITE 650 1001 BISHOP STREET HONOLULU, HAWAII 96813 TELEPHONE: (808) 521-5631 FAX: (808) 523-1402
BRANCH OFFICE: HILO LAGOON CENTER 101 AUPUNI STREET, SUITE 310 HILO, HAWAII 96720 TELEPHONE: (808) 961-3333 FAX: (808) 961-4989

Mr. Roy C. Price, Sr., Vice Director of Civil Defense
SUBJECT: LIHUE-HANAMAULU MASTER PLAN
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)
January 12, 1995
Page 2

We appreciate your review and comments on the EA and EISPN; your concerns are addressed in Section 4.8.C.(3) of the Final EIS. Please contact us if you have any questions or require additional information.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi
Project Planner

cc: Ms. Esther Ueda, Land Use Commission

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JOHN WAIHEE
GOVERNOR

HERMAN M. AIZAWA, Ph.D.
SUPERINTENDENT

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

OFFICE OF THE SUPERINTENDENT

November 4, 1994

NOV 10 9 51 AM '94
LAND USE COMMISSION
STATE OF HAWAII

Ms. Esther Ueda, Executive Officer
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

SUBJECT: Lihue-Hanamaulu Master Plan
Draft Environmental Impact Statement
Kalapaki and Hanamaulu, Lihue District, Kauai

We have reviewed the subject draft EIS and have the following comment regarding the 12-acre school and park site. The Department of Education (DOE) finds the proposed site within the project unacceptable due to the close proximity of Wilcox Elementary School, King Kaumualii Elementary School, and the Lihue Airport. The DOE prefers that the developer dedicate another school site on land owned by the developer in the Lihue/Puhi area which would allow the school service boundaries to be adjusted. The students in the project would attend the existing elementary schools. The new school site would allow redistribution of students at Wilcox Elementary School.

The revised enrollment projections based on 1,800 residential units are still valid. The project will have a severe enrollment impact on the schools in the area. All three schools are operating beyond capacity and report a shortage of classrooms.

The DOE will request that the developer provide a fair-share contribution in a form of land dedication and/or cash for the construction of school facilities being impacted by the proposed residential subdivision.

Should there be any questions, please call the Facilities Branch at 733-4862.

Sincerely,

Herman M. Aizawa, Ph.D.
Superintendent

HMA:hy

cc: A. Suga, OBS
S. Akita, KDO

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

Mr. Herman Aizawa, Ph.D., Superintendent
State of Hawaii
Department of Education
P.O. Box 2360
Honolulu, Hawaii 96804

**SUBJECT: LIHUE-HANAMAULU MASTER PLAN
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)**

Dear Dr. Aizawa:

We have reviewed your letter of November 4, 1994 regarding the Draft EIS for the Lihue-Hanamaulu Master Plan. The developer, Amfac/JMB Hawaii, Inc. ("Amfac") and PBR Hawaii and other consultants have met with several of your staff in the review process of the Draft EIS; we appreciate the consultation which has been provided. We offer the following responses to the comments which have been raised.

1. Provision of a School Site

The Lihue-Hanamaulu Master Plan includes a 12-acre elementary school and park site as an integral component of the pedestrian oriented master-planned community which will extend the boundaries of Lihue to accommodate the growth which is expected into the 21st century. It would be fitting for Lihue, the County's governmental and economic center to have a state-of-the-art school built in concert with the growth of Lihue.

Your comment that the proposed school site is unacceptable due to the close proximity of two elementary schools, Wilcox School in Lihue and King Kaumualii Elementary School in Hanamaulu, and the Lihue Airport is well taken. In discussions with the DOE over the last year, Amfac has been very open and willing to cooperate to resolve the need for a new school site in the Lihue area as the existing schools are operating beyond their capacities. In that regard, Amfac has provided the DOE with maps of other off-site properties it owns in the Puhi area. On December 15, 1994, we conducted a site visit with your staff and staff of the Department of Land and Natural Resources to evaluate potential school sites in Puhi on lands owned by Amfac or its subsidiaries.

During that site visit a new alternative emerged. We believe this idea has merit and warrants the DOE's detailed analysis. Wilcox School, located in the heart of the existing civic center, was built in the 1950's and is currently serving Lihue students in kindergarten to grade six. The idea suggested at the site visit involves the eventual phasing-out of Wilcox School and shifting its student population to a new state-of-the-art facility at the Lihue-Hanamaulu Master Plan project area. In addition, an

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BRANCH OFFICE: HILO LAGOON CENTER 101 AUPUNI STREET, SUITE 310 HILO, HAWAII 96720 TELEPHONE: (808) 961-3333 FAX: (808) 961-4989

elementary school site in Puhi may also be reserved for future use if needed. The Wilcox School property would then become available to the State and/or County for other civic center land uses. This concept is supported and encouraged by Amfac. However, Amfac will continue to assist your Department in finding a solution that would meet DOE's requirements and be mutually beneficial to the Lihue-Hanamaulu project.

Regarding the noise issue, the acoustical consultant reiterates that the school site is located outside of the line delineating the Lihue Airport 60 Ldn noise contour. In addition, other mitigative measures which could be implemented include: improved sound proofing in the building design and air conditioning.

2. Enrollment Projections

We appreciate the information provided regarding enrollment projections. The project proposes 1,400 to 1,800 residential units and is expected to generate 596 students from kindergarten through grade 12 at full build-out, which is projected to occur by the year 2016. The elementary school enrollment is projected to approximately 353 at full buildout, with an average of 21 new students per year based on an average build-out of 100 units per year.

3. Fair-Share Contribution

We also appreciate the information provided on DOE's planned request for land dedication and/or cash for school facilities. As noted earlier, Amfac will continue to work with your Department on mitigating impacts on area schools from the proposed project, and will provide their fair-share contribution.

We appreciate your review and comments on the Draft EIS; your concerns are addressed in the Final EIS. We look forward to continued discussions to find an appropriate solution to meet the community's need for a new elementary school. Please contact us if you have any questions or require additional information.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi
Project Planner

cc: Esther Ueda, Land Use Commission
A. Suga, OBS/DOE
S. Akita, KDO/DOE

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JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

PETER A. SYBINSKY, Ph.D.
[redacted]
DIRECTOR OF HEALTH

In reply, please refer to:

December 7, 1994 94-124/epo

To: Ms. Ester Ueda, Executive Officer
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii

From: Peter A. Sybinsky, Ph.D.
Director of Health

Subject: Draft Environmental Impact Statement (DEIS)

Lihue - Hanamaulu Master Plan
Kauai

Thank you for allowing us to review and comment on the subject document. We have already made comments in our letter to you dated July 21, 1994, and we do not have any additional comments to offer at this time.

LAND USE COMMISSION
STATE OF HAWAII
DEC 15 12 48 PM '94

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

Mr. Peter A. Sybinsky, Ph.D., Director
State of Hawaii
Department of Health
Environmental Planning Office
919 Ala Moana Blvd, 3rd Floor
Honolulu, Hawaii 96813

**SUBJECT: LIHUE-HANAMAULU MASTER PLAN
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)**

Dear Dr. Sybinsky:

We have reviewed your memorandum of December 11, 1994 regarding the Draft EIS for the Lihue-Hanamaulu Master Plan. We note that your agency has reviewed the subject EIS and has no comments to offer at this time.

Thank you for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi

Yukie Y. Ohashi
Project Planner

cc: Ms. Esther Ueda, Land Use Commission

1144.01\rl-11.w60

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PACIFIC TOWER, SUITE 650 1001 BISHOP STREET HONOLULU, HAWAII 96813 TELEPHONE: (808) 521-5631 FAX: (808) 523-1402
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BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER II

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

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

REF:OCEA:

File No.: 95-199

DEC 7 1994

MEMORANDUM

TO: Esther Ueda, Executive Officer
State Land Use Commission

FROM: Keith W. Ahue, Chairperson
Board of Land and Natural Resources

SUBJECT: Draft Environmental Impact Statement (DEIS): Lihue-Hanamaulu Master Plan, Lihue District, Kauai, TMKs: 3-6-02: 1, por. 4, 17; 3-6-02: por. 20; 3-7-01: por. 1; 3-7-02: 1, por. 12; 3-7-03: por. 20

We have reviewed the DEIS for the subject plan transmitted by PBR Hawaii's letter dated October 14, 1994, and have the following comments:

Division of Aquatic Resources

The Division of Aquatic Resources (DAR) comments that concerns raised by our Kauai aquatic biologist resulted in a meeting on November 23 between the developer, its consultants (PBR Hawaii, Water Resources Associates, Environmental Assessment Company, Pacific Aquatic Environmental), and staff from DAR, the Commission on Water Resource Management, and the U.S. Fish and Wildlife Service. The PBR written response to issues raised at that meeting is attached (see enclosed).

In general, there appears to be a good faith effort to attempt to limit the environmental impacts of the project. A question remains about the adequacy of State and County standards pertaining to runoff, but the project seems to be in compliance with existing regulations. The commitment to vegetated buffer zones, re-vegetation of the former Rego Trucking site, and the stewardship arrangements for Hanamaulu Gulch, in addition to the defined Best Management Practices (BMP), will help to mitigate the laxity in existing runoff standards.

Some clarification of certain points raised in the PBR response is needed (see enclosure). First, DAR is concerned that the BMP lack definition in Hawaii and that their ultimate quality is too dependent on the rigor or weakness of government agency review.

This deficiency of course is not unique to the Lihue-Hanamaulu Master Plan, but it does emphasize the need to try to recognize critical factors that should be taken into account. The State Department of Health is currently developing biological criteria in connection with the development of water quality standards for Hawaiian streams to meet EPA requirements and the goals of the Clean Water Act.

DAR suggests that the Hanamaulu River should be described with reference to these criteria and that a monitoring scheme should be implemented to assure that the development does not cause deterioration in the Hanamaulu River and Bay environment. Some provisions for mitigative action would have to be proposed if such a deterioration is demonstrated.

PBR's response suggests that two annual samples, one during a dry period and one after a heavy rain would be adequate for water quality monitoring in streams. DAR is convinced that that would be insufficient for the Hanamaulu situation. The reference in part, was to the adoption of such a protocol by the West Hawaii Coastal Monitoring Task Force. However, there are no perennial streams in West Hawaii. It was also stated that additional data would only "fill in" the points between the two samples.

Unfortunately, this suggests a linearity that simply does not exist under natural conditions, even for water quality, and emphatically not for the biota, where seasonality and population cycling are inseparable from meaningful sampling. Furthermore, it misses the point that a major purpose of the monitoring is to gather information about the ecological relationships of biota which are still only partially understood. It should be emphasized that DAR's mandated responsibility is for protection and management of the aquatic biota, not water quality per se.

The relationships between sediment loading and flow rate changes in the Hanamaulu River resulting from the project are two of the concerns which have been raised and which have particular import for the welfare of the aquatic biota. Sediment concentration increases exponentially with stream discharge, suggesting that relatively small increases in discharge can result in large increases in sediment movement and exemplifying the unavoidable complexity when the independent biotic fluctuations are factored in. Inadequate sampling under such conditions can only lead to confusion, statistically meaningless values, or misapprehension of the findings. DAR comments that sediment loading is only one of the water quality criteria that matter.

CORRECTION

THE PRECEDING DOCUMENT(S) HAS
BEEN REPHOTOGRAPHED TO ASSURE
LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

This deficiency of course is not unique to the Lihue-Hanamaulu Master Plan, but it does emphasize the need to try to recognize critical factors that should be taken into account. The State Department of Health is currently developing biological criteria in connection with the development of water quality standards for Hawaiian streams to meet EPA requirements and the goals of the Clean Water Act.

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Unfortunately, this suggests a linearity that simply does not exist under natural conditions, even for water quality, and emphatically not for the biota, where seasonality and population cycling are inseparable from meaningful sampling. Furthermore, it misses the point that a major purpose of the monitoring is to gather information about the ecological relationships of biota which are still only partially understood. It should be emphasized that DAR's mandated responsibility is for protection and management of the aquatic biota, not water quality per se.

The relationships between sediment loading and flow rate changes in the Hanamaulu River resulting from the project are two of the concerns which have been raised and which have particular import for the welfare of the aquatic biota. Sediment concentration increases exponentially with stream discharge, suggesting that relatively small increases in discharge can result in large increases in sediment movement and exemplifying the unavoidable complexity when the independent biotic fluctuations are factored in. Inadequate sampling under such conditions can only lead to confusion, statistically meaningless values, or misapprehension of the findings. DAR comments that sediment loading is only one of the water quality criteria that matter.

The mechanism for design and implementation of appropriate sampling could involve community based volunteers for the bulk of the field work. Preliminary inquiries by DAR's Kauai aquatic biologist have suggested that it would be relatively easy to establish such a program. DAR would be willing to coordinate these activities if the developer will commit to funding of the purchase of requisite sampling gear for the volunteers and certain laboratory examinations, specifically the identification of aquatic plants and invertebrates that would be collected by the volunteers. As an option, a consultant could be hired by the developer to design and conduct the monitoring plan in consultation with DAR and perhaps with our field cooperation. However, a monthly sampling regime would be the minimum acceptable frequency.

PBR's response (enclosed) notes that the development occupies only a small proportion of the watershed and runoff would represent only some 3% of total stream flow. However, the development is located near the stream mouth where the influences of drainage will be felt directly and most significantly without the natural attenuation of non-point source pollutants, characteristic of urban runoff, that would be associated with downstream travel. Incorporation of some broadband testing for pesticide residues in the monitoring scheme would be appropriate, especially given the long-term agricultural use of the area. Testing could be done inexpensively, since only type of pesticide, rather than specific identification would be required, and only occasionally (but it would be a useful indicator of the trend in overall water and environmental quality).

Re-vegetation of the former Rego Trucking site is one of the especially valuable steps that could be taken to improve the quality of runoff waters into the Hanamaulu River. The PBR response commits to this action "insofar as practicable." DAR is uneasy about this caveat. Much of the quarry wall is extremely steep and probably can sustain or be stabilized by vegetation at this point. DAR has been advised that the U. S. Soil Conservation Service has guidelines for re-vegetating old rock quarries and would like to see a plan for re-vegetation in accordance with those guidelines. DAR's Kauai aquatic biologist has indicated that the south wall of Hanamaulu Gulch, for which Amfac has noted a commitment to "proper stewardship" of its land and natural resources, is largely denuded of vegetation. DAR suggests that this area should also be revegetated.

DAR believes this project offers an opportunity for a private corporation to lead the way in the initiation of planning on a watershed rather than piecemeal basis. Amfac owns most of the 18,400 acre watershed, of which this project indeed represents only a small part, and has the expertise to move in this direction. It would be unprecedented in Hawaii, but in the long run it would benefit the corporation, the community, and the State.

Although the PBR response shows an ongoing commitment to continued sugar production, the only assurance about the future is change. DAR is certainly willing to work with Amfac or PBR planners if the occasion or need arises. There may even be opportunities that appear as agricultural operation efficiency improves, or if other crops are planted on lands not under sugar cultivation. It would be worthwhile, for example, to evaluate how these changes affect the stream, assuming they are detected in the monitoring program.

In the shorter term, the communications between Amfac and the USFWS about the Private Lands Program, involving fencing to protect sensitive endangered species habitat, and with Ducks Unlimited about its taro lands program, are highly positive steps that should also be recognized as components of watershed planning.

We will forward the comments of the Commission on Water Resource Management (CWRM) as they become available.

We note that our Historic Preservation Division (HPD) comments were previously forwarded to you directly in their letter dated October 25, 1994 (enclosed).

Please feel free to call Steve Tagawa at our Office of Conservation and Environmental Affairs at 587-0377, should have any questions.

Enclosures

c: PBR Hawaii (w/o encl.)
OEQC
OSP-LUD

ST:

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

December 1, 1994

Mr. William Devick
Department of Land and Natural Resources
Division of Aquatic Resources
Kalanimoku Building, Room 330
1151 Punchbowl Street
Honolulu, Hawaii 96813

SUBJECT: **LIHUE-HANAMAULU MASTER PLAN**
RESPONSE TO DIVISION OF AQUATIC RESOURCE'S COMMENTS

Dear Mr. Devick:

We would like to thank you for coordinating the meeting with members of your Division of Aquatic Resources, and staff of the Water Commission and U.S. Fish and Wildlife Service to discuss the Lihue-Hanamaulu Master Plan. This letter responds to the comments and issues which were discussed at the meeting on November 23rd and raised in Don Heacock's memorandum to you dated November 21, 1994.

A. DRAINAGE ISSUES

General Comments. As stated in the Draft EIS, the storm drainage system will be designed to County of Kauai and State Department of Health ("DOH") standards with the intent that the infrastructure improvements will be dedicated to the County. In developing the project, Amfac/JMB Hawaii, Inc. ("Amfac") intends to incorporate Best Management Practices, such as detention basins, buffer strips, and biofiltration channels, to the fullest extent practicable. It should be noted that sediment loads to Hanamaulu Stream and offshore areas will decrease as lands are taken out of sugar cane use.

The Soil Conservation Service's TR-55 method was used by Kodani & Associates to calculate peak discharge rates. This method was accepted by the County Public Works Department and is commonly used and accepted for a development of this type and size.

The detention basins for the Molokoa and Ahukini Mauka areas will be designed to keep peak discharge rates for the proposed development at or below existing discharge rates for the 2- and 10-

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y.J. Chung

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year, 24-hour storms as well as the 100-year, 24-hour storm. This is consistent with present County Department of Public Works policy that requires the design of detention basins and consideration of the more frequent storms as well as the 100-year storm which is used to set base flood elevations.

Best Management Practices ("BMP") Plan. State of Hawaii and County of Kauai regulations and guidelines will be followed in preparing a grading plan in accordance with the County's Grading Ordinance and State DOH National Pollutant Discharge Elimination ("NPDES") Guidelines. A specific and detailed BMP Plan will be prepared and submitted for review when project specific plans require these permits. A BMP Plan will need to be approved by DOH and the County Public Works Department to assure that water quality degradation will not occur and negatively affect organisms in the receiving freshwater, estuarine and marine water environments. Amfac will consult with the appropriate DLNR Divisions in the preparation of the BMP Plan.

We have reviewed the reports by Powers and Powers and Phinney and note that Hawaii's geologic and climatic conditions differ significantly from that of the State of Washington. We wish to discuss further with you the validity of extrapolating certain inferences from studies done in a different geographic area for application to an island environment.

Watershed Management. The watershed area which drains into Hanamaulu Stream at the project location is approximately 18,400 acres. Flows from the project area represent approximately three percent of the total flows to Hanamaulu Stream. Much of this area is forested or in sugarcane cultivation. Amfac, owners of The Lihue Plantation Company, Limited ("LPCo"), has no current plans to discontinue its sugar operations and has no plans to close the plantation. In fact, LPCo is examining strategies to consolidate certain operations with its sister company, Kekaha Sugar, in an attempt to keep both viable in the long-term. Therefore, watershed planning which assumes termination of the sugar operation is contradictory to Amfac's goals and premature at this time. Nonetheless, Amfac will work to encourage good management practices throughout the watershed and will consult with DLNR divisions as appropriate if our land use patterns change significantly within the watershed. In this regard, any programs or ideas the Division of Aquatic Resources may have regarding multi-agency, multi-party cooperative long-term watershed planning would be welcome.

Water Quality Monitoring. The project's drainage system has been designed to contain runoff in detention basins on-site to reduce the flow rate and to settle waterborne sediment before discharging to Hanamaulu and Kalapaki Streams; however, we recognize that there may be development impacts and a water quality monitoring program would help to determine the extent of those impacts. Mr. Heacock has recommended that monthly monitoring and sample testing be conducted, and in addition, immediately following any storm event. However, Dr. Brock, as a member of the ad hoc West Hawaii Coastal Monitoring Task Force, has recommended a protocol for a setting such as Hanamaulu Bay which would entail, at a minimum, sampling during a relatively dry period when the stream flow is relatively low and just after a reasonably heavy rain when the stream flow is increased. These samples would provide data on two extremes in water quality conditions of Hanamaulu Bay and adjacent marine areas. According to Richard Brock, Ph.D. of Environmental Assessment Company, monthly water quality sampling would be difficult to justify because the data would merely "fill in" the envelope of conditions whose endpoints were identified in the first two sample periods.

Amfac recognizes the need for land management practices which will contribute toward improving water quality. Amfac would be willing to participate in a coordinated effort with the appropriate State and County agencies and other landowner/developers within the affected watersheds in developing and implementing a water quality monitoring program. Other landowners or developers with proposed plans in the near term which may affect the same watersheds include the State of Hawaii, County of Kauai, Okada Trucking Company, Kauai Lagoons, Wal Mart Store, and Wilcox Hospital.

B. HANAMAULU STREAM GULCH OPEN SPACE AND NATURAL RESOURCES

The Project Area. The Lihue-Hanamaulu Master Plan boundary nearest the Hanamaulu Stream Gulch is at the top of the bluff. Development will be characterized by setbacks and appropriate landscape guidelines to address visual issues as well as runoff and erosion control along the edge of the bluff. No development is proposed or planned for Hanamaulu Gulch.

Hanamaulu Stream Gulch. The Hanamaulu Stream Gulch is characterized as open space on the Master Plan. The walls of the gulch are comprised of steep densely vegetated slopes with natural swales and gullies which create a large buffer between the development and stream. Hanamaulu Stream courses through the valley. At its widest, from the Ahukini bluff to the Hanamaulu bluff, the gulch measures approximately 1,750 feet across and narrows to less than 800 feet at other mauka areas. The broad area near the Kapule Highway bridge contains wetlands.

Land Ownership and Land Uses. Much of the approximately 220-acre gulch area is owned by Amfac. In addition, there are 13 kuleanas, representing approximately 15 acres owned by various landowners scattered throughout the gulch. As such, land uses are varied, including residential, cattle pasture, agricultural and industrial uses.

Former Rego Trucking Site. Concerns have been raised about the former Rego Trucking site. Briefly, this area was leased to Rego Trucking for rock quarrying for several years. Due to legal disputes over whether Rego Trucking performed its contractual obligations under the lease (including the restoration of exposed, benched areas), Rego Trucking is no longer leasing Amfac lands. Exposed soils remain due to the improper quarrying methods in some areas. To the extent practicable, Amfac will provide corrective measures by revegetating and grassing the exposed areas to reduce erosion.

Hanamaulu Stream Restoration. In a survey of Hanamaulu Stream, Ron Englund of Pacific Aquatic Environmental noted that the stream and watershed are currently affected by soil erosion and water diversion associated with agriculture, riparian degradation due to livestock grazing, and urban and industrial runoff, the presence of reservoirs, and introduced biota. Therefore, any restoration of Hanamaulu Stream would require participation from a wide number of parties. The cost and timeframe for such restoration would be extensive, and restoration efforts would be limited unless the full range of watershed land uses are taken into account.

Mitigation measures associated with the proposed project can provide an opportunity to participate in stream restoration by 1) improving portions of the stream and watershed within the project area, and 2) ensuring that the Lihue-Hanamaulu project is not an obstacle to future restoration efforts undertaken if current land uses change. Amfac is willing to work with DAR and other appropriate agencies to identify measures to improve the stream.

Dedication of Land to County for Hanamaulu Beach Park Expansion. Amfac is currently considering dedicating land makai of the Kapule Highway bridge and adjacent to Hanamaulu Bay to expand the County park. The land, which consists of a coconut grove, would greatly augment the park facilities and provide greater shoreline access.

Amfac Commitments at Hanamaulu Gulch. Amfac is committed to proper stewardship of its Hanamaulu Gulch land and the natural resources and endangered waterbird species which inhabit this area Recognizing that water quality within the stream is vital, a drainage control plan, revegetating program for eroded areas, and cattle fencing will be considered to promote better water quality.

Amfac has contacted the U.S. Fish and Wildlife Service ("FWS") about its Private Lands Program and will be exploring the potential of utilizing this program which could provide cattle fencing to protect sensitive endangered species habitat in exchange for a ten year commitment to maintain the land in conservation. Ducks Unlimited ("DU") has also been contacted about its taro lands program. DU is working closely with FWS at Hanalei; the State's model for dual purpose use of agricultural lands as waterbird habitat.

C. HANAMAULU BAY

Hanamaulu Bay Resources. Hanamaulu Bay is recognized as an important islandwide resource for its recreational value as well as its importance as a fisheries resource. Our planning process recognizes the relationship between Amfac's development plans and the bay. As a result, Dr. Brock has prepared studies for water quality and marine resources of the bay and the surrounding coastal waters.

Baseline Data Gathering. The environmental monitoring program to establish a benchmark or baseline for the Hanamaulu area intends to sample during a relatively "dry" period (as documented in the Draft EIS report in Appendix H and in the attached Addendum Report) and a relatively "wet" period that will be completed during the next major rainfall.

DAR's comment that water quality sampling should be carried out on a monthly or bimonthly basis is without strong scientific rationale. Many baseline studies in Hawaii rely on a one time sampling effort; this may or may not be adequate depending on the location and the local environmental conditions. Dr. Brock, with more than 10 years of experience in sampling nearshore marine waters, has determined that one dry and one wet sample will establishe a preliminary baseline to assess water quality and marine resources at Hanamaulu Bay for the Environmental Impact Statement. As mentioned earlier, Dr. Brock also recommends that a water quality and marine monitoring program could entail, at a minimum, sampling during the wet and dry seasons.

D. WATER SOURCE DEVELOPMENT

Proposed Water Source Development Plan. A hydrologic study for the project by Water Resource Associates has identified an area on Amfac/LPCo lands approximately three quarters of a mile mauka of the project area as a potential site for potable water well development. The proposed wells will serve this project and will be designed to County standards with the intention that the system will be dedicated to the County of Kauai. Permits will be required prior to drilling, testing and drawing of water. Mr. Heacock's statement for "on-site development of potable water which will not have a significant negative impact on groundwater resources now flowing into coastal waters" is contrary to the findings of the project hydrologist.

As we discussed at the meeting, there has been no consideration for use of Makaleha Stream water for the project, contrary to statements which have been made and published in the newspaper. Amfac has not been involved in any discussions regarding the same and has not considered Makaleha spring as a water resource for this project.

Again, we would like to thank you for the opportunity to meet and discuss the project. As more detailed planning and engineering is prepared upon receipt of various land use approvals, we look forward to working with you and your staff, as well as with the staff of the Water Commission and the FWS to address your concerns. Please call me at 521-5631 if we can further provide information or clarify any questions.

Sincerely yours,

PBR HAWAII

Yukie Y. Ohashi

Yukie Y. Ohashi
Project Planner

cc: Tim Johns, Amfac/JMB Hawaii, Inc.
Tom Witten, PBR Hawaii
David Higa/Charlie Ice, DLNR, Water Commission
Christine Willis/Adam Asquith, FWS
Clyde Kodani/Stanford Iwamoto, Kodani & Associates
Dan Lum, Water Resource Associates
Richard Brock, Environmental Assessment Co.
Ron Englund/Randall Filbert, Pacific Aquatic Environmental

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

Mr. Keith W. Ahue, Chairperson
State of Hawaii
Department of Land and Natural Resources
Kalanimoku Building
1151 Punchbowl Street
Honolulu, Hawaii 96813

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Dear Mr. Ahue:

We have reviewed your memorandum of December 7, 1994 regarding the Draft EIS for the Lihue-Hanamaulu Master Plan. The developer, Amfac/JMB Hawaii, Inc. ("Amfac") and PBR Hawaii and other technical consultants have met with several of your staff in the review process of the Draft EIS; we appreciate the consultation which has been provided. In addition to our letter to Mr. William Devick of the Division of Aquatic Resources dated December 1, 1994 (attached to your memorandum) we offer the following responses to the comments which have been raised by the Division of Aquatic Resources.

Thank you for acknowledging Amfac's good faith efforts to limit the environmental impacts of the Lihue-Hanamaulu Master Plan project. Amfac recognizes the value of the Hanamaulu Stream ecosystem and has strived to incorporate appropriate protective and enhancement measures into its plans. Amfac thanks your staff for their helpful suggestions on how our plans may be further refined and Amfac will continue to work towards a cooperative effort to resolve any questions and concerns that may arise. For example, the project now incorporates drainage control measures to mitigate impacts to the stream and the bay, such as vegetated buffer zones, re-vegetation of the former Rego Trucking site, and best management construction practices. In addition, we are continuing to investigate cooperative conservation programs of the U.S. Fish and Wildlife Service and Ducks Unlimited which will add protective and enhancement measures regarding the endangered waterbirds that inhabit the Hanamaulu wetlands which are outside of but near the project site.

We acknowledge that there are several issues which require further discussion for resolution. We offer our perspectives on these issues in this letter.

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung
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1) **Adequacy of State and County Standards Pertaining to Runoff**

As stated in the Draft EIS, the storm drainage system will be designed to meet County of Kauai and State Department of Health ("DOH") standards with the intent that the infrastructure improvements will be dedicated to the County. In developing the project, Amfac/JMB Hawaii, Inc. ("Amfac") intends to incorporate Best Management Practices, such as detention basins, buffer strips, and biofiltration channels to the fullest extent practicable. It should be noted that sediment loads to Hanamaulu Stream and offshore areas will be decreased by 80 percent as lands are taken out of sugar cane use (Section 5.8.5 and the Preliminary Engineering Report for Drainage Requirements, Appendix D). Our plans are based on existing State and County guidelines and standards which have been established after study and review by the appropriate regulatory agencies.

We note that you "question the adequacy of the current State and County standards pertaining to runoff" and that "the BMP lack definition in Hawaii and that their *ultimate quality is too dependent* on the rigor or weakness of government agency review". Amfac is not in the position of evaluating whether the current State and County standards are inadequate or whether they are insufficiently enforced by governmental agencies. Thus, we cannot evaluate whether or not your statement is an accurate representation of the current situation. In any event, Amfac will continue to rely on approved and established Federal, State and County guidelines and engineering standards in planning for the Lihue-Hanamaulu Master Plan project.

We are aware that the DOH Environmental Planning Branch is presently preparing revisions to Chapter 11-5-4, Hawaii Administrative Rules, to develop new definitions and standards for native biota and water quality standards for Hawaiian streams but our understanding is that these guidelines have not yet been completed, publicly reviewed, published or adopted and are not available at this time. We, therefore, reiterate that project plans are being prepared in compliance with the guidelines currently acceptable to the State Department of Health and the County of Kauai.

2) **Marine Water Quality Monitoring Program and Mitigative Measures**

We provide the following clarification on marine water quality monitoring strategies. In the earlier referenced PBR letter, we stated that "*at a minimum*, sampling [would occur] during a relatively dry period when the stream flow is relatively low, and just after a reasonably heavy rain when the stream flow is increased." These samples would provide data on two extremes in water quality conditions of Hanamaulu Bay and adjacent marine areas. According to Richard Brock, Ph.D. of Environmental Assessment Company, monthly water quality sampling is not called for and would not provide significant new information concerning ecological relationships because the data would merely "fill in" the envelope of conditions whose endpoints were identified in the first two sample periods. This recommendation significantly differs from your recommendation of "monthly monitoring". We agree that in general more data is better than less; however, no justification in terms of better protection and management of aquatic biota for monthly monitoring is provided in your letter. Considering the high costs associated with sampling and laboratory testing and analysis, the rationale for monthly monitoring would need to be justified before such a program is developed. We would like to emphasize that the wet/dry strategy would be *the minimum* acceptable sampling intervals. Quarterly or seasonal monitoring, which would include the wet/dry sampling periods, could also provide for variable conditions. We will continue these discussions with the Department of Health and your Department, as applicable, as project plans become more specific. Current permitting requirements of this project include the National Pollutant Discharge Elimination System ("NPDES") and the County Grading Ordinance, both of which are intended to protect water quality of the receiving waters.

3) Hanamaulu Stream Biological and Water Quality Monitoring

Stream biologist, Ron Englund of Pacific Aquatic Environmental, clarifies that a biological monitoring plan for a freshwater stream such as Hanamaulu Stream would require quarterly sampling to account for variability in the aquatic biota. Mr. Englund does not concur with your recommendation of monthly monitoring for the aquatic biota. In concept, an aquatic biology monitoring plan could involve sampling for fish, crustaceans, molluscs, and aquatic insects. In addition, testing of water quality field parameters could include stream flow measurements, temperature, pH, dissolved oxygen, turbidity, salinity, and conductivity.

4) Timeframe for Monitoring

To establish a baseline for marine and freshwater sampling during development of the project, in addition to the sampling performed for the EIS, Dr. Brock and Mr. Englund recommend that sampling activities be performed during the one year period prior to the onset of construction activities to establish a baseline. Under the current project planning and development to schedule, this monitoring would be scheduled in 1995/96.

5) Sediment Loading and Flow Rate Impact to Aquatic Biota

Your concern that sediment loading and flow rate changes in Hanamaulu Stream is well taken. Kodani & Associates ("Kodani"), the project civil engineer for drainage improvements and controls, have thoroughly evaluated and calculated the existing flows and sediment loss and the expected changes over the 15 to 20 year development period. Kodani has revised the study of the Ahukini Mauka area which drains to Hanamaulu Stream based on comments from the County Department of Public Works. The planned park/detention basin concept has been modified to now allow continuous use of the active recreational areas of the park. Additionally, because of safety and liability concerns, the flood depth within the park areas shall be designed to not exceed a depth of about 1.5 feet. Kodani's new findings indicate that there will be an increase in flow rate of approximately 25 percent during peak discharge periods compared to the pre-existing rate. It is important to remember that the project area represents approximately three percent of the total watershed draining to Hanamaulu Stream and that during the 100-year 24-hour storm event used for this calculation, the stream will be swollen from the mauka 97 percent of the drainage area.

According to Mr. Englund, Hawaii streams naturally experience a wide fluctuation in flow rates and no significant impact of the increased runoff from the Project Area to the aquatic biota in the stream is expected (as documented in Section 4.7 and Appendix I-1). The changes to the drainage discussion is documented in the Final EIS, Section 5.8.5 and Appendix D. In summary, while flow rates are expected to increase due to impervious surfaces such as roadways and building and parking surfaces and rooftops, sediment loss from the project site will be reduced significantly to approximately 20 percent of the existing conditions under the current agricultural land use (as noted in Section 5.8.5 and Appendix D). The increase in the runoff volumes to Hanamaulu Stream will be mitigated by throttling discharge rates through the drainage detention controls planned within the project area. Therefore, we disagree with your statement that "Sediment concentration increases exponentially with stream discharge, suggesting that relatively small increases in discharge can result in large increases in sediment movement..." With regard to the aquatic ecology and health of a stream system, we do agree with your statement that "sediment loading is only one of the water quality criteria that matter."

6) Design and Implementation of Appropriate Sampling

We do not concur with the suggestion of your Kauai aquatic biologist "to involve community based volunteers for the bulk of the field work" associated with water quality and biological sampling. Both Dr. Brock and Mr. Englund are involved in such programs as professional trainers. The basic goals of community programs are 1) to educate the lay community, and 2) to heighten environmental awareness. Dr. Brock emphasizes that valid scientific sampling requires years of training, consistency in methodology and understanding of ecology. Amfac has made a commitment to appropriate stewardship of the natural resources on its property and is committed to proper scientific methods; a volunteer sampling program, while it may provide environmental awareness, would not yield reliable data.

7) Hanamaulu Stream Watershed and its Relationship to the Estuary

Reference is made to your statement that "the development is located near the stream mouth where the influences of drainage will be felt directly and *most significantly* (our emphasis) without the natural attenuation of non-point source pollutants, characteristic of urban runoff, that would be associated with downstream travel."

The project area, representing approximately three percent of the total watershed draining through Hanamaulu Stream, is located near the stream mouth. A natural function of an estuary is to serve as a giant filter; Hanamaulu Stream estuary serves this function before emptying to Hanamaulu Bay. The existing land uses within the watershed and directly adjacent to the gulch and stream presently impacts water quality of the stream. The presence of cattle and other livestock, domestic sewers, leaching of petroleum products, soil erosion and other pollutants are known to be present within the gulch area.

The coastal plateau location of the project at the proposed site in close proximity to the estuary, relative to the watershed, is in our view better than say, at the headwaters of the stream. Coupled with the engineered drainage and sediment controls which are planned, the non-point source pollutants will be mitigated, contrary to your statement.

8) Monitoring for Pesticides

You state that incorporation of some broadband testing for pesticide residues in the monitoring scheme would be appropriate, especially given the long-term agricultural usage of the project lands. You also state that such testing would be inexpensive. We concur that testing for pesticides/herbicide residue utilizing several screens (EPA 8080, 8150, etc.) will be of value following research with Lihue Plantation Company as to the specific kinds of chemicals which have been used on the sugar fields over the course of cultivation in the area. However, we disagree with your statement that such testing would be inexpensive.

9) Re-Vegetation of the Former Rego Trucking Site

As we stated in our letter of December 1, 1994, Amfac will provide appropriate corrective measures to the former Rego Trucking quarry site to reduce erosion. We will utilize the applicable referenced U.S. Soil Conservation Service guidelines.

10) Watershed Planning

We again emphasize that Amfac and Lihue Planation are committed to maintaining its sugar operations. However, your point about watershed planning is well taken, and to the extent practicable, Amfac will participate in future watershed planning efforts.

11) Stewardship of Hanamaulu Gulch Resources

We reiterate from our December 1, 1994 letter, that Amfac is committed to proper and appropriate stewardship of its Hanamaulu Gulch land and the natural resources and endangered waterbird species which inhabit this area. Recognizing that water quality within the stream is vital, a drainage control plan, revegetating program for eroded areas, and cattle fencing will be considered to promote better water quality.

Amfac representatives have contacted the U.S. Fish and Wildlife Service ("FWS") about its Private Lands Program and will continue to explore the potential of utilizing this program which could provide cattle fencing to protect sensitive endangered species habitat in exchange for a ten year commitment to maintain the land in conservation. Ducks Unlimited ("DU") has also been contacted about its taro lands program. DU is working closely with FWS at Hanalei; the State's model for dual purpose use of agricultural lands as waterbird habitat. Thank you for recognizing our communication with FWS and DU as "highly positive steps." We, too, are encouraged by these early discussions.

We appreciate your review and comments on the Draft EIS; your concerns are addressed in the Final EIS. Please contact us if you have any questions or require additional information.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi

Yukie Y. Ohashi
Project Planner

cc: Ms. Esther Ueda, Land Use Commission

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STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

October 25, 1994

Ester Ueda
State Land Use Commission
335 Merchant St., Rm 104
Honolulu, Hawaii 96813

LOG NO: 12985
DOC NO: 9410NM17

Dear Ms. Ueda:

SUBJECT: **Historic Preservation Review -- Lihue Hanamaulu Master Plan**
The Lihue Plantation Co. Ltd. (AMFAC/JMB)
TMK: 3-6-2: 01, 04; 3-6-2: 17, 3-7-2: 01, 12 por.; 3-7-1: 01 por., 3-7-3: 20
Kalapaki and Hanamaulu, Lihue, Kauai

We reviewed the earlier EA and EIS for the project and could not concur with the applicant that archaeological inventory surveys had taken place in this project area. Shortly after submitting our comments we received a survey report (Franklin and Walker 1994. Archaeological Inventory Survey of Molokoa Lands Parcel Area. PHRI ms. PHRI ms. 1458-0501941994). We have reviewed this revised report and believe that it is acceptable.

We believe that the project areas were adequately covered, finding two historic sites. These sites were significant solely for their information content and a reasonable amount of this information was recorded in the survey, so we agree that the sites are "no longer significant". Thus, no significant sites are in the project area, and we believe that the project will have "no effect" on significant historic sites.

If you have any questions, please contact Ms. McMahon, our staff archaeologist for the County of Kaua'i, at 587-0006.

Sincerely,

Ross Cordy

for DON HIBBARD, Administrator
State Historic Preservation Division

NM:jk

cc: Paul Rosendahl, PHRI
✓Yukie Ohashi, PBR Hawaii
Dee Crowell, County of Kauai
Roger Evans, OCEA

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

Mr. Don Hibbard, Administrator
Department of Land and Natural Resources
State Historic Preservation Division
33 South King Street, 6th Floor
Honolulu, Hawaii 96813

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Dear Mr. Hibbard:

We have reviewed your letter of October 25, 1994 regarding the Draft EIS for the Lihue-Hanamaulu Master Plan. We note that the Historic Preservation Division has reviewed the archaeological survey report prepared by Paul H. Rosendahl, Ph.D. entitled "Archaeological Inventory Survey of the Molokoa Lands Parcel Area" and has found that it is acceptable. We also note that your agency has determined that two historic sites which were significant for their information content have completed the data recovery process and therefore, are "no longer significant". Thus, you conclude that"no significant sites are in the project area, and that the project will have 'no effect' on significant historic sites."

We appreciate your review and comments on the Draft EIS; your concerns are addressed in the Final EIS. Please contact us if you have any questions or require additional information.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi

Yukie Y. Ohashi
Project Planner

cc: Ms. Esther Ueda, Land Use Commission

1144.01\rl-05.w60

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung
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JOHN WAIHEE
GOVERNOR

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

STATE OF HAWAII

DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
677 QUEEN STREET, SUITE 300
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FAX (808) 587-0600

IN REPLY REFER TO:
94:PPE/6136

December 12, 1994

TO: Esther Ueda, Executive Office
State Land Use Commission

FROM: Joseph K. Conant
Executive Director

SUBJECT: Draft EIS for the Lihue-Hanamaulu Master Plan

Thank you for the opportunity to review the subject draft EIS. We have no further comments to offer.

c: OEQC
Amfac/JMB Hawaii, Inc.
PBR Hawaii

DEC 14

H F D C

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

Mr. Joseph K. Conant, Executive Director
State of Hawaii
Department of Budget and Finance
Housing Finance and Development Corporation
677 Queen Street, Suite 300
Honolulu, Hawaii 96813

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Dear Mr. Conant:

We have reviewed your memorandum of December 12, 1994 regarding the Draft EIS for the Lihue-Hanamaulu Master Plan. We note that your agency has reviewed the subject EIS and has no further comments.

We appreciate your participation in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi

Yukie Y. Ohashi
Project Planner

cc: Ms. Esther Ueda, Land Use Commission

1144.01\rl-13.w60

OFFICE OF STATE PLANNING
Office of the Governor
MAILING ADDRESS: P.O. BOX 3540, HONOLULU, HAWAII 96811-3540
STREET ADDRESS: 250 SOUTH HOTEL STREET, 4TH FLOOR
TELEPHONE: (808)587-2846, 587-2800

FAX: Director's Office 587-2848
Planning Division 587-2824

Ref. No. C-939

November 25, 1994

MEMORANDUM

TO: Ms. Esther Ueda, Executive Officer
State Land Use Commission

SUBJECT: Lihue-Hanamaulu Master Plan Environmental Impact Statement

We have reviewed the environmental impact statement (EIS) and have the following concerns relative to impacts on the wetland habitat adjacent to the project site and the endangered species that inhabit the wetland.

Four endangered water birds (coot, stilt, gallinule, and koloa) are sensitive to development (light, noise, etc.) and human activity. An adequate buffer zone to shield the probable adverse impacts on the water birds from the proposed development should be incorporated.

The wildlife section on page 4-19 provides the status on native and non-native species. However, it does not address endangered and non-endangered species. Because it is an important topic supported by federal law, the subject should be discussed thoroughly in the EIS rather than being identified as endangered only in the appendix.

If there are any questions regarding our comments, please contact our CZM Program at 587-2876.

Norma Wong

Norma Wong
Director

cc: OEQC
PBR Hawaii ✓
Amfac/JMB Hawaii, Inc.

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

Ms. Norma Wong, Director
Office of State Planning
Office of the Governor
P.O. Box 3540
Honolulu, Hawaii 96811-3540

**SUBJECT: LIHUE-HANAMAULU MASTER PLAN
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)**

Dear Ms. Wong:

We have reviewed your memorandum of November 25, 1994 regarding the Draft EIS for the Lihue-Hanamaulu Master Plan and offer the following responses to the comments provided by the Coastal Zone Management Program.

1. Clarification of the Project Area

The Lihue-Hanamaulu Master Plan area includes approximately 555 acres located at Lihue and Hanamaulu with the project boundary nearest the Hanamaulu Stream Gulch situated at the top of the bluff. No development is proposed or planned for Hanamaulu Gulch which is characterized as "open space" on the Master Plan. Wetlands are present in the valley and native waterbirds which are listed as "endangered" inhabit the wetlands. The walls of the gulch are generally comprised of steep densely vegetated slopes with natural swales and gullies which serve as a natural shield and create a buffer between the development and the wetland.

Much of the approximately 220-acre Hanamaulu Gulch area near the project boundary is owned by Amfac. In addition, there are 13 kuleanas, representing approximately 15 acres owned by various landowners scattered throughout the gulch. As such, land uses are varied, including residential, livestock pasture, agricultural and industrial uses and vacant open space.

2. Proposed Mitigative Measures for Potential Development Impacts to Hanamaulu Gulch

Amfac is committed to proper and appropriate stewardship of its Hanamaulu Gulch land and the natural resources and endangered waterbird species which inhabit this area. Recognizing that water quality within the stream is vital, a drainage control plan and revegetating program for eroded areas will be considered to promote better water quality.

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung

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Amfac has contacted the U.S. Fish and Wildlife Service ("FWS") about its Private Lands Program and will be exploring the potential of utilizing this program which could provide fencing to protect sensitive endangered species habitat in exchange for a ten year commitment to maintain the land in conservation. Ducks Unlimited ("DU") has also been contacted about its taro lands program. DU is working closely with FWS at Hanalei, the State's model for dual purpose use of agricultural lands as waterbird habitat.

We appreciate your review and comments on the Draft EIS; your concerns are addressed in Section 4.10 of the Final EIS. Please contact us if you have any questions or require additional information.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi
Project Planner

cc: Ms. Esther Ueda, Land Use Commission

University of Hawai'i at Mānoa

Environmental Center
A Unit of Water Resources Research Center
Crawford 317 • 2550 Campus Road • Honolulu, Hawai'i 96822
Telephone: (808) 956-7361 • Facsimile: (808) 956-3980

December 7, 1994
RE:0656

Ms. Esther Ueda
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Draft Environmental Impact Statement (DEIS)
Lihue-Hanamaulu Master Plan
Lihue, Kauai

The referenced project is a development proposal for a 552-acre master planned community located in the Lihue District adjacent to Lihue Town, the Lihue Airport and Hanamaulu Town. The proposed village is a mixed use concept that will "in-fill" lands adjacent to the existing Lihue Town, and will include commercial retail and office uses, public service facilities and open spaces within walking distance of one another. Industrial uses are planned for areas adjacent to the airport.

Residential development will provide approximately 1,400 to 1,800 units in a mix of product type and price range and will feature public and quasi-public facilities including police headquarters, a YMCA-type teen center and an elementary school. In support of the development, infrastructure facilities that will be constructed include roadways, bike routes and pedestrian paths, wastewater treatment and freshwater supply systems and fire protection.

The initial land use approvals to allow implementation of the proposed Master Plan include a State Land Use District Boundary Amendment to reclassify State Agricultural and Conservation land to the State Urban District and a County General Plan Amendment to designate Agricultural and Public Facility land as Urban Mixed Use.

This review was completed with the assistance of Peter Flachsbart, Urban and Regional Planning; George Taoka, Civil Engineering; Jon Matsuoka, Social Work; and Tom Hawley, Environmental Center.

5.3.A Aircraft Noise

Our reviewers expressed some concern about the findings on aircraft noise. The DEIS reads, ". . . existing aircraft noise levels do not exceed 60 Ldn at planned residential or other noise sensitive areas of the project area. Consequently, the proposed land uses are considered to be in the 'Acceptable' category as defined by the American National Standards Institute." According to our reviewers, however, the American National Standards Institute defines acceptable noise levels in relation to specific land uses. Given that the Lihue project incorporates different land uses in different areas of the project, we suggest that applying a 60 Ldn standard to the entire project represents an over-simplification of the impact of aircraft noise.

We suggest that noise criteria used by the developer should be clarified. The same paragraph quoted above refers to a noise contour of 65 Ldn. The 65 Ldn figure is the federal standard, while the 60 Ldn figure quoted earlier is the state of Hawaii benchmark. Our reviewers feel it is important to explain which of the two standards are being used.

5.3.B Traffic Noise

There is a discrepancy between the noise increase figures found on page 5-10 and figures reported in Appendix N, page I-1. On page 5-10, the text reads, "Along the existing roadways which will service the project, traffic noise levels are expected to increase by 3.4 to 8.2 Ldn between CY 1994 and CY 2016." The summary of Appendix N on page I-1 reads "Along the existing roadways which are expected to service the project traffic, noise levels are expected to increase by 0.4 to 5.7 Ldn between CY 1994 and CY 2016 as a result of project traffic." The numbers in the appendix summary seem to correspond with those found in Table 6 on page VI-2 of Appendix N. However, the source of the numbers cited on page 5-10 of the DEIS is unclear.

Our reviewers also commented that the DEIS features a study of combined aircraft and traffic noise level increases, but it lacks a contour map that reflects this combined study. The final EIS should include such a map to assist interpretation of noise impacts. Also, the project could curtail future improvements to the Lihue Airport due to the proximity of the airport to residential land uses within the project area. In view of this, the developer may wish to consider additional appropriate mitigative measures.

5.2 B Future Traffic Projections and Impacts

Roadway improvements scheduled in the DEIS for 2006 and 2016 are crucial. Specifically, widening Rice Street and Kapule Highway must be implemented on schedule, or else traffic congestion will result.

Appendix P: Social Impact Assessment

Our reviewers have expressed concern about the methodology employed in preparation of the Social Impact Assessment (SIA). According to Section 5.1 of Appendix P, 62 Kauai residents were asked to comment on a series of questions regarding the proposed project. However, we note that the list of interviewees was provided for the most part by Amfac/JMB and Kauai-based project team members. Reviewing the affiliations listed in the appendix to the SIA, we are concerned that the group is over-representative of business and development interests. By contrast, representation of the farming, fishing and environmental advocacy communities is sparse, and we are concerned that this sampling may not accurately reflect the opinions of Kauai's diverse population. Given that the entire island will be affected by the proposed project, it is important to explore the island-wide consequences of the project through a more comprehensive interview process. Because the developer or the developer's agents largely provided the list of interviewees, we question the objectivity of the survey methodology.

Social impacts are of particular concern to Kauai's native Hawaiian population. Native Hawaiians may have a different view of development issues, and it is inappropriate, not to mention discriminatory, to deny them a voice. Crucial issues including beach and shoreline access and the affordability of residential units within the proposed project need to be clarified, since these issues are part of the larger cultural context of the island. If a certain percentage of the units are purchased by non-residents, how will this affect the culture of the island, and who on Kauai will be most directly affected?

In a similar vein, we believe the developer has not adequately clarified the price range of residential units within the project area and to whom they intend to market these units. Will marketing efforts target current island residents, state residents or people from out of state? Table 5 on page 19 of Appendix P lists median annual income in Lihue Town at $48,000, but fails to clarify what this means and how this information fits into the overall plan. Will the price range of residential units in the project be tailored to this information, or will prices reflect a marketing strategy designed to attract outside buyers?

Though a variety of measures are proposed on pages 71-74 of Appendix P to mitigate some of the social impacts of the project, there is no explicit description of processes designed to ensure that these measures are implemented. We suggest that a project of this magnitude requires more definitive proposals and procedures to alleviate cultural and social conflicts than those provided in the DEIS.

Although the rationale for issues analysis (section 5.11) downplays the relevance of quantitative opinion sampling, our reviewers suggest that qualitative data alone are insufficient, and there is a need to quantify the sentiments of island residents toward the proposed project. In addition, a study by Jon Matsuoka entitled "Kauai: Between Hurricanes" in the 1994 edition of Social Process in Hawai'i, vol. 35, provides information about the social attitudes of many Kauai residents. We believe this kind of information would be helpful in assessing and mitigating some of the social impacts of the proposed project.

12.0 Comments and Responses

We note that the letter from the Department of Business, Economic Development and Tourism specifically suggested that the DEIS include use of the state Model Energy Code as a guide for energy efficient planning. In response, the developer states ". . . the Model Energy Code will be considered during the preparation of the Draft and Final Environmental Impact Statements for the Lihue-Hanamaulu Master Plan." However, we were unable to find evidence that the Model Energy Code was consulted in the evaluation of energy impacts found in section 5.8.6 of the DEIS and we would like to see the DBEDT's concerns addressed more specifically.

Thank you for the opportunity to comment.

Sincerely,

John T. Harrison
Environmental Coordinator

cc: OEQC
AmFac/JMB Hawaii, Inc.
PBR Hawaii ✓
Peter Flachsbart
George Taoka
Jon Matsuoka
Tom Hawley

DEPARTMENT OF WATER
COUNTY OF KAUAI
P.O. BOX 1706
LIHUE, HAWAII 96766-5706
PHONE NO: (808) 245-6986 FAX NO. 245-5813

DEC 12

December 7, 1994

Ms. Ester Ueda
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, HI 96813

RE: Petition for Amendment to the State Land Use District Boundaries, A94-703/The Lihue Plantation Co., Ltd. Agricultural and Conservation to Urban. Hanamaulu and Kalapaki, Kauai. TMK: 3-6-2: Por. 1, Por. 4, and 17, 3-7-1: Por. 1; 3-7-2: Por. 1 and Por. 12, and 3-7-3: Por 20.

We have no objections to this General Plan Amendment. However, any actual subdivision or development will be dependent on the adequacy of the Source, Storage and Transmission facilities existing at that time. At the present time, the proposed development is outside of the Department of Water, County of Kauai's full-growth service area. The existing Source, Storage and Transmission facilities are not adequate to handle the proposed demands of this development.

Prior to granting approval for any actual subdivision or development of the area, the applicant must:

1. Prepare and receive Department of Water's approval of a Water Master Plan for full development of this area, along with hydraulic calculations and details of the proposed water system improvements.

2. Develop additional Source, Storage and Transmission facilities which are required as part of the approved water master plan for the proposed development.

Murl T. Nielsen
Manager and Chief Engineer

ED:dc
cc: Timothy Johns, Amfac/JMB Hawaii
Yukie Ohashi, PBR Hawaii

JOHN WAIHEE
GOVERNOR

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
677 QUEEN STREET, SUITE 300
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FAX (808) 587-0600

IN REPLY REFER TO:
94:PPE/6136

December 12, 1994

TO: Esther Ueda, Executive Office
State Land Use Commission

FROM: Joseph K. Conant
Executive Director

SUBJECT: Draft EIS for the Lihue-Hanamaulu Master Plan

Thank you for the opportunity to review the subject draft EIS.

We have no further comments to offer.

c: OEQC
Amfac/JMB Hawaii, Inc.
PBR Hawaii

HFDC

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

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

SUBJECT: LIHUE-HANAMAULU MASTER PLAN DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Dear Mr. Harrison:

We have reviewed your letter of December 7, 1994 regarding the Draft EIS for the Lihue-Hanamaulu Master Plan and offer the following responses to your comments:

1. Noise Impacts

a. Aircraft Noise

The siting of noise sensitive uses of the project comply with both the existing federal noise standard of 65 Ldn (as defined by the American National Standards Institute) as well as the more stringent State of Hawaii planning guideline of 60 Ldn for the siting of noise sensitive land uses in the vicinity of airports, and are considered to be 'Acceptable' by both federal and state noise criteria.

The Master Plan takes into account the existing airport noise contours as shown in Figure 5-3 (on page 5-12) and the projected 2010 noise contours as shown in Figure 5-4 (on page 5-13). The Master Plan depicts a combined 60 Ldn noise contour line for 1994 and 2010 and noise sensitive land uses including residential areas and the school site are sited within the acceptable area outside of the 60 Ldn contour line. In the higher noise exposure zone of 65 to 70 Ldn, Industrial and Public/Quasi-Public uses are planned, and are also considered to be 'Acceptable' by local and federal noise criteria. Therefore, special aircraft noise attenuation measures are not applicable to this project.

b. Traffic Noise

The reason for the apparent difference is that the increase of 3.4 to 8.2 Ldn (as found on page 5-10 of the Draft EIS) is expected to result from total (including non-project) traffic, while the increase of 0.4 to 5.7 Ldn (as reported in Appendix N, page I-1) is expected to result only from project traffic.

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung
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CORRECTION

THE PRECEDING DOCUMENT(S) HAS
BEEN REPHOTOGRAPHED TO ASSURE
LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

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

SUBJECT: LIHUE-HANAMAULU MASTER PLAN DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

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c. Combined Aircraft and Traffic Noise

The study of the effects of combined aircraft plus traffic noise was performed to reduce risks of exceeding the FHA/HUD standard of 65 Ldn when siting residential properties. Aircraft noise levels between 60 and 55 Ldn can increase the setback distances to the 65 Ldn traffic noise contours shown in TABLE 4B of Appendix N under unobstructed line-of-sight conditions between the receptor and the traffic and aircraft noise sources. According to the acoustical consultant, Y. Ebisu & Associates, development of additional combined aircraft plus traffic noise contours were not considered appropriate for this study for the following reasons:

(1) The available forecast years for the aircraft operations and the traffic were not the same (CY 2010 and CY 2016, respectively). For demonstration of compliance with the FHA/HUD noise standard of 65 Ldn when federal financial assistance is sought, a separate noise study will be required with a common forecast year.

(2) The general locations of the combined (aircraft plus traffic) 65 Ldn contours using the two different forecast years were provided in Pages VII-4 and VII-5 of Appendix N. As indicated on Page VII-4 in Appendix N, the locations of the combined 70 Ldn contours in the noise sensitive areas of interest should remain at the setback distances indicated in TABLE 4B since forecasted aircraft noise levels are less than 60 Ldn in these noise sensitive areas. The locations of the combined 60 Ldn contours are generally not definable without knowledge of the locations and characteristics of the future residential structures since traffic noise shielding effects can be expected from the first row of new homes.

2. Future Traffic Projections and Impacts

The traffic impact analysis for the project was prepared by Austin, Tsutsumi & Associates ("ATA"). ATA is also the traffic engineer presently preparing the Kauai islandwide traffic update for the State Department of Transportation. As noted in Section 5.2 and Appendix E, the widening of Rice Street is recommended even without the development of the Lihue-Hanamaulu Master Plan by the year 2006, and the widening of Kapule Highway is recommended by the year 2016 also with or without the proposed project. We concur that these roadway improvements should be implemented on schedule to mitigate future traffic congestion.

3. Lihue-Hanamaulu Master Plan Social Impact Assessment

The Social Impact Assessment ("SIA") prepared by Earthplan (attached to the Draft and the Final EIS as Appendix P) is a comprehensive report which includes a profile of the existing community, an identification of the major forces of change on Kauai and the related potential social impacts of the project. The assessment also includes the result of a survey of community members.

a. Survey Methods

Selection of Interviewees. The survey sample included 62 individuals and was intended to identify preliminary issues related to the proposed master plan project. As stated on page 61 of the Lihue-Hanamaulu Master Plan Social Impact Assessment, four major sources helped to provide the list of interviewees, these included: 1) Amfac/JMB Hawaii staff on Kauai, 2) the then County of Kauai Planning Department Deputy Director, 3) individuals with whom Earthplan had made previous contact, and 4) additional referrals from interviewees. The latter two sources provided thoughtful and overlapping suggestions and gave Earthplan access to several environmental and cultural or special interest groups. Your statement, "Because the developer or the developer's agents largely provided the list of interviewees, we question the objectivity of the survey methodology," is incorrect.

Balanced Interests. We disagree that those interviewed over-represented development and business interests. As noted on page 62 of the SIA, 46 percent of those interviewed were very active in community affairs. The interviewees were further categorized as follows: 38 percent were current or former public employees and/or officials, and 21 percent live near the project site. By comparison, 39 percent of the interviewees were members of business organizations. It is too simplistic to infer that membership in a "business organization" means that all members will support all development wherever it occurs.

Environmental Interests. Earthplan did attempt to contact community members who are known to represent environmental concerns. Earthplan contacted representatives of organizations such as the Sierra Club and Kauai's Thousand Friends. Most of them responded that the site or the project was out of their area of concern, and they asked Earthplan to concentrate on people who live in the area. Please note that Earthplan was able to interview a Board member of Kauai's Thousand Friends.

Concerns about Native Hawaiians. The social impact assessment did not discriminate against native Hawaiians as your letter implies. It would be difficult to determine how many of the interviewees were ethnic Hawaiian since individuals were not asked their ethnicity, but Earthplan notes that it interviewed five people who are very active in Hawaiian organizations. These five individuals provided referrals both within their ethnic community and the general community. Please refer to Appendix A of the SIA, and note some of the affiliations listed by individuals including memberships in The Royal Order of Kamehameha, hula halau, Hale Opio Kauai, Inc., a canoe club, Ho'ola Lahui Hawaii, Hawaiian Sovereignty Election Council, and Kauai Burial Council. Earthplan also made sure that it spoke with people in Japanese and Filipino organizations since those are the predominant ethnicities in the Lihue and Hanamaulu areas.

Farming and Fishing Interests. Given the task of uncovering all interests relevant to this project, Earthplan asserts it made every effort in the interview and referral process to seek out a variety of interests and disclose their opinions. Also, Earthplan sought comments specifically on this project. Regarding your comment that farming and fishing interests were sparsely represented, we would like to clarify that this is not a rural area, and the farming and fishing community is not active on-site. None of the wide cross-section of interviewees suggested that Earthplan contact such groups, including the 23 people involved in public or social services.

Media Coverage. Finally, the project was highly publicized in Kauai and Oahu print and broadcast media. We are reasonably assured that those who were not identified and directly contacted would have been alerted of the proposed development through these means. In addition, Amfac staff on Kauai have made extensive efforts to provide information to a broad spectrum of organizations and individuals. At two public hearings held before the Kauai Planning Commission, public testimony was received from groups or interests already acknowledged in the SIA or Draft EIS. All testimony was in favor of the project.

b. Beach and Shoreline Access

The area of application is not on the beach or shoreline, so the basis for wanting these issues addressed is unclear. However, it should be noted that is currently considering, in a separate effort, to increase shoreline access through the dedication of land makai of the Kapule Highway bridge to allow the expansion of the County's Hanamaulu Beach Park fronting Hanamaulu Bay. Should this occur, funding would be provided by the County of Kauai.

c. Mitigation

The recommendations presented on pages 71 through 74 of the Social Impact Assessment was provided by those interviewed. Many of these recommendations are consistent with the Lihue-Hanamaulu Master Plan and helps to confirm the planning process Amfac is pursuing. To ensure that any potential impacts to residents are mitigated, other recommendations can be used by decision makers in addition to comments received on the EIS and public testimony that have and will be submitted through various permit processes.

d. Use of Quantitative Analysis

We concur that quantitative analysis is a valuable tool in social impact assessments. Page 60 of Appendix P, Social Impact Assessment describes the "strengths" and "weaknesses" of quantitative analysis. We also believe that the issues analysis is a valuable tool in identifying community-wide issues in an in-depth manner. It goes well beyond having people respond to simplified statements with "strongly agree," "strongly disagree," and so on. The respondent is thus able to express appreciation and desires for only a part of what makes Kauai a community. It is felt that an objective study should explore feelings regarding all aspects of quality of life. In the interviews, Earthplan asked people to relate their existing lifestyle and community to the specific proposal, and sought their recommendations on ways to mitigate any impacts. Ideally, these recommendations garnered from interviews help the applicant and government agencies to identify ways to improve the project and/or mitigate impacts to existing residents.

In reference to the article prepared by Jon Matsuoka, we note that although the paper was published in 1994, the survey was conducted in 1991 prior to Hurricane Iniki which devastated the island two years ago. This information is considered outdated because the survey was taken when the island was experiencing relatively strong economic growth. Unemployment was low, new hotels were opening, and people were happy with their quality of life. As Matsuoka's study shows, almost three-fourths of the respondents were generally satisfied with their standard of living.

Since Hurricane Iniki, Earthplan has completed three in-depth social impact studies on Kauai and has spoken to people of many walks of life, cultural backgrounds, business and environmental orientations. Earthplan always inquires about quality of life, and respondents indicate a general deterioration since Iniki. Because of the closure of many businesses resulting in families leaving Kauai there is social stress and tension, and the housing supply is not improving. There is no doubt that the island residents want at least some economic development, and Earthplan's studies have reflected that desire.

We note that the comments on the SIA raised in your letter emphasize rural lifestyle, the protection of native Hawaiian resources, and fishing, hunting and gathering issues. Absent are questions about economic development and jobs which are fundamentally linked to the well-being of the citizenry and the overall health of the community. We feel that an objective study should explore feelings regarding all aspects, which when balanced, provides a relative assessment of the community's quality of life.

3. Market Demand for Residential Units

a. Intended Market

The market analysis prepared by Arthur Andersen & Co., (Section 2.5 and Appendix F) indicates that the primary market for residential units will be the Lihue District resident and the secondary market buyer will be other Kauai residents. In addition, the mix of product type will include affordable for-sale and rental housing, as well as market priced homes, to allow all residents an opportunity to live within the project area. While the project area will be attractive to Kauai residents due to proximity to commercial centers and public recreational facilities, it is unlikely to be attractive to short-term residents who would rather be near the ocean, beaches and resort-type amenities. Reactions to the proposed plan voiced in the interviews for the SIA survey indicate that the project goals are consistent with the community's overall expectations for the expansion of Lihue.

b. Price Range for Residential Units

According to Arthur Andersen & Co., in order to promote as rapid an absorption of residential units as possible, a variety of residential products is recommended to be offered at different prices to appeal to a broad portion of the market as possble. This will mean, over time, that units will be offered in a range of prices from the "affordable" to that which could be bought by upper-middle class Kauai residents consistent with price levels in other areas of the Lihue District. Generally, prices will follow the range of prices for other residential units in the Lihue District.

c. Median Income

The distribution of income levels is more important than median income levels because residential units are typically bought by individuals or families with a variety of incomes, rather than larger groups with similar incomes.

4. Model Energy Code

The State's Model Energy Code, Energy Efficient Standard for Buildings (DBEDT, July 1993) goal is to reduce our consumption of oil and provide significant savings in utility costs as well as help improve air quality by reducing fossil-fuel burning. The Code is currently being reviewed and revised by the County of Kauai and is expected to be adopted by Spring 1995 according to DBEDT Energy Division staff. As adopted, applicable standards of the Code for residential and public buildings will be integrated into the Design Guidelines for the project and will become a code requirement to obtain building permits for the various structures planned at the project.

We appreciate your review and comments on the Draft EIS; your concerns are addressed in the Final EIS. Please contact us if you have any questions or require additional information.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi
Project Planner

cc: Ms. Esther Ueda, Land Use Commission

1144.01\rl-uh.w60

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO

11010
Ser N42/7472
OCT 24 1994

State Land Use Commission
335 Merchant Street, Room 104
Honolulu, HI 96813

Dear Ms. Ueda,

Thank you for the opportunity to review the final EIS for Lihue-Hanamulu Master Plan dated October 1994.

The Navy has no comments to offer at this time and appreciates the opportunity to participate in your review process.

The Navy's point of contact is Mr. Stanford Yuen at 474-0439.

Sincerely,

STANFORD B.C. YUEN, P.E.
Facilities Engineer
By direction of
the Commander

Copy to:
Amfac/JMB Hawaii, Inc.
700 Bishop Street, 21st Floor
Honolulu, HI 96813

PBR HAWAII
Pacific Tower, Suite 650
1001 Bishop Street
Honolulu, HI 96813

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

Mr. Stanford B.C. Yuen, P.E., Facilities Engineer
Department of the Navy
Naval Base Pearl Harbor
Box 110
Pearl Harbor, Hawaii 96860-5020

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Dear Mr. Yuen:

We have reviewed your letter of October 24, 1994 regarding the Draft EIS for the Lihue-Hanamaulu Master Plan. We note that your agency has reviewed the subject EIS and has no comments to offer at this time.

Thank you for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi

Yukie Y. Ohashi
Project Planner

cc: Ms. Esther Ueda, Land Use Commission

1144.01\rl-02.w60

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y.J. Chung

PACIFIC TOWER, SUITE 650 1001 BISHOP STREET HONOLULU, HAWAII 96813 TELEPHONE: (808) 521-5631 FAX: (808) 523-1402
BRANCH OFFICE: HILO LAGOON CENTER 101 AUPUNI STREET, SUITE 310 HILO, HAWAII 96720 TELEPHONE: (808) 961-3333 FAX: [illegible]

Cheryl Lovell-Obatake
P.O. Box 366
Lihue, Hawaii 96766

October 31, 1994

State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Attention: Ms. Esther Ueda, Executive Officer

**Re: Lihue - Hanamaulu Master Plan
Draft Environmental Impact Statement
TMK: 3-6-2:01 and 4 (pors.); 3-6-2:17; 3-6-2:20 (por.); 3-7-1:01 (por.); 3-7-2:01 and 12 (pors.); 3-7-3:20 (por.)
Kalapaki and Hanamaulu, Lihue District, County of Kaua'i, Hawaii**

Dear Ms. Ueda:

I recently had the opportunity to review the Draft Environmental Impact Statement. I, like others have concerns, and desire additional information.

Question: Is the proposed industrial area similar to the Lihue Industrial Center Phase I & II? If so, how? If not, why?

Clarify: "Light Industrial Use."

As a life time resident of Kalapaki, Nawiliwili, I raise these concerns in light of my witnessing past experiences of negative impacts to the water quality and ocean habitats at Nawiliwili Stream and Kalapaki Bay. Hanamaulu and Nawiliwili have similar land contours and waterway features.

The Draft EIS Lihue - Hanamaulu Master Plan/ section on Social Impact Statement prepared by Earthplan; Pg. A-4 indicates my little participation as one of the listed people interviewed in this study. I concur with the County, State and Federal agencies comments at this time. I understand further comments will be available at a later date.

I am enclosing for your review a Draft Master Plan Proposal which I am proposing to Amfac/JMB's Lihue - Hanamaulu Community Development Master Plan. I welcome your comments.

Thank you for your time, and diligent reviews of this project as it progresses.

Sincerely,

Cheryl Lovell-Obatake

Cheryl Lovell-Obatake

cc: Amfac/JMB Hawaii Inc. - Mr. Timothy Johns
PBR HAWAII - Ms. Yukie Ohashi
Lihue Plantation Company, Limited - Mr. Mike Furukawa

DRAFT
LIHUE - HANAMAULU
CEMETERY MASTER PLAN
PROPOSAL

PROPOSED BY: CHERYL LOVELL-OBATAKE

DRAFT
LIHUE - HANAMAULU
CEMETERY MASTER PLAN
PROPOSAL

PROPOSED BY: CHERYL LOVELL-OBATAKE

October 31, 1994

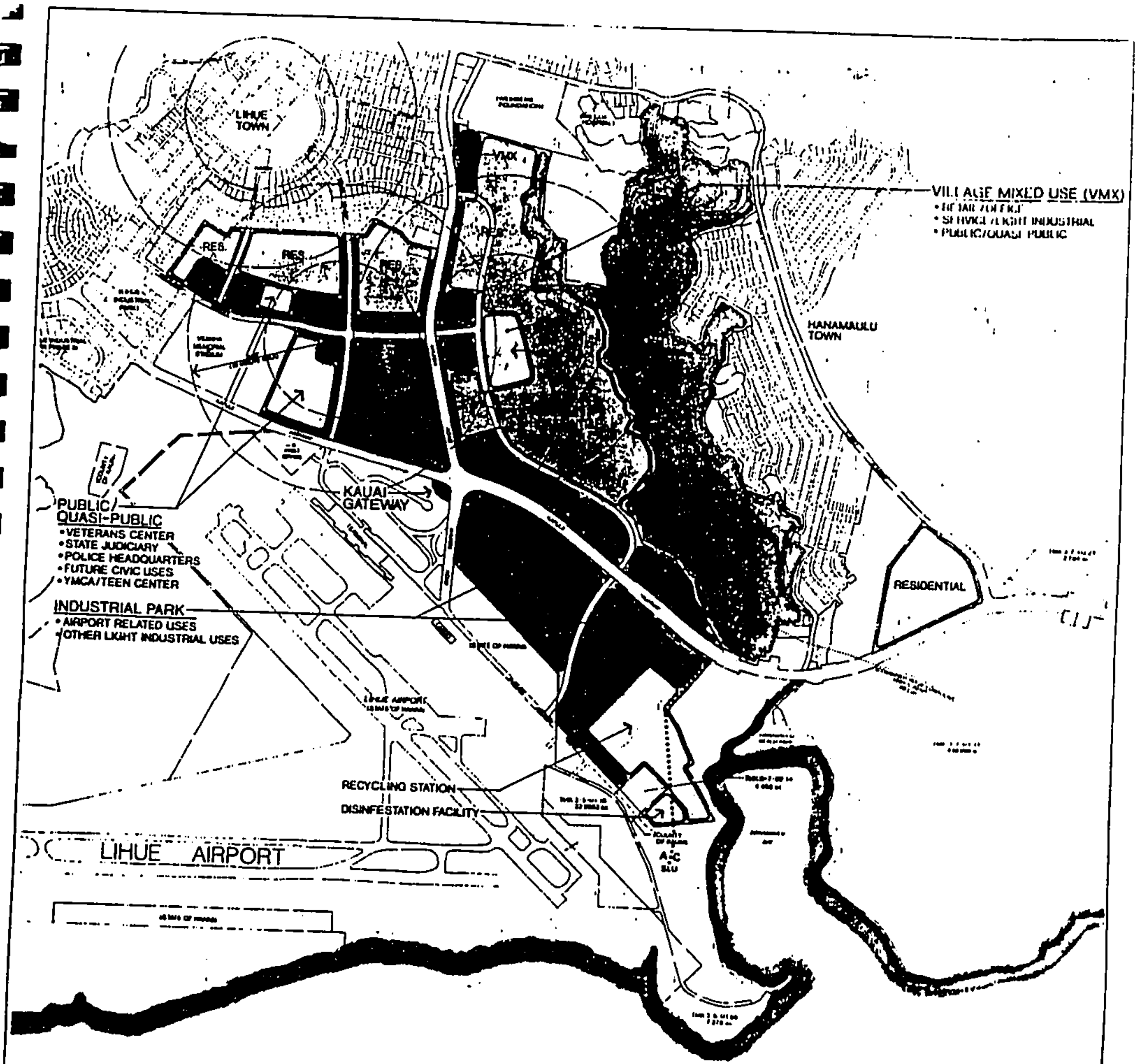
TO:

Amfac/JMB Hawaii, Inc. and The Lihue Plantation Co. Ltd.
2970 Kele Street
Lihue, Hawaii 96766

Ms. Esther Ueda, Executive Officer
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

FROM:

Cheryl Lovell-Obatake
P.O. Box 366
Lihue, Kaua'i, Hawaii
9 6 7 6 6



LAND USE SUMMARY	APPROX. ACRES
RESIDENTIAL	
SINGLE FAMILY (1,000-1,250 UNITS)	178
MULTI-FAMILY (400-550 UNITS)	34
VILLAGE/MIXED USE	
RETAIL/OFFICE	70
SERVICE/LIGHT INDUSTRIAL	26
INDUSTRIAL	102
PUBLIC/QUASI-PUBLIC	70
PARKS/OPEN SPACE	48
MAJOR ROADWAYS	24
TOTAL	552

SUBJECT TO CHANGE

FIGURE 1
LIHUE-HANAMAULU MASTER PLAN

LIHUE-HANAMAULU

AMFAC/JMB HAWAII — LIHUE DISTRICT, ISLAND OF KAUAI

0 450 900 1800 FEET

PBR HAWAII

INTRODUCTION

The Lihue - Hanamaulu Master Plan with its village mixed use development proposal is unique. I concur that the plan will meet the projected growth of Lihue Town and the demand for housing. Considering the future growth of Kaua'i, I believe that the plan should also meet the reality of death rates. Master planning for community cemeteries is necessary, as studies reveal that Kaua'i's known cemeteries are soon to be filled.

Concerns for known abandoned cemeteries such as the "Old" Hanamaulu Community Cemetery has been neglected and trashed. The location is near Mt. Kalepa. Due to the slopes, rain water runoffs have eroded most of the burials there. A solution for restoring or relocating needs to be addressed to the various agencies, and associations involved.

Therefore, I propose this Draft Lihue - Hanamaulu Cemetery Master Plan Proposal to Amfac/JMB Hawaii Inc.

LIHUE - HANAMAULU
CEMETERY MASTER PLAN
PROPOSAL

VISION

To establish a community cemetery in the Lihue - Hanamaulu area.

GOALS

* To provide final resting places for the people.
* Prevent future burdens on family members, and the community, of finding locations for their loved ones.
* Provide accurate and up-date record keeping for interments, burials, and all pertinent information.
* Coordination with DCCA, DOH, and the County of Kaua'i to establish long-term maintenance programs that keep the grounds and books in order.

APPROACH

* PHASE ONE

  Design Guidelines and Standards:

  During this phase, efforts for cemetery design layout, as well as interment and reinterment, would be documented into a set of standards to be used at a future cemetery location. These would include, but not limited to, the following: Beliefs and customs, proper treatment, and all the Federal, State and County regulations that must be followed.

* PHASE TWO

  Site Analysis:

  After completing the first task, efforts would be shifted to a detailed analysis of the site, and that the best location can be found. This analysis would also include infrastructure demands such as roads, water, electricity, etc.

  In addition concerns such as proximity to towns, morturaries, cremation facilities, and embalmers would also be taken into consideration. Cost analysis, usability, and the above mentioned issues for a site would also be used to determine the best location during the phase of the work.

* PHASE THREE

  Land Acquisition:

  Once the site is determined, a value and acquisition process can commence with interested buyers in this type of business.

* PHASE FOUR

Entitlement and Recordation:

While under option or as conditions of the site, the entitlement process, including but not limited to the DOH, DCCA, and the County, should receive all permits as required and delineated by the Design Guidelines and Standards created in Phase One of this proposal.

* PHASE FIVE

Construction:

As required by any project the construction of basic facilities would be necessary for preparing the cemetery for use. These improvements may include, but not be limited to: driveways, water, fencing or walls, etc. These elements will be detailed in the Design Guidelines and addressed in the analysis (Phase One and Two).

* PHASE SIX

Operations, Management, and Maintenance:

As essential, and required by the State, all new cemeteries are required to prepare an Operations, Management and Maintenance Plan guarantee that the facility is well kept and meets all requirements set forth by DCCA and DOH. The most important element of this document is the perpetual fund, which is paid into at the sale of each burial plot and is placed in an interest bearing account, to be managed by the owners, solely to pay for upkeep of the property.

EXAMPLE:

CONCEPTUAL SITE PLAN

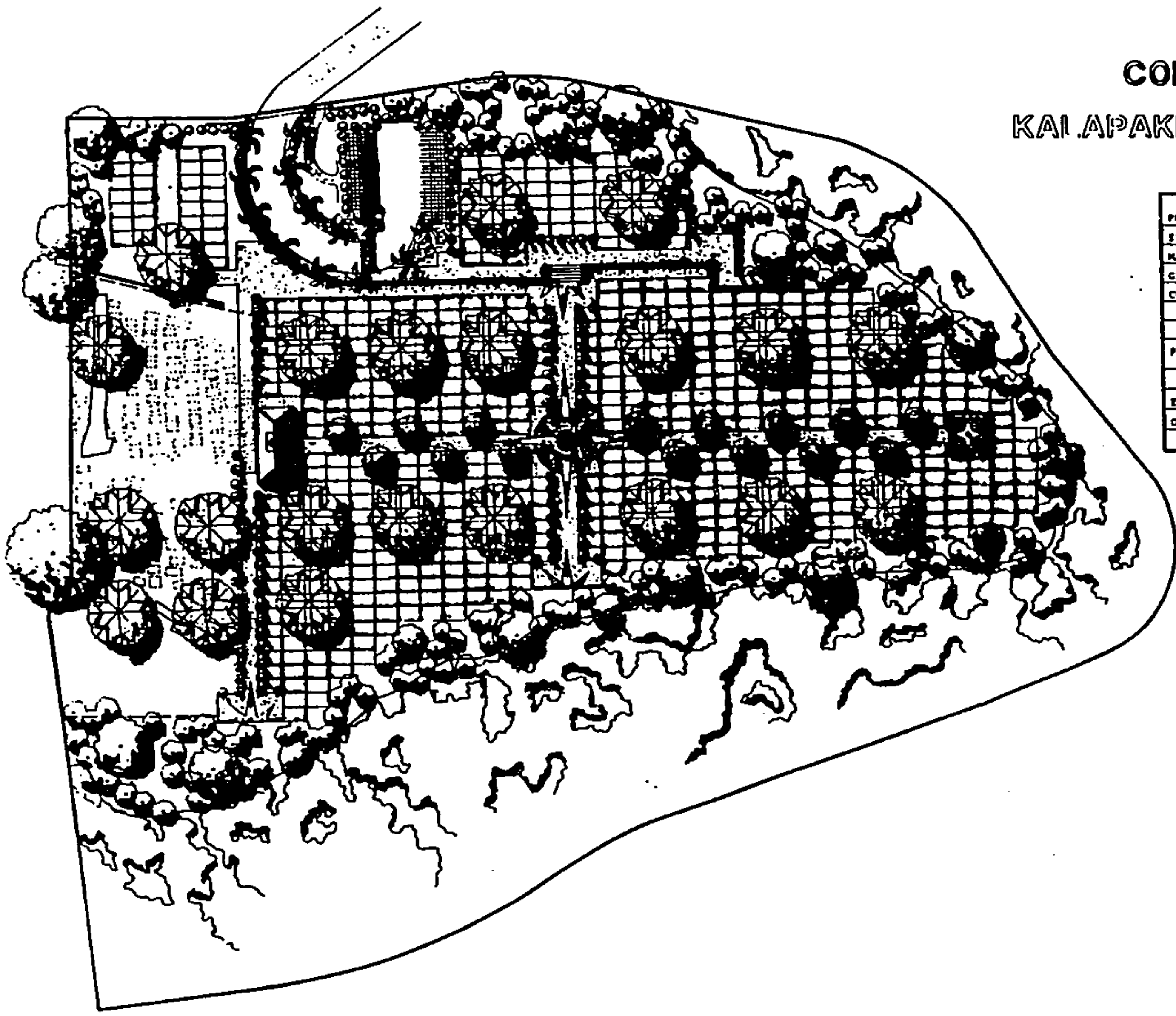
AT

KALAPAKI POINT

NAWILIWILI, KAUA'I, HAWAII

CONCEPTUAL SITE PLAN

KALAPAKI POINT MEMORIAL GARDENS



STATISTICAL SUMMARY

PROPOSED USE		SQUARE FEET	ACRES	AREA (%)	PROJECT (%)
SINGLE GRAVE PLOTS	2,750	72,875	1.67	29	
MAUSOLEUM PLOTS	250	1,000	0.02	<1	
GRASS CREMATION PLOTS	600	600	0.01	<1	
COLUMBARIUM NICHES	2,800	600	0.01	<1	
TOTAL PLOTS	6,400	75,075	1.72	31	31
PAVED SURFACE	ROADS WALKS	4,390 10,392	0.101 0.420	2 7	8
EXISTING CEMETERY		26,136	0.60	10	10
OPEN SPACE/LANDSCAPE AREA		123,479	2.83	50	50
TOTAL PROJECT		247,904	5.679		100

THE KEITH COMPANIES-HAWAII, INC.

PBR HAWAII

LAND PLANNING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL STUDIES

January 12, 1995

Ms. Cheryl Lovell-Obatake
P.O. Box 366
Lihue, Hawaii 96766

SUBJECT: LIHUE-HANAMAULU MASTER PLAN DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Dear Ms. Lovell-Obatake:

Thank you for your letter of October 31, 1994 regarding the Draft EIS for the Lihue-Hanamaulu Master Plan. We have reviewed your letter and offer the following responses.

1. Design Standards for Proposed Industrial Development

The proposed light industrial development will differ from the Lihue Industrial Center in that there will be strict design and use controls established through the preparation of design guidelines, the creation of a design review committee, and the adoption of covenants, conditions and restrictions (CC&Rs). The design guidelines will establish the character of the industrial development addressing such issues as: minimum lot sizes; minimum lot width and depth; minimum front, side and rear yard setbacks; maximum building area; maximum building heights; building materials; building colors; signage and landscaping. The landscaping portion of the design guidelines will likely specify visual screening measures along Kapule and Ahukini Highways, such as planted berms and taller and wider canopy trees. These design guidelines will be incorporated into the CC&Rs, which will also include the establishment of a design review committee to review the design of any structures before they are built within the project. The review function is to maintain consistency to the guidelines and where there is non-conformance, the committee may require corrective action. These tools are intended to supplement the Kauai County Zoning Code to ensure a well planned and controlled development of Industrial-zoned areas. Amfac/JMB Hawaii, Inc.'s ("Amfac") proposed design controls will be beneficial not only to the residents of Kauai, but will help to maintain the desirability and marketability of the light industrial area.

2. Clarification: Definition of "Light Industrial Use"

"Light or Limited Industrial Use" is intended to include uses which are generally in support of but not necessarily compatible with permissible uses in the Commercial District. According to the Kauai County Zoning Code, the following uses and structures are permitted in the Limited Industrial District: accessory uses and structures; animal hospitals; automobile services, sales, repair and

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y.J. Chung
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BRANCH OFFICE: HILO LAGOON CENTER 101 AUPUNI STREET, SUITE 310 HILO, HAWAII 96720 TELEPHONE: (808) 961-3333 FAX: (808) 961-4989

storage; cemeteries, mortuaries and crematoriums; communication facilities; construction material storage; food processing and packaging; light manufacturing; manufacturing in retail sales; private and public utilities and facilities; public parks and monuments; research and development; restaurants, bars and food services; retail sales; and warehouses. Industrial uses in this area will be limited to those which have few environmental impacts (such as noise). By comparison, "Heavy or General Industrial Use" are uses that are generally considered offensive to the senses or pose some potential threat or hazard to health, safety and welfare.

3. Potential Water Quality Impacts

We share your concern about the potential downstream impacts from proposed light industrial areas. As stated in the Draft EIS, the storm drainage system will be designed to County of Kauai and State Department of Health ("DOH") standards with the intent that the infrastructure improvements will be dedicated to the County. In developing the project, Amfac/JMB Hawaii, Inc. ("Amfac") intends to incorporate Best Management Practices, such as detention basins, buffer strips, and biofiltration channels, to the fullest extent practicable. It should be noted that sediment loads to Hanamaulu Stream and offshore areas will decrease as lands are taken out of sugar cane use. The Drainage Study that was prepared for the Draft EIS estimated that with the proposed drainage improvements, peak discharge rates to Nawiliwili Stream and Bay would be slightly better than the existing conditions (existing flow is 811 cubic feet per second, future flow is estimated at 810 cubic feet per second).

State of Hawaii and County of Kauai regulations and guidelines will be followed in preparing a grading plan in accordance with the County's Grading Ordinance and State DOH National Pollutant Discharge Elimination ("NPDES") Guidelines. A specific and detailed BMP Plan will be prepared and submitted for review when project specific plans require these permits. A BMP Plan will need to be approved by DOH and the County Public Works Department to assure that water quality degradation will not occur and negatively affect organisms in the receiving freshwater, estuarine and marine water environments.

Please note that the disposal of materials, liquid and solid, will also be addressed in the CC&Rs, as well as by Federal, State and County laws regarding the control, handling and disposal of such materials..

4. Participation in the Community Survey

We appreciated your participation in the interviews conducted by Earthplan. Your comments (and those of others interviewed) helped to identify community issues to formulate the Social Impact Assessment.

5. Draft Cemetery Master Plan

Please note that Amfac has reviewed your draft Cemetery Master Plan proposal. The applicant or one of its subsidiaries owns lands that are closer to the existing Old Hanamaulu Community Cemetery, which may be more suitable for expansion or reinterment than a site within the Lihue-Hanamaulu area. We understand that Amfac's Project Coordinator, Pat Lee, as well as Asset Manager, Mike Furukawa, have been in contact with you and will continue to keep you informed of any developments regarding this issue.

Thank you again for your interest in the Lihue-Hanamaulu Master Plan. If you should have any further questions, please do not hesitate to contact me at 521-5631 or Pat Lee at 245-4947.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi

Yukie Y. Ohashi
Project Planner

cc: Ms. Esther Ueda, Land Use Commission

1144.01\rl-07.w60

12.3 COMMENTS RECEIVED ON THE ENVIRONMENTAL ASSESSMENT / NOTICE OF PREPARATION OF DRAFT EIS

COUNTY OF KAUAI
Department of Public Works

STATE AGENCIES
Department of Accounting and General Services
Department of Business, Economic Development and Tourism
Department of Business, Economic Development and Tourism - Energy Division
Department of Education
Department of Hawaiian Home Lands
Department of Health
Department of Land and Natural Resources
Department of Land and Natural Resources - Historic Preservation Division
Department of Transportation
Housing Finance and Development Corporation
Office of Hawaiian Affairs
Office of State Planning

FEDERAL AGENCIES
Federal Aviation Administration
U.S. Department of Agriculture, Soil Conservation Service
U.S. Army Corps of Engineers
U.S. Geological Survey

12.4 EA/NOP COMMENT LETTERS AND THE APPLICANT'S RESPONSES (Published Initially in the Draft EIS)

The following section includes letters sent to the Land Use Commission in response to the Notice of Preparation of a Draft EIS for the Lihue-Hanamaulu Master Plan. Responses to the comments have been prepared by PBR HAWAII on behalf of The Lihue Plantation Company and Amfac/JMB, Inc.

JOANN A. YUKIMURA
MAYOR

AN EQUAL OPPORTUNITY EMPLOYER
COUNTY OF KAUAI
DEPARTMENT OF PUBLIC WORKS
3021 UMI STREET
LIHUE, KAUAI, HAWAII 96766

ELDON FRANKLIN
COUNTY ENGINEER
TELEPHONE 241-6600

EDMOND P.K. RENAUD
DEP. COUNTY ENGINEER
TELEPHONE 241-6600

PW6.243

June 23, 1994

State Land Use Commission
335 Merchant St., Room 104
Honolulu, Hawaii 96813

Attention: Esther Ueda

Gentlemen:

RE: LIHUE-HANAMAULU MASTERPLAN
KALAPAKI AND HANAMAULU
TMK: 3-6-2:01 & 04 (POR), 3-6-2:17,
3-7-1:01 (POR), 3-7-2:01 & 12 (POR)
AND 3-7-3:20 (POR)

Reference is made to your letter dated June 13, 1994 requesting our comments on the proposed project. Our comments are as follows.

The general plan amendment proposes to change the land use of approximately 552 acres of land which are mostly in agricultural land use into single and multifamily residences, village/mixed uses, and industrial and public land uses. The Environmental Assessment (Exhibit E), Section 4.42 Traffic, mentions that ".... the conceptual masterplan next to Lihue where established roadways already exists, present traffic conditions should not be altered significantly." We do not feel that the statement is an accurate assessment for the potential traffic impacts. We would expect considerable traffic that would be generated from almost 1,700 single and multifamily units and the 208 acres planned for industrial and public uses. (1,700 units is derived from the projected densities given in the assessment). We will need a traffic report that study and evaluate the traffic impact from the project with recommended improvements that need to be made to State and County roadways. The report must be reviewed and accepted by the State and the County.

The project will change the storm water coefficient by changing about 552 acres of lands that are in agriculture to urban residential, industrial and public areas. The Environmental Assessment (Exhibit E), Section 5.3.4 Soil Erosion indicates ".... that runoff will increase slightly or decrease slightly for the developed site with retention basins (conservatively estimated to retain 25 percent of runoff)." A drainage masterplan that show the predevelopment and afterdevelopment hydrologic and hydraulic conditions will be required. Retention or detention basin appears to be an acceptable measure to keep runoff sediments, and urban pollutants onsite to minimize environmental and physical damages to downstream lands and waters. However, we believe that the retention or detention basin should also be designed for multipurpose use such as a park and must have shallow ponded depths in the interest of safety.

The Environmental Assessment, Section 5.13 Wastewater, mentions "The sewer pump station has enough capacity to handle the additional flows that will be generated by the developed Hanamaulu triangle". This is not an accurate assessment. The sewer pump station off Hanamaulu Road needs to be evaluated to determine whether sufficient capacity is available to handle flows generated by the developed Hanamaulu triangle.

Section 5.13.3 Wastewater, only discusses the wastewater issues relative to the Hanamaulu triangle area. The Section should be expanded to also address the other areas that are expected to be developed, especially since those areas may be outside of the "County sewerable area" and public sewerage may not be available.

Please contact Kenneth Kitabayashi at 241-6616 if there are any questions.

Very truly yours,

ELDON FRANKLIN
County Engineer

KK/cu

cc: OEQC
AMFAC/JMB Hawaii
PBR Hawaii Inc.

PBR HAWAII

October 10, 1994

Mr. Eldon Franklin, County Engineer
County of Kauai
Department of Public Works
3021 Umi Street
Lihue, Hawaii 96766

SUBJECT: **LIHUE-HANAMAULU MASTER PLAN**
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Mr. Franklin:

Thank you for providing your comments on the EA/NOP for the Lihue-Hanamaulu Master Plan. We have prepared responses to the issues you raised in your letter of June 29, 1994.

1) Traffic Impact Analysis

A study to analyze potential development-generated traffic impacts on the roadway system within the project's study area has been prepared by Austin, Tsutsumi & Associates, Inc. and is included in the Draft EIS as Appendix E. Proposed base roadway improvements by the State and the County, to allow the street and highway system to accommodate the future traffic volumes after the completion of development are key factors in the study. The proposed Lihue-Hanamaulu Master Plan development is projected to be completed over a 15 to 20 year period; therefore, additional traffic resulting from this development will be phased. Appropriate mitigative measures are described for the project related impacts and include roadway modification measures such as turning lanes which will be implemented to maintain the flow of traffic. The traffic impact analysis report will be submitted to both State and County traffic departments for review and approval.

2) Stormwater Runoff and Erosion Control

Mitigative measures which include detention basins will be implemented during the construction period and as permanent features of the project. This is detailed in the Preliminary Engineering Report for Drainage Requirements prepared by Kodani and Associates, Inc. which is attached as Appendix D in the Draft EIS. The study analyzes the existing and future conditions of the storm water coefficient used to calculate the effectiveness of the developed condition with on-sited, detention facilities. Mitigative measures for short-term construction period impacts are described

in the Draft EIS. Permanent drainage facilities (which will serve a dual purpose as parks) as you suggest, are incorporated in the engineering plans for the project.

3) Development of Wastewater Treatment Facilities

An infrastructure report for the development of a wastewater system to serve the Lihue-Hamnamaulu Master Plan flows of approximately 1.51 mgd average daily flow has been prepared for the project by Austin, Tsutsumi & Associates. The study addresses wastewater collection, treatment and effluent disposal alternatives. For wastewater treatment the options include 1) expansion of the Lihue WWTP, 2) construction of a new WWTP on the project site, and 3) a combination of a new on-site WWTP and expansion of the Lihue plant. The alternatives for effluent disposal will include re-use applications on existing sugar cane fields and landscaping on and off the project area. These options are presently being discussed between the developer, the County, the Department of Transportation Airports Division and Lihue Airport.

We appreciate your review and comments on the Notice of Preparation; your concerns are further addressed in the Draft EIS. Thank you again for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Ohashi

Yukie Ohashi
Project Planner

OFFICE OF STATE PLANNING
Office of the Governor

Ref. No. C-751

July 27, 1994

LAND USE COMMISSION
STATE OF HAWAII
JUL 29 8 31 AM '94

MEMORANDUM

TO: Ms. Esther Ueda, Executive Officer
Land Use Commission

SUBJECT: LUC Docket No. A94-703
Environmental Assessment and Notice of Preparation for an Environmental Impact Statement: Lihue-Hanamaulu Master Plan; Kalapaki and Hanamaulu

The applicant, AMFAC/JMB HAWAII, INC., will be preparing an Environmental Impact Statement (EIS) for the Lihue-Hanamaulu Master Plan, Kalapaki and Hanamaulu pursuant to Chapter 343 and Administrative Rules, Title 11, Chapter 200.

These lands, located at Kalapaki and Hanamaulu, Kauai, Hawaii and identified as TMK: 3-6-02:01 (por.) and 04 (por.), 3-6-02:17, 3-7-1:01 (por.), 3-7-2:01 and 12 (por.), and 3-7-3:20 (por.) are part of an overall 552-acre Master Planned Area adjacent to Lihue to be developed for residential, commercial retail and office, industrial, and public/quasi public uses.

The master plan area has been submitted as a Petition to the State Land Use Commission requesting the reclassification of 539.153 acres from the Agricultural District, and 12.873 acres from the Conservation District to the Urban District. As stated in the Environmental Assessment, the petition area is recommended for reclassification to the Urban District in the State Land Use District Boundary Review, Kauai, 1992.

The impacts of the Master Plan on Lihue airport should be thoroughly assessed.

Thank you for the opportunity to review and comment. Should you have any questions, please contact Robyn Loudermilk at 587-2889.

Mary Lou Kobayashi for
Harold S. Masumoto
Director

PBR HAWAII
LANDSCAPE ARCHITECTURE
PLANNING
ENVIRONMENTAL STUDIES

October 10, 1994

Ms. Norma Wong, Director
Office of State Planning
Office of the Governor
P.O. Box 3640
Honolulu, Hawaii 96811-3540

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Ms. Wong:

Thank you for your comments of July 27, 1994 regarding the Notice of Preparation for an Environmental Impact Statement (EIS) for the Lihue-Hanamaulu Master Plan.

As noted in your letter, a Petition to the State Land Use Commission has been submitted to request the State Land Use Commission reclassification for "552 acres" of Agricultural (539.153 acres) and Conservation (12.873 acres) District lands to the Urban District. However, since the Environmental Assessment was prepared, please be advised that a boundary interpretation by the LUC has adjusted actual the Agricultural acreage to 538.819 acres.

As stated in your letter, the Project Area has been recommended for reclassification to the Urban District in the State Land Use District Boundary Review, Kauai 1992. We concur that there is a need for additional Urban District land in the Lihue District and as called for in the Lihue-Hanamaulu Master Plan.

The planning for the Lihue-Hanamaulu Master Plan has thoroughly assessed the potential impacts to Lihue Airport and associated noise and safety zones applicable to the project area. The developer, Amfac/JMB Hawaii, Inc., has met with DOT-Airports Division and Lihue Airport administrators and staff, to discuss all issues relative to the operations at the airport. We will continue to coordinate our efforts with the respective agencies.

Thank you again for participating in the environmental review process.

Sincerely,
PBR HAWAII

Yukie Y. Ohashi
Yukie Y. Ohashi
Project Planner

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W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung

(P)1647.4

JUL 20 1994

State Land Use Commission
335 Merchant Street
Honolulu, Hawaii 96813

Attention: Ms. Esther Ueda

Gentlemen:

Subject: Lihue-Hanamaulu Master Plan
Lihue, Kauai, Hawaii
EIS Preparation Notice

Thank you for the opportunity to review the subject document. We have no comments to offer.

If there are any questions, please have your staff contact Mr. Ralph Yukumoto of the Planning Branch at 586-0488.

Very truly yours,

Gordon Matsuoka

GORDON MATSUOKA
State Public Works Engineer

RY:jk
cc: Amfac/JMB Hawaii, Inc.
✓PBR Hawaii, Inc.
OEQC

.M. 22

PBR HAWAII

October 10, 1994

Mr. Gordon Matsuoka
State Public Works Engineer
Department of Accounting and General Services
1151 Punchbowl Street
Honolulu, Hawaii 96813

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Mr. Matsuoka:

We have reviewed your letter of July 20, 1994 regarding the Lihue-Hanamaulu Master Plan. We note that your agency has reviewed the subject EISPN and has no comments to offer at this time.

Thank you for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Ohashi

Yukie Ohashi
Project Planner

1144 01EACOM

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

(P)1647.4

JUL 20 1994

State Land Use Commission
335 Merchant Street
Honolulu, Hawaii 96813

Attention: Ms. Esther Ueda

Gentlemen:

Subject: Lihue-Hanamaulu Master Plan
Lihue, Kauai, Hawaii
EIS Preparation Notice

Thank you for the opportunity to review the subject document. We have no comments to offer.

If there are any questions, please have your staff contact Mr. Ralph Yukumoto of the Planning Branch at 586-0488.

Very truly yours,

GORDON MATSUOKA
State Public Works Engineer

RY:jk
cc: Amfac/JMB Hawaii, Inc.
✓PBR Hawaii, Inc.
OEQC

.F1. 22

PBR HAWAII

October 10, 1994

Mr. Gordon Matsuoka
State Public Works Engineer
Department of Accounting and General Services
1151 Punchbowl Street
Honolulu, Hawaii 96813

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Mr. Matsuoka:

We have reviewed your letter of July 20, 1994 regarding the Lihue-Hanamaulu Master Plan. We note that your agency has reviewed the subject EISPN and has no comments to offer at this time.

Thank you for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Ohashi
Project Planner

11440IEA.COM

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
677 QUEEN STREET, SUITE 300
HONOLULU, HAWAII 96813
FAX (808) 587-0600

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

IN REPLY REFER TO:
94:PPE/4056

July 22, 1994

TO: Esther Ueda, Executive Officer
State Land Use Commission

FROM: Joseph K. Conant
Executive Director

SUBJECT: Environmental Assessment and Notice of Preparation for an Environmental Impact Statement for the Lihue-Hanamaulu Master Plan

Thank you for the opportunity to review the subject report.

Policies A(3) and B(3) of the State Housing Functional Plan seek to ensure that housing projects and projects which impact housing provide a fair share/adequate amount of affordable homeownership and rental opportunities. The applicant has indicated that affordable housing and special needs housing will be provided in accordance with applicable State and County requirements. We look forward to further discussions with the applicant.

c: OEQC
Amfac/JMB Hawaii
PBR Hawaii

HFDC

PBR HAWAII
LANDSCAPE ARCHITECTURE
PLANNING
ENVIRONMENTAL STUDIES

October 10, 1994

Mr. Joseph K. Conant
Executive Director
State of Hawaii
Housing Finance and Development Corporation
677 Queen Street, Suite 300
Honolulu, Hawaii 96813

SUBJECT: **LIHUE-HANAMAULU MASTER PLAN**
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Mr. Conant:

Thank you for providing your comments on the EA/NOP for the Lihue-Hanamaulu Master Plan. We have prepared a response to the issues you raised in your letter of July 22, 1994

The proposed project will provide a full range of housing opportunities for Kauai residents, including affordable homes for purchase and for rent. The project theme is of a village mixed use master planned development. This will allow not only the availability of affordable housing, but housing in relationship to employment opportunities within the village context. The plan is sensitive to residents who prefer to reside within short distances of their place of employment for economic or other reasons. In addition, gap group and market priced homes will be available.

Our client, Amfac/JMB Hawaii, Inc. and its representatives will continue to meet with your Department to ensure that applicable provisions of the State Housing Functional Plan are implemented.

We appreciate your review and comments on the NOP; your concerns are further addressed in the Draft EIS. Thank you again for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Ohashi
Project Planner

1144.01EACOM

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung
PACIFIC TOWER, SUITE 650 · 1001 BISHOP STREET · HONOLULU, HAWAII 96813 · TELEPHONE (808) 521-5631 · FAX (808) 523-1402
BRANCH OFFICE: [illegible]

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

MUFI HANNEMANN, Director
RICK EGGED, Deputy Director
JEANNE K. SCHULTZ, Deputy Director
TAKESHI YOSHIHARA, Deputy Director

JUL 8

June 29, 1994

Ms. Esther Ueda
Executive Officer
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

The Department of Business, Economic Development & Tourism is pleased to submit the enclosed comments on the Lihue-Hanamaulu Master Plan, Kalapaki and Hanamaulu Environmental Assessment and the Notice of Preparation for an Environmental Impact Statement.

The comments were provided by our Energy Division. Questions regarding these comments may be directed to Maurice Kaya, Energy Division Chief, at 587-3800.

Thank you for the opportunity to comment.

Sincerely,

Mufi Hannemann

Enclosure

cc: Mr. Tim Johns
Mr. Yukie Ohashi

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

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

Director
JEANNE SCHULTZ, Deputy Director
RICK EGGED, Deputy Director
TAKESHI YOSHIHARA, Deputy Director

June 22, 1994

SUBJECT: Lihue-Hanamaulu Master Plan, Kalapaki and Hanamaulu Environmental Assessment and Notice of Preparation for an Environmental Impact Statement (EIS)

The Energy Division has the following comments on the subject:

Draft Environmental Impact Statements should comply with the requirements found in State laws for evaluating any energy impacts that the project will have. The mandate for such an evaluation is found in Chapter 344, HRS ("State Environmental Policy") and Chapter 226, HRS ("Hawaii State Planning Act"). In particular Chapter 226-18 (a)(2) and (c)(3); 226-52 (a) and (b)(2)(D); and 226-103 (f)(1) and (2) should be considered.

We also would like to call your attention to the Model Energy Code which may be used as a guide for energy efficiency. If you do not already have a copy of the Energy Code, please call the Energy Division at 587-3800 and we will forward one to you.

PBR HAWAII

October 10, 1994

Ms. Jeanne Schultz, Director
State of Hawaii
Department of Business,
Economic Development, and Tourism
P.O. Box 2359
Honolulu, Hawaii 96804

SUBJECT: **LIHUE-HANAMAULU MASTER PLAN**
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Ms. Schultz:

Thank you for providing your comments in your letter of June 29, 1994 on the EA/NOP for the Lihue-Hanamaulu Master Plan.

The Draft Environmental Impact Statement will include an evaluation of any energy impacts of the proposed project in accordance with Chapter 344, HRS (State Environmental Policy") and Chapter 226, HRS ("Hawaii State Planning Act"). You may note that Chapter 226-18 (c)(3), 226-103 (f)(2) and (f)(3) were discussed in the EISPN.

These laws and the Model Energy Code will be considered during the preparation of the Draft and Final Environmental Impact Statements for the Lihue-Hanamaulu Master Plan.

We appreciate your review and comment on the Notice of Preparation; your concern is addressed in the Draft EIS. Thank you again for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi

Yukie Y. Ohashi
Project Planner

1144.01EACOM

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung

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JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF EDUCATION

HERMAN M. AIZAWA, Ph.D.
SUPERINTENDENT

OFFICE OF THE SUPERINTENDENT

July 14, 1994

LAND USE COMMISSION
STATE OF HAWAII
JUL 22 11 57 AM '94

Ms. Esther Ueda
Executive Officer
State Land Use Commission, DBEDT
Old Federal Building
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

SUBJECT: Lihue-Hanamaulu Master Plan
Environmental Assessment

We have reviewed the subject assessment and have determined that the proposed development will have the following enrollment impact on the area schools:

Schools	Grades	Projected Students
Wilcox/Kaumualii Elementary	K-5	242
Kauai Intermediate	6-8	73
Kauai High	9-12	94

All three schools in the area are operating at or beyond capacity. The Department of Education cannot assure the availability of classrooms to accommodate the students projected from this development.

A new elementary school will be needed to prevent overcrowding at Wilcox and Kaumualii Elementary Schools. Although the DOE has plans to build two new intermediate schools and one elementary school in the Lihue and Kapaa areas, the projected enrollments from new developments in the service boundary areas of the schools will surpass the capacities of both elementary schools.

AN AFFIRMATIVE ACTION AND EQUAL OPPORTUNITY EMPLOYER

The DOE will request that the developer make a fair-share contribution to the satisfaction of the DOE for the construction of needed school facilities. The dedication of a twelve-acre school site will be required and can be credited toward the fair-share contribution.

Should there be any questions, please call the Facilities Branch at 737-4743.

Sincerely,

Herman M. Aizawa, Ph.D.
Superintendent

HMA:hy

cc: A. Suga, OBS
S. Akita, KDO

PBR HAWAII

LANDSCAPE ARCHITECTURE
PLANNING
ENVIRONMENTAL STUDIES

October 10, 1994

Dr. Herman Aizawa, Superintendent
State of Hawaii
Department of Education
P.O. Box 2360
Honolulu, Hawaii 96804

SUBJECT: **LIHUE-HANAMAULU MASTER PLAN**
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Dr. Aizawa:

Thank you for your comments of July 14, 1994 regarding the Lihue-Hanamaulu Master Plan Preparation Notice.

To address the potential impact of the Lihue-Hanamaulu Master Plan on schools in Lihue and within the service boundary, a 12-acre school site is shown within the Ahukini-Mauka area of the project area. Approximately four acres of the school site will also serve as a community park.

Since the Environmental Assessment was distributed, the project's land use components have been revised in accordacnce with the findings and recommendations of technical studies prepared for the Draft EIS. The revised Lihue-Hanamaulu Master Plan now calls for between 1,400 to 1,800 residential units rather than the 2,000 as originally envisioned. To reflect the revised residential component of the Plan, new student projections have been calculated in discussions with your staff. These projections are as follows:

Schools	Grades	Project Students
Elementary	K-5	353
Intermediate	6-8	107
High School	9-12	136

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung
PACIFIC TOWER, SUITE 650 · 1001 BISHOP STREET · HONOLULU, HAWAII 96813 · TELEPHONE (808) 521-5631 · FAX (808) 523-1402
BRANCH OFFICE: HILO LAGOON CENTER · 101 AUPUNI STREET, SUITE 310 · HILO, HAWAII 96720 · TELEPHONE (808) 961-3333 · FAX (808) 961-4989

Dr. Herman Aizawa, Superintendent
SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS
October 10, 1994
Page 2

To accommodate the educational needs of Lihue and project residents, we understand that the DOE may also consider other off-site elementary school sites as a viable alternative. Determination of the most suitable location is on-going through discussions between Amfac/JMB and the DOE.

Amfac/JMB will continue to work with the DOE to identify future educational requirements in accordance with adopted policy.

Thank you again for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Ohashi

Yukie Ohashi
Planner

11440IEACOM.DOC

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

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

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

Ms. Esther Ueda, Executive Officer
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Subject: Lihue-Hanamaulu Master Plan, Kauai

Thank you for allowing our review of the Environmental Assessment for the above project to reclassify approximately 552 acres into the Urban District for development of a planned community by Amfac/JMB Hawaii, Inc.

The proposed project and affiliated boundary amendments will have no direct impacts on programs and projects of this department. We have no objections to approval.

Should you have any questions, please call Joe Chu of our Planning Office at 586-3838.

Warmest aloha,

for Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

HLD:DY:JC/3324L2

cc Office of Environmental Quality Control
Amfac/JMB Hawaii, Inc.
PBR Hawaii, Inc.

PBR HAWAII

October 10, 1994

Ms. Hoaliku L. Drake, Chairman
Hawaiian Homes Commission
P.O. Box 1879
Honolulu, Hawaii 96805

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Ms. Drake:

Thank you for your review and letter of June 21, 1994 regarding the Lihue-Hanamaulu Master Plan Environmental Impact Statement Preparation Notice.

We appreciate your participation in the environmental review process. Thank you again.

Sincerely,

PBR HAWAII

Yukie T. Ohashi

Yukie Ohashi
Project Planner

1144 01EACOM

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung

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JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

PETER A. SYBINSKY, Ph.D.
DIRECTOR OF HEALTH

-2

In reply, please refer to:
94-124/epo

LAND USE COMMISSION
STATE OF HAWAII
JUL 29 11 52 AM '94

July 21, 1994

Ms. Esther Ueda
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii

Dear Ms. Ueda:

Subject: Environmental Assessment and Notice of Preparation for an Environment Impact State
Lihue - Hanamaulu Master Plan
Kalapaki & Hanamaulu, Kaua'i, Hawaii

Thank you for allowing us to review and comment on the subject document. We have the following comments to offer:

1. The proposed development shall be serviced by the existing County system serving the Lihue-Hanamaulu area.

2. A portion of the proposed development for the Lihue area will be in close proximity to a Kaua'i Electric Company transformer site. A prudent approach is needed at this time to regulate magnetic fields around low-frequency electric power facilities. The public should be protected against the known and possible health risks associated with transmitters. The existing research data suggests that uncertainties relating to the health effects of electromagnetic fields should be resolved in favor of protecting public health. Where technically feasible, public exposures should be minimized. The applicant should contact Mr. Leslie Au of the Hazard Evaluation & Emergency Response Office of the Department of Health at 586-4249 to address and resolve this concern.

3. Although the assessment describes the existing drainage pattern, it fails to address the impact from stormwater discharges from the proposed development into Hanamaulu Stream and Hanamaulu Bay. Any increase in discharges into Hanamaulu Stream and Hanamaulu Bay could adversely degrade the water quality of Hanamaulu Bay to a point where recreational activities would be curtailed or restricted.

4. The impact of fugitive dust emissions and noise from the Niu Construction, Inc. asphalt concrete batch plant (TMK: 3-7-02:12) on any development adjacent to and downwind of the plant needs to be addressed. We have had complaints from residents in Hanamaulu and the Wilcox Hospital area.

5. In accordance with Chapter 11-60.1, "Air Pollution Control," Hawaii Administrative Rules (HAR), the property owner/developer shall be responsible for ensuring that effective control measures are provided to prevent or minimize any fugitive dust emission caused by the construction work from impacting the surrounding areas, including the off-site roadways used to enter/exit the project. These measures include, but are not limited to, the use of water wagons, sprinkler systems, dust fences, etc.

6. In accordance with Chapters 11-55, "Water Pollution Control" and 11-54, "Water Quality Standards," HAR, the property owner/developer shall be responsible for ensuring that the best management practices (BMP) are provided to prevent or minimize the discharge of sediments, debris, and other water pollutant into state waters.

7. In accordance with Chapter 11-58.1, "Solid Waste Management Control," HAR, the property owner/developer shall be responsible for ensuring that grub material, demolition waste and construction waste generated by the project are disposed of in a manner or at a site approved by State Department of Health. Disposal of any of these wastes by burning is prohibited.

8. The property owner/developer shall be responsible for obtaining all applicable permits from the Department of Health, prior to construction, including but not limited to, National Pollution Discharge Elimination System (NPDES) permits for storm water, hydrostatic testing and dewatering.

9. The property may harbor rodents which will be dispersed to the surrounding areas when the site is cleared. In accordance with Chapter 11-26, "Vector Control," HAR, the applicant shall ascertain the presence or absence of rodents on the property. Should the presence of rodents be determined, the applicant shall eradicate the rodents prior to clearing the site.

10. The proposed development shall be provided with potable water from an approved source.

Due to the general nature of the application submitted, we reserve the right to implement future environmental health restrictions when more detailed information is submitted to the Department of Health.

Sincerely,

PETER A. SYBINSKY, Ph.D.
Director of Health

c: Kaua'i District Health Office

PBR HAWAII

October 10, 1994

Dr. Peter A. Sybinsky, Ph.D, Director
State of Hawaii
Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801

SUBJECT: **LIHUE-HANAMAULU MASTER PLAN**
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Dr. Sybinsky:

Thank you for your comments on the EA/NOP for the Lihue-Hanamaulu Master Plan Environmental Impact Statement Preparation Notice. We have prepared responses to the issues you raised in your letter of July 21, 1994.

1) Connection to County Water and Wastewater

The proposed project will be connected to the existing County of Kauai water and wastewater systems after appropriate improvements are in place to accommodate future requirements. The Applicant The Lihue Plantation Company, Limited ("LPCo") and the developer, Amfac/JMB Hawaii, Inc. ("Amfac/JMB") are working with the County and will provide the infrastructure improvements to accommodate the additional demand the development will place on the County's resources. The infrastructure systems are anticipated to be tied into and dedicated to the county's existing systems for water and wastewater.

2) Kauai Electric Company Transformer Site

Amfac/JMB and Kauai Electric are presently negotiating to relocate the transformer to an off-site location in anticipation of project development and the expiration of Kauai Electric's lease in July 1995. The negotiations for Kauai Electric's continued use of LPCo's lands are currently underway. The Department of Health will be consulted in the final selection of the relocation site to ensure public health and safety.

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung
PACIFIC TOWER, SUITE 650 1001 BISHOP STREET HONOLULU, HAWAII 96813 TELEPHONE (808) 521-5631 FAX (808) 523-1402

3) Impact of Storm Water Discharge to Hanamaulu Stream and Hanamaulu Bay

We recognize Hanamaulu Bay as a valued community resource widely used by the community. The proposed project takes into consideration the effect of runoff into Hanamaulu Stream and the bay and has planned stormwater runoff control measures on-site to minimize the impact to both bodies of water.

As described in the Draft EIS studies have been completed and described in three technical reports, the Drainage Report (Appendix D), the Marine Communities and Water Quality Report in Hanamaulu Bay (Appendix H), and the Hanamaulu Stream Biological Survey (Appendix I). The studies assessed the existing conditions and evaluated the project's potential for impacts to the bay and stream. With the planned drainage control measures proposed for storm water detention, the studies concluded that the proportionate level of increase relative to the total drainage basin is not sufficient to significantly impact the stream or ocean water quality, plant and animal habitats, or recreational activities in Hanamaulu Bay. In addition, at project completion, recreational activities are not expected to be curtailed or restricted, but in fact, may improve somewhat by reducing the soil erosion into the bay currently resulting from existing sugar cane agricultural practices.

4) Impacts From Niu Construction Co. (Located Adjacent to the Project Area)

Impacts of fugitive dust emissions and noise from the Niu Construction, Inc. asphalt concrete batch plant have been addressed in the Air Quality Impact Analysis (Appendix O) and the Acoustic Study (Appendix N) for the Draft EIS. Although no significant health impacts were noted, the concrete batch plant may periodically be a nuisance which could impact the proposed project. However, Applicant LPCo has used its best efforts to locate land uses under the Lihue-Hanamaulu Master Plan to be compatible with batch plant noise. The plant is under a short-term lease with LPCo; and if necessary, LPCo will explore relocating the plant to other more suitable LPCo lands.

5) Air Quality During Construction

The developer will fully comply with all provisions of Chapter 11-60.1, "Air Pollution Control," Hawaii Administrative Rules during project construction. The mitigation measures that were described in your letter will also be incorporated into the EIS. We would also like to add that given the phasing of the project over 15 to 20 years, the potential for fugitive dust emissions will be significantly less than would the development of the entire 552-acre site over a shorter development period, or during cane burning and harvesting.

6) Best Management Practice Plan

A Best Management Practice Plan ("BMP") will be developed and implemented in accordance with Hawaii Administrative Rules, Chapters 11-55, Water Pollution Control" and 11-54 "Water Quality Standards," by the developer. These will include the installation of sedimentation basins during construction and other best management practices. A BMP Plan will be prepared and submitted to the Department of Health in association with a National Pollution Discharge Elimination System ("NPDES") permit request.

7) Solid Waste Management Control

All provisions of Hawaii Administrative Rules, Chapter 11-58.1 regarding "Solid Waste Management Control" will be implemented. The project includes a site for the proposed County Lihue Debris Recycling Station whose uses would include the sorting, reuse or proper disposal of debris such as construction materials.

8) NPDES Compliance

All grading permits and the NPDES permit(s) will be obtained. Other permits for stormwater discharge, hydrostatic testing and dewatering will be obtained at the appropriate time in the entitlement approval and development process as they become necessary.

9) Vector Control Measures

In accordance with Hawaii Administrative Rules Chapter 11-26 the developer will ascertain the absence or presence of rodents on the property, which will likely be much less than presently occurring under the agricultural land use during harvest periods. The development of the proposed master plan will occur over a 15 to 20 year period, which will not require the clearing of large land areas. Consequently, the primary vector control impact will continue to occur during agricultural harvests. Although construction activities will also require vector control measures, the impacts should be relatively minor with appropriate mitigation measures.

10) Potable Water Development

To accommodate the increased demand of 1.75 mgd generated by the proposed project, approximately nine new wells will be developed. To ensure that this groundwater resource is developed in a manner which will protect its quality and continued sustainability, a Hydrologic Study (Appendix B) has identified two potential well sites at an elevation of approximately 393 feet MSL, approximately 1.5 miles mauka of the proposed project.

We appreciate your review and comments on the Notice of Preparation; your concerns are addressed in the Draft EIS. Please contact us if you have any questions or require additional information.

Sincerely,

PBR HAWAII

Yukie Ohashi
Project Planner

11401EACOM

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

REF:OCEA:DKP

FILE NO.: 94-704
DOC. ID.: 4678

LAND USE COMMISSION
STATE OF HAWAII
JUL 18 12 47 PM '94

JUL 15 1994

Ms. Esther Ueda, Executive Officer
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN): Lihue-Hanamaulu Master Plan, Lihue, Kauai, TMKs: 3-6-02: 1, por. 4; 17; 3-7-01: por. 1; 3-7-02: 1, por. 12; 3-7-03: por. 20

We have reviewed the EISPN information for the subject plan received on June 15, 1994, and have the following comments:

Historic Preservation Division

The Historic Preservation Division (HPD) comments that no archaeological inventory surveys have taken place in this project area, so they are uncertain if significant historic sites are present. According to this application, an archaeological survey was conducted, but HPD has not received a copy of the survey report for review. Thus, at this point, HPD is unable to determine if significant historic sites are present and, if so, if acceptable mitigation treatments are proposed. Until HPD has a chance to review the report and make these evaluations, they will recommend deferment of any permit decisions on this project.

Office of Conservation and Environmental Affairs

The Office of Conservation and Environmental Affairs (OCEA) comments that portions of TMK: 3-7-02: 1 are presently located within the General "G" and Limited "L" subzones of the Conservation District. OCEA also notes that portions of parcel 1 were involved in Conservation District Use Permit (CDUP) KA-1415, approved by the Board of Land and Natural Resources (Board) on December 4, 1981. This CDUP was for the construction of the Hanamalu-Ahukini Cutoff Road which was subject to seventeen (17) conditions (enclosed). A time extension for the completion of this project was also granted by Board on September 28, 1984.

We have no other comments to offer at this time. Thank you for the opportunity to comment in this process.

Please feel free to call Steve Tagawa at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

Very truly yours,

Keith W. Ahue
KEITH W. AHUE

PBR HAWAII

October 10, 1994

Mr. Keith W. Ahue
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Mr. Ahue:

Thank you for the comments of July 15, 1994 regarding the Lihue-Hanamaulu Master Plan EIS Preparation Notice.

1) Historic Preservation Division Review of the Archaeology Survey Report

The comments referred to from the State Historic Preservation Division have been acknowledged under separate correspondence to Mr. Don Hibbard. To reiterate, the archaeological inventory survey conducted on the property has been transmitted to the HPD and its review is being coordinated by Ms. Nancy McMahon. The full report is provided in the Draft EIS.

2) Conservation District Land

Regarding your comments received from the Office of Conservation and Environmental Affairs, we concur that portions of TMK: 3-7-02:1 are located within the General "G" and Limited "L" subzones of the Conservation District. The Conservation District Use Permit regarding the Hanamaulu-Ahukini Cutoff Road have been reviewed and will be incorporated into the Draft and Final Environmental Impacts Statements when applicable. The State Land Use District Boundary Amendment petition has been filed to request a reclassification of 12.873 acres of Conservation District land to the Urban District. The proposed land uses at this location include two facilities: 1) the Lihue Debris Recycling Station which is proposed to be developed by the County of Kauai, and 2) the Kauai Tropical Fruit Disinfestation Facility proposed by the University of Hawaii Office of Technology Transfer and Economic Development. Both of these projects are undergoing independent environmental review and permitting pursuant to Chapter 343, Hawaii Revised Statutes.

Mr. Keith W. Ahue
SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS
October 10, 1994
Page 2

Thank you again for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Ohashi

Yukie Ohashi
Project Planner

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

REF:OCEA:DKP

JUL 21 1994

FILE NO.: 94-704a
DOC. ID.: 4692

Ms. Esther Ueda, Executive Officer
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN): Lihue-Hanamaulu Master Plan, Lihue, Kauai, TMKs: 3-6-02: 1, por. 4; 17; 3-7-01: por. 1; 3-7-02: 1, por. 12; 3-7-03: por. 20

The following are our additional comments on the subject project which supplement those forwarded by our previous letter dated July 15, 1994:

Commission on Water Resource Management

The Commission on Water Resource Management (CWRM) comments that they have reviewed the subject EA/EISPN and have the following comments:

1. This project is not recognized in the Kauai County Water Use and Development Plan. CWRM recommends coordination with the Kauai Department of Water so that it is incorporated into the plan.

2. If well sources are anticipated, well construction permits must be obtained from CWRM.

3. In the situation that a drainage facility may affect nearby streams, a stream channel alteration permit would be required.

We have no other comments to offer at this time. Thank you for the opportunity to comment in this process.

Please feel free to call Steve Tagawa at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

Very truly yours,

KEITH W. AHUE

PBR HAWAII

October 10, 1994

Mr. Keith W. Ahue
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Mr. Ahue:

Thank you for the comments provided by the Commission on Water Resource Management ("CWRM") in your letter dated July 21, 1994 regarding the Lihue-Hanamaulu Master Plan EIS Preparation Notice. We offer the following in response to your comments.

1) Coordination with the Kauai Department of Water

A Preliminary Engineering Report for Water Requirements of the proposed project has been prepared by Kodani & Associates through consultation with the Kauai Department of Water. The developer, Amfac/JMB Hawaii, Inc. intends to integrate the project's requirements into the Kauai County Water Use and Development Plan. It is our understanding that the Kauai County Water Use and Development Plan incorporates population growth projections that must include new developments such as that proposed Lihue-Hanamaulu Master Plan if the projections are to be realized in the future. The project will coordinate with the Kauai Department of Water, as the Commission recommends, to efficiently utilize existing and future water system infrastructure.

2) Water Source Development

Approximately nine new wells will be required for the project which will require well construction permits from the CWRM. Permit requests will be submitted to the CWRM and County of Kauai at the appropriate time during the approval and development process.

3) No Impact to Streams

No streams or drainageways will be altered or otherwise impacted by the proposed project. Consequently, no stream channel alteration permits will be required.

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung

Mr. Keith W. Ahue
SUBJECT: LIHUE-HANAMAULU MASTE RPLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS
October 10, 1994
Page 2

Thank you again for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Y. Ohashi

Yukie Y. Ohashi
Project Planner

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER II
DONA L. HANAIKE

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

16

REF:OCEA:DKP

FILE NO.: 94-704b
DOC. ID.: 4753

SEP 13 1994

LAND USE COMMISSION
STATE OF HAWAII
SEP 14 2 48 PM '94

Ms. Esther Ueda, Executive Officer
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN): Lihue-Hanamaulu Master Plan, Lihue, Kauai, TMKs: 3-6-02: 1, por. 4, 17; 3-7-01: por. 1; 3-7-02: 1, por. 12; 3-7-03: por. 20

The following are our additional comments on the subject document which supplement those forwarded by our previous letter dated July 21, 1994:

Division of Land Management

The Division of Land Management (DLM) comments that in review of the masterplan concept, they have no objections to the proposal; however, they do offer the following:

1. Beach Access Inasmuch as only a portion of TMK 3-7-02: 1 is being affected by the proposal, it is recommended that vehicular and pedestrian beach accesses, picnic, and parking areas be established via easement or dedication to the County, especially parallel to the coastline. This would provide additional coastal recreational and scenic opportunities for the visitors and residents of Kauai.

2. Drainage Sec. 5.5, Flood and Drainage, as it is presently written, does not provide any assurance that development of the properties as proposed will not create adverse flood or drainage problems downstream. It may be appropriate to reflect that any drainage flows over and above that existing, caused by development, will not cause adverse erosion, siltation, velocity, etc. Impacts downstream due to improvements that the developer(s) will provide, the minimum being catch basins and siltation ponds similar to that provided by A&B-Hawaii Inc. in Koloa. A channelized drainage, catch and siltation system to service this masterplan area should be reflected in this masterplan.

3. Noise Due to the proximity of these areas to the airport, it is recommended that a building/use setback line be established utilizing the appropriate dB noise level contour line. Such a concept was similarly imposed on the later phases of development of the Westin Kauai Lagoons/Shinwa resort project. This will assure that all development in the surrounding airport environs are compatible to the airport operations.

We have no other comments to offer at this time. Thank you for the opportunity to comment in this process.

Please feel free to call Steve Tagawa at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

Very truly yours,

Keith W. Ahue

KEITH W. AHUE

PBR HAWAII

LANDSCAPE ARCHITECTURE
PLANNING
ENVIRONMENTAL STUDIES

October 10, 1994

Mr. Keith W. Ahue
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Mr. Ahue:

Thank you for the comments provided by the Division of Land Management in your letter of September 13, 1994 regarding the Lihue-Hanamaulu Master Plan Environmental Impact Statement Preparation Notice.

1) **Beach Access**

The portion of the master plan area which is presently bounded by the shoreline of Hanamaulu Bay will become owned by either the County of Kauai or State of Hawaii upon implementation of the proposed master plan. As such, shoreline access will become the responsibility of the County and/or the State.

2) **Drainage**

The drainage concerns identified in your comments, will be largely mitigated by the drainage infrastructure proposed for the project. Although project development will result in drainage flows increasing above current levels during a 100-year storm, on-site retention facilities will control the quality and quantity of off-site drainage flows during the balance of normal rainfall periods. Channelization of existing drainageways or streams is not planned as part of the proposed master plan.

3) **Noise**

Noise considerations have also been considered in the development of the master plan by locating land uses compatible with higher noise levels (i.e. open space, industrial, commercial) within the noise contours generally considered unsuitable for residential development. The relationship of aircraft noise to the master plan will be fully explored in the Draft and Final EIS documents.

Mr. Keith W. Ahue
SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS
October 10, 1994
Page 2

Thank you again for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Ohashi

Yukie Ohashi
Project Planner

JOHN WAIHEE
GOVERNOR OF HAWAII

COPY

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

LOG NO: 11934
DOC NO: 9406NM59

June 30, 1994

Ms. Ester Ueda
State Land Use Commission
335 Merchant St., Rm. 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

SUBJECT: **Historic Preservation Review -- EA - Lihue-Hanamaulu Master Plan (AMFAC/JMB)**
TMK: 3-6-2: 01, 04; 3-6-2: 17, 3-7-2: 01, 12 por.; 3-7-1: 01 por., 3-7-3: 20
Kalapaki and Hanamaulu, Lihue, Kauai

No archaeological inventory surveys have taken place in this project area, so we are uncertain if significant historic sites are present. According to this application an archaeological survey was conducted, but we have not received a copy of the survey report for review. Thus, at this point, we are unable to determine if significant historic sites are present and, if so, if acceptable mitigation treatments are proposed. Until we have a chance to review the report and make these evaluations, we will recommend deferment of any permit decisions on this project.

If you have any questions, please contact Ms. McMahon, our staff archaeologist for the County of Kaua'i, at 587-0006.

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

NM:amk

c: Tim Johns, AMFAC/JMB
Yukie Ohashi, PBR Hawaii

PBR HAWAII

LANDSCAPE ARCHITECTURE
PLANNING
ENVIRONMENTAL STUDIES

October 10, 1994

Mr. Don Hibbard, Administrator
State Historic Preservation Division
33 South King Street, 6th Floor
Honolulu, Hawaii 96813

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Mr. Hibbard:

Thank you for providing your comments in your letter of June 29, 1994 on the EA/NOP for the Lihue-Hanamaulu Master Plan.

An archaeological inventory survey report based on the work conducted on the property by Paul H. Rosendahl, PhD., Inc. has been completed and submitted to your office for review. Ms. Nancy McMahon of your staff is coordinating the review. Archaeological and historic resources at the property are addressed in Section 5.1 of the Draft EIS; the full report is provided in the Draft EIS as Appendix M.

The findings of the archaeologist indicate that two sites, a historic house (Site 9402) and a wall (SIHP Site 1842), were identified within or immediately adjacent to the Master Plan area. Research and data recovery have been completed on both sites. No sites recommended for preservation were identified.

We appreciate your review and comments on the Notice of Preparation. Thank you again for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Ohashi

Yukie Ohashi
Project Planner

1144.01EACOM

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung

JOHN WAIHEE
GOVERNOR

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

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
KANANI HOLT
GLENN M. OKIMOTO
JOYCE T. OMINE
CALVIN M. TSUDA

IN REPLY REFER TO
STP 8.6211

July 26, 1994

Ms. Esther Uyeda
Executive Director
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Uyeda:

Subject: Environmental Assessment and Environmental Impact Statement Preparation Notice
Lihue-Hanamaulu Master Plan
Kalapaki and Hanamaulu, Kauai
TMK: 3-6-02: por. 1, por., 4, 17, por. 20;
3-7-01: por. 1, por. 12;
3-7-02: por. 1; 3-7-03: por. 20

We have the following comments on the Lihue-Hanamaulu Master Plan:

1. A Traffic Impact Analysis Report (TIAR) must be submitted for our review. The TIAR should evaluate the local and regional traffic impacts associated with the proposed development and identify the measures necessary to mitigate any adverse traffic impacts.

2. The developer is expected to provide required localized roadway improvements at no cost to the State and contribute its fair share for regional highway improvements as determined by our department.

3. There will be a need for identifying and dedicating additional rights-of-way for future bypasses and the widening of Kuhio and Kaumualii Highways. Details should be coordinated with our Highways Division.

4. Any proposed new highway access points and plans for work within the State highway rights-of-way must be submitted for our review and approval.

Ms. Esther Uyeda
Page 2
July 26, 1994

STP 8.6211

5. Portions of the petition area proposed for residential are located within the 55-65 Ldn noise contour and/or is subject to Lihue Airport aircraft overflights. We recommend that no residential units be constructed within areas exposed to noise levels of 60 Ldn or greater.

6. The developer should be aware of the disclosure requirements of aircraft noise levels for any real estate transactions as stated in Chapter 467-31, HRS. The noise exposure maps of the Lihue Airport Noise Compatibility Program Report, dated May 1989, may be used for this disclosure. The report is available for review at our Airports Division.

We appreciate the opportunity to provide comments.

Sincerely,

Glenn M. Okimoto

for Rex D. Johnson
Director of Transportation

Enc.

c: OEQC
Mr. Tim Johns, AMFAC/JMB Hawaii, Inc.
[redacted] PBR Hawaii, Inc.

PBR HAWAII

October 10, 1994

Mr. Rex D. Johnson
Director of Transportation
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Mr. Johnson:

Thank you for your comments of July 26, 1994 regarding the Lihue-Hanamaulu Master Plan Environmental Impact Statement Preparation Notice.

1) Traffic Impact Analysis Report (TIAR)

As indicated in your comments, a Traffic Impact Analysis Report (TIAR) has been prepared by Austin, Tsutsumi & Associates and will be submitted to the Department of Transportation for review under separate cover. The TIAR will also be included in the Draft and Final Environmental Impact Statements.

2) Project Related Roadway Improvements

Based in the findings of the TIAR, localized transportation mitigation measures directly associated with the proposed development have been identified and mitigative measures are planned to be implemented by Amfac/JMB Hawaii, Inc.("Amfac/JMB"), the developer. The developer will coordinate, through discussions with the DOT, a "fair share" contribution for the regional transportation improvements associated with the proposed development in accordance with DOT policy.

3) Coordination for Highway Widening

Amfac/JMB and The Lihue Plantation Company, Limited ("LPCo") have been involved with DOT in the planning for the widening of Kuhio and Kaumualii Highway on LPCo lands. Details will continue to be coordinated with the DOT Highways Division.

Mr. Rex D. Johnson
SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS
October 10, 1994
Page 2

4) Highway Right-of-Way Review and Approval

Any new highway access points and plans for work within the State highway right-of way will be submitted to the DOT for review and approval.

5) Conformance to Airport Noise Contours

After consultation with DOT Airports Division, the aircraft noise contours have been considered in the design process of the master plan to ensure that no incompatible land uses are planned within the 60 Ldn and above noise contour. Noise sensitive land uses such as residential development, schools and day care facilities are not planned within areas exposed to noise levels of 60 Ldn or greater or within aircraft safety hazard zones.

6) Disclosure Requirements

The noise impacts of Lihue Airport will be disclosed in accordance with the requirements of Chapter 467-31, HRS, based on the noise exposure maps of the Lihue Airport Noise Compatibility Program Report dated May 1989.

Thank you again for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Ohashi
Project Planner

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPIOLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813-5249
PHONE (808) 594-1888
FAX (808) 594-1865

RECEIVED
JUL 19 P 1:07

LAND USE COMMISSION
STATE OF HAWAII
JUL 15 12 02 PM '94

July 12, 1994

Ms. Esther Ueda
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, HI 96813

Dear Ms. Ueda:

Thank you for the opportunity to review the Environmental Assessment (EA) concerning the Lihue-Hanamaulu Master Plan, District of Lihue, Island of Kauai.

We find the EA insufficient to meet the provisions of Chapter 343 of the Hawaii Revised Statutes. Specifically, the report uses numerous referenced materials to support the assessment but lacks a reference section. This precludes us from truly ascertaining the depth of the assessment. As it stands, the EA is incomplete and virtually voids the review process. We believe that a new review is warranted and advise the Commission to require the preparer to submit an amended EA. Please contact me or Linda Delaney, Land and Natural Resource Officer, at 594-1938, should you have any questions on this matter.

Sincerely yours,

Dante K. Carpenter
Administrator

LM:lm

PBR HAWAII

October 9, 1994

Mr. Dante K. Carpenter, Administrator
Office of Hawaiian Affairs
711 Kapi'olani Boulevard, Suite 600
Honolulu, Hawai'i 96813-5248

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Mr. Carpenter:

Thank you for providing your comments on the EA/NOP for the Lihue-Hanamaulu Master Plan. We have prepared a response to the issue you raised in your letter of July 12, 1994.

- Clarification of the Chapter 343 Process.

We have reviewed your comments regarding Chapter 343, HRS provisions which require a reference section for environmental assessments. Upon our reexamination of both Chapter 343, HRS and the Office of Environmental Quality Control (OEQC) Administrative Rules (Section 11-200-10), we are unable to identify the specific provision your comment letter is referring to. It should be noted that a list of Agencies Consulted in the preparation of the Environmental Assessment (Section 3.0, pages 1-2) and numerous references to various materials are included within the text of the document. In addition, where preliminary consultant studies are referenced in the EA but not included as an appendix, the EA narrative identifies those consultant studies which will be included in the Final and Draft EIS.

Our understanding is that the Environmental Assessment process is to identify whether a proposed action will result in significant environmental effects (Section 11-200-2). If none are identified, a Negative Declaration is issued. However, as you know from your review of the Environmental Assessment, the recommended Determination (Section 9.0, page 40) states,

> *"the petitioner has determined that significant environmental affects may result and that an Environmental Impact Statement (EIS) will be required."*

Consequently, a Draft and Final Environmental Impact Statement will be prepared and a "reference section" will be included to facilitate your review of the document.

We would like to thank you again for participating in the review of this EA/NOP and look forward to hearing your comments on the Draft EIS.

Sincerely,

PBR HAWAII

Yukie Ohashi
Project Planner

1144.01EACOM

U.S. Department
of Transportation
Federal Aviation
Administration

AIRPORTS DISTRICT OFFICE
BOX 50244
HONOLULU, HI 96850-0001
PHONE: (808) 541-1243
FAX: (808) 541-3462

June 22, 1994

Ms. Esther Ueda
State Land Use Commission
333 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

We have reviewed the Environmental Assessment and Environmental Impact Statement Preparation Notice for the proposed Lihue-Hanamaulu Master Plan transmitted on June 13, 1994. We have only one comment on the EA; the Noise Impacts should include references and information from the Lihue Airport Noise Compatibility Program (NCP) plus the Hawaii State Helicopter System Plan (SHSP). We have enclosed a copy of Figure 6-4 from the Lihue NCP which shows the 5 year Noise Exposur Map plus copy of Figures 76 and 77 from the SHSP which shows the helicopter Ldn contours for your information. Please contact the State of Hawaii Airports Division for additional information on these two reports.

We appreciate the opportunity to review this EA and if you have any questions regarding the above, please contact us.

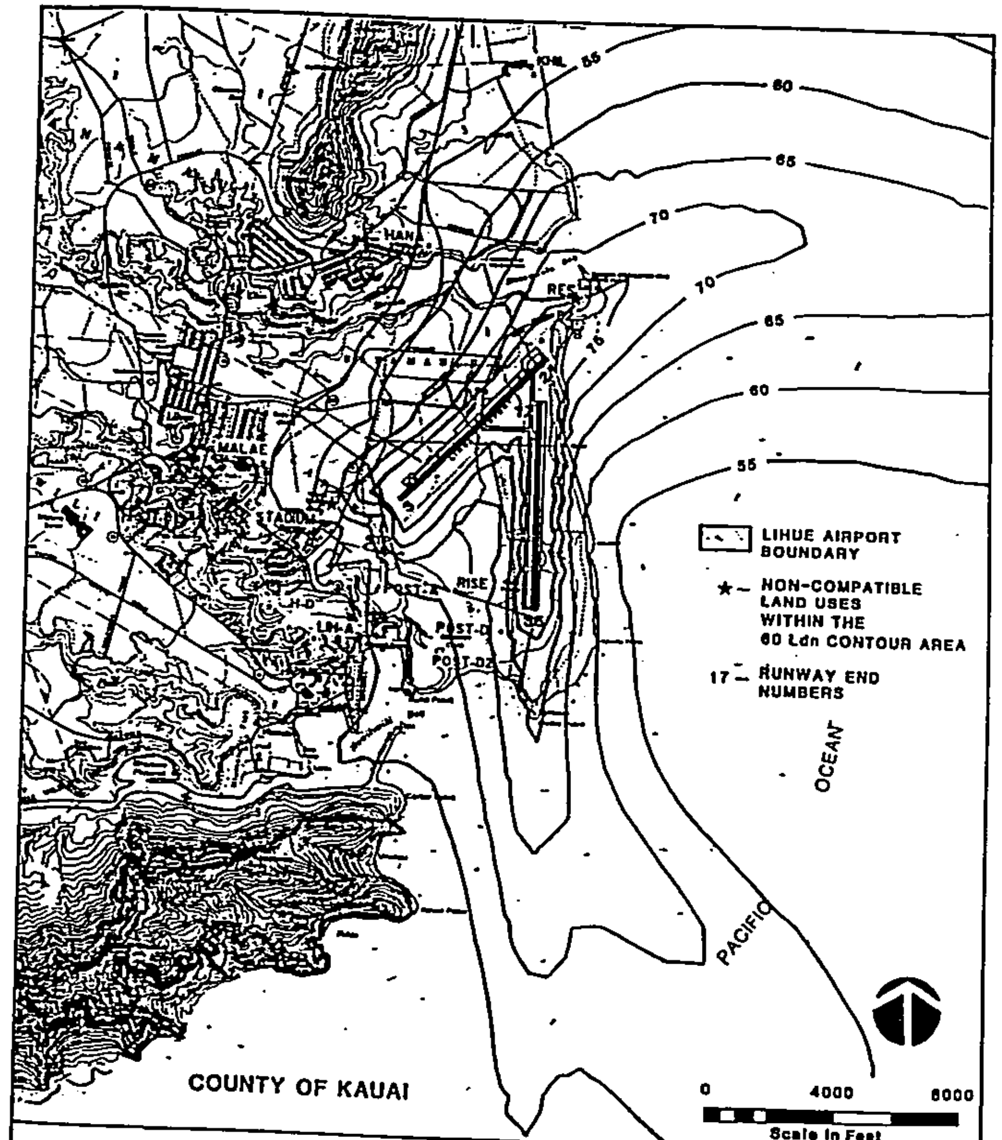
Sincerely,

David J. Welhouse

David J. Welhouse
Airport Engineer/Planner

Henry A. Sumida
Airports District Office Manager

cc: Tim Johns, AMFAC/JMB HAWAII, INC.
✓Yukie Ohashi, PBR HAWAII, INC.
Ben Schlapak, DOT Airports



LIHUE AIRPORT NOISE COMPATIBILITY PROGRAM
VOLUME I

5 YEAR NO MITIGATION SCENARIO NOISE EXPOSURE MAP FIGURE 6-4

Prepared for:
DEPARTMENT OF TRANSPORTATION
AIRPORTS DIVISION

Prepared by:
WILSON OKAMOTO
& ASSOCIATES, INC.

Airports Division

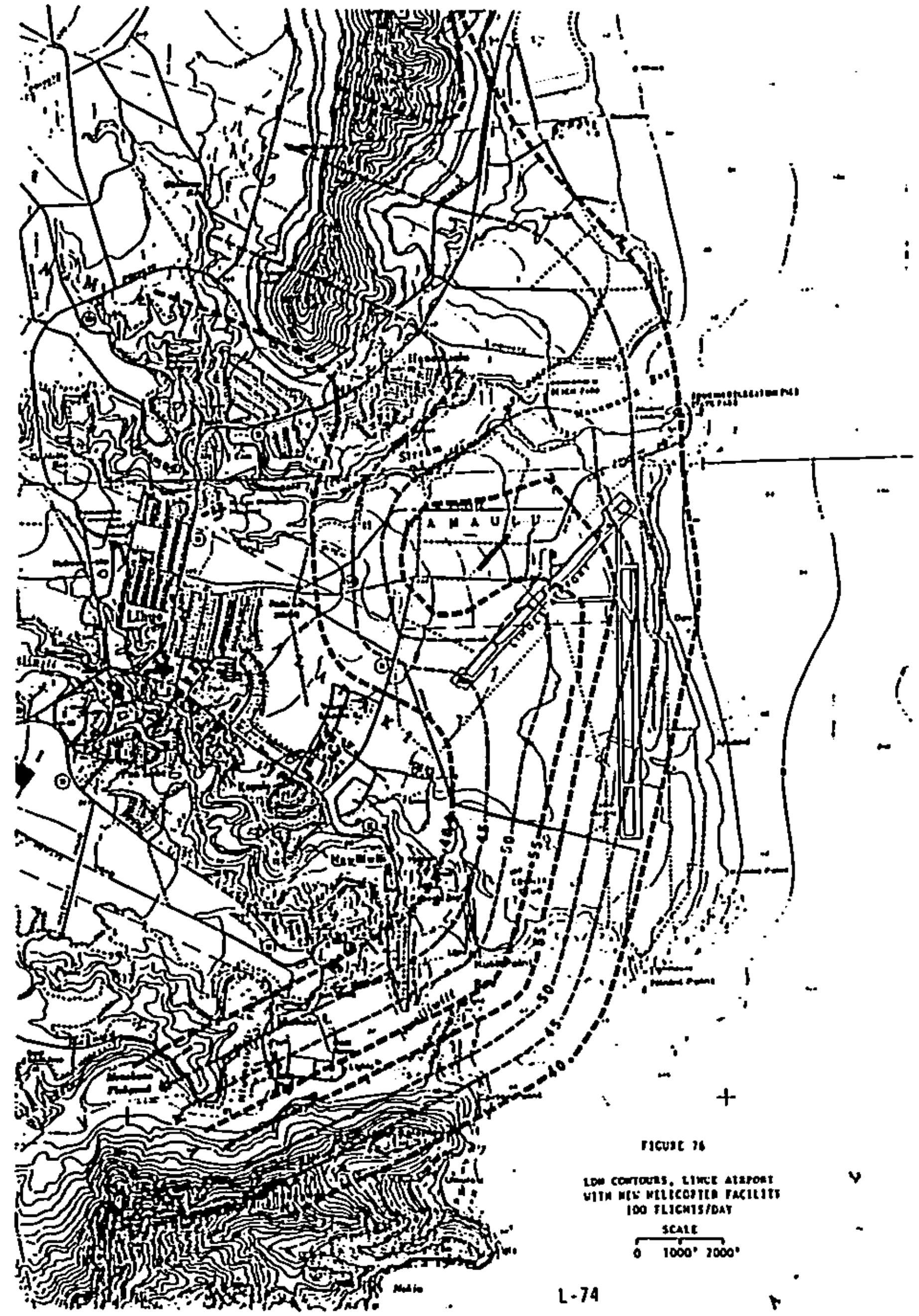


FIGURE 76

LDN CONTOURS, LIHUE AIRPORT
WITH NEW HELICOPTER FACILITY
100 FLIGHTS/DAY

SCALE
0 1000' 2000'

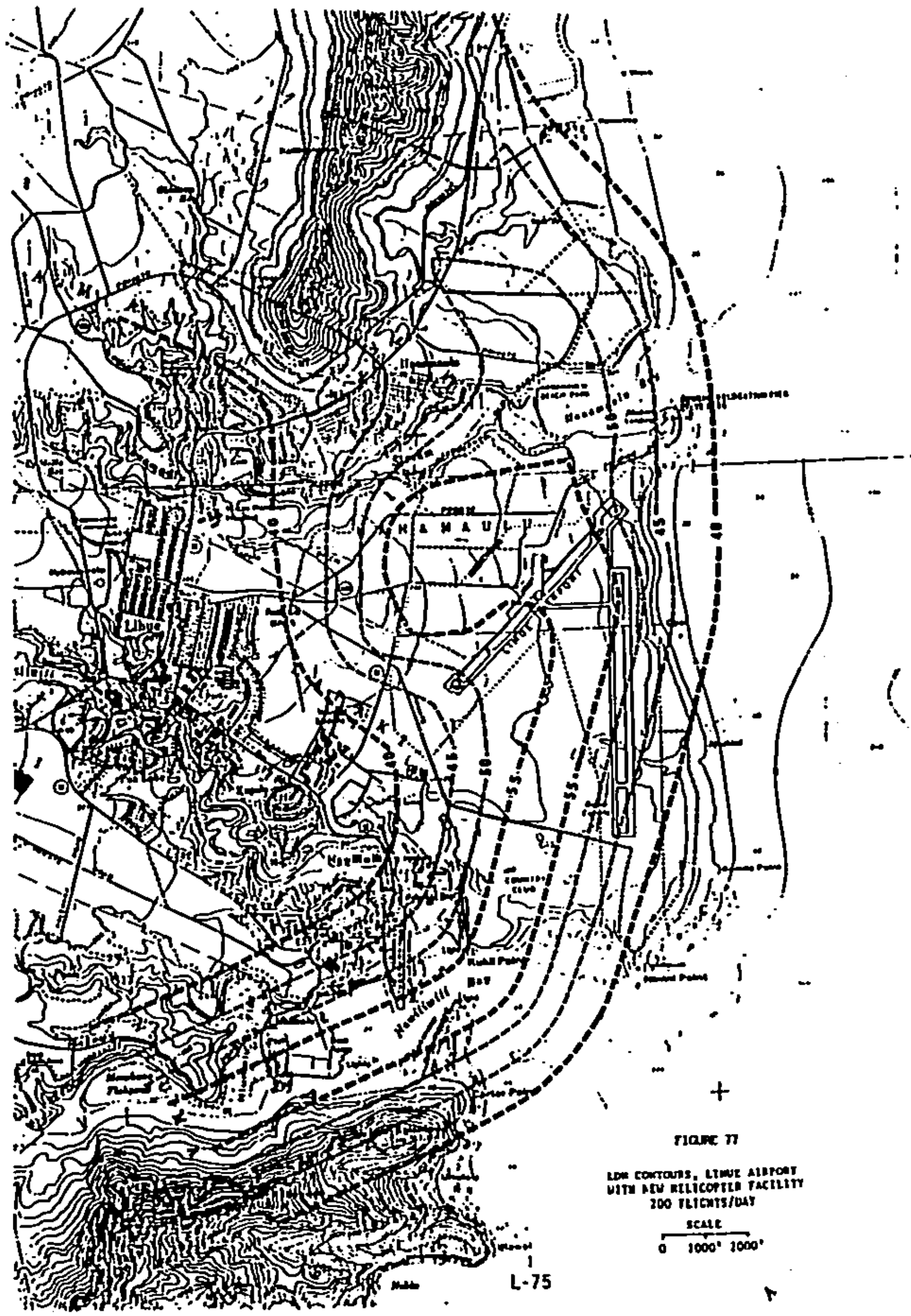


FIGURE 77

LDN CONTOURS, LIHUE AIRPORT
WITH NEW HELICOPTER FACILITY
200 FLIGHTS/DAY

SCALE
0 1000' 2000'

PBR HAWAII

October 10, 1994

Mr. David Welhouse, Airport Engineer/Planner
U.S. Department of Transportation
Federal Aviation Administration
Airports District Office
Box 50244
Honolulu, Hawaii 96850-0001

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Mr. Welhouse:

Thank you for providing your comments in your letter of June 22, 1994 on the EA/NOP for the Lihue-Hanamaulu Master Plan.

The noise impacts referenced by the Lihue Airport Noise Compatibility Program and the Hawaii State Helicopter System Plan have been addressed in the Acoustic Study for the Lihue-Hanamaulu Master Plan by Y. Ebisu and Associates. The study will be submitted for your review in the Draft EIS.

The land uses planned and the associated noise impacts emanating from airport activities have been incorporated in the design of the Lihue-Hanamaulu Master Plan. No residential land uses are planned for areas above the 60 Ldn noise contour. We have met with the State Airports Division and Lihue Airport to discuss the project.

We appreciate your review and comments on the Notice of Preparation; we have addressed your concerns in the Draft EIS Section 5.3 and Appendix N. Thank you again for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Ohashi
Project Planner

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

REPLY TO ATTENTION OF

July 21, 1994

Planning Division

Ms. Esther Ueda
State of Hawaii
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Thank you for the opportunity to review and comment on the Environmental Assessment and Notice of Preparation for an Environmental Impact Statement for the Lihue-Hanamaulu Master Plan, Kauai. The following comments are provided pursuant to Corps of Engineers authorities to disseminate flood hazard information under the Flood Control Act of 1960 and to issue Department of the Army (DA) permits under the Clean Water Act; the Rivers and Harbors Act of 1899; and the Marine Protection, Research and Sanctuaries Act.

a. Our Operations Division is currently reviewing the document and will submit their comments under separate cover.

b. The flood hazard information provided on page 12 is correct.

Sincerely,

Ray H. Jyo, P.E.
Director of Engineering

Copies Furnished:

Mr. Tim Johns
AMFAC/JMB Hawaii, Inc.
700 Bishop Street, 21st Floor
Honolulu, Hawaii 96813

Mr. Yukie Ohashi
PBR Hawaii, Inc.
1001 Bishop Street, Suite 650
Honolulu, Hawaii 96813

PBR HAWAII

October 10, 1994

Mr. Ray H. Jyo, P.E.
Director of Engineering
Department of the Army
U.S. Army Engineer District
Ft. Shafter, Hawaii 96858-5440

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Mr. Jyo:

Thank you for your comments of July 21, 1994 regarding the Notice of Preparation for an Environmental Impact Statement (EIS) for the Lihue-Hanamaulu Master Plan.

We have evaluated the potential hazards at the project lands, including the flood hazard potential in the Draft EIS. There are no streams or associated flood hazards present on the development areas. Drainage improvements to accommodate surface runoff during storm events, will be controlled through on-site detention basins to slow flow rates to reduce the potential for flooding.

We appreciate your review and comment on the Notice of Preparation. Thank you again for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Ohashi
Planner

1144.01BL-10.W60

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
677 Ala Moana Boulevard, Suite 415
Honolulu, Hawaii 96813

June 29, 1994

Ms. Esther Ueda
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Subject: Lihue-Hanamaulu Master Plan, Kalapaki and Hanamaulu

The staff of the U.S. Geological Survey, Water Resources Division, Honolulu, Hawaii, has reviewed the Environmental Assessment (EA) and Notice of Preparation (NOP) for an Environmental Impact Statement for the subject Master Plan, and we have no comments to offer at this time.

Thank you for allowing us to review this document.

We are returning the EA/NOP to your office for your future use.

Sincerely,

William Meyer
District Chief

Enclosure

cc: Mr. Tim Johns
AHFAC/JHB Hawaii, Inc.
700 Bishop Street, 21st Floor
Honolulu, Hawaii 96813

Yukie Ohashi
PBR Hawaii, Inc.
Pacific Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Office of Environmental Quality Control
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

PBR HAWAII

October 10, 1994

Mr. William Meyer, District Chief
United States Department of the Interior
U.S. Geological Survey
Water Resources Division
677 Ala Moana Boulevard, Suite 415
Honolulu, Hawaii 96813

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Mr. Meyer:

We have reviewed your letter of June 29, 1994 regarding the Lihue-Hanamaulu Master Plan. We note that your agency has reviewed the subject EISPN and has no comments to offer at this time.

Thank you for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Ohashi

Yukie Ohashi
Project Planner

11440IEACOM

W. Frank Brandt • Thomas S. Witten • R. Stan Duncan • Russell Y. J. Chung

---

United States Department of Agriculture — Soil Conservation Service — P. O. Box 50004, Honolulu, HI 96850-0001

September 6, 1994

SEP 16

PBR HAWAII, INC
Pacific Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

ATTENTION: Ms. Yukie Ohashi

Dear Ms. Ohashi:

Subject: **Lihue-Hanamaulu Master Plan**
Kalapaki and Hanamaulu - Environmental Assessment

We have completed our review of the Environmental Assessment and Notice of Preparation for an Environmental Impact Statement (EIS). While we recognize the need to develop near or adjacent to existing infrastructure, we are vitally concerned about the loss of prime agricultural lands for the project. Except for a small parcel, all of the land (552 acres) proposed for development is classified as prime agricultural land.

Runoff calculations were completed for sugarcane production. Post-development runoff calculations should be completed and analyzed for its additive impact to Hanamaulu Bay and the nearshore marine environment. Equally important is the quality of added runoff and its probable impact to the Hanamaulu Estuary system. As such, best management practices should be incorporated into the permanent landscaping plan to control the movement of sediment laden runoff during the construction phases. Furthermore, innovative erosion control measures should be considered to retain all the project generated sediment and runoff on site.

Thank you for the opportunity to provide comment. Should you have any questions, please do not hesitate to contact Mr. Michael C. Tulang at (808) 541-2606 or Ms. Laurie Ho at (808) 245-6513.

Sincerely,

For KENNETH M. KANESHIRO
State Conservationist

cc: Ms. Laurie Ho, District Conservationist, Lihue Field Office.

"To lead the way in helping our customers conserve, sustain, and enhance Hawaii's natural resources through efficient service of the highest quality."

PBR HAWAII

October 10, 1994

Mr. Kenneth M. Kaneshiro
State Conservationist
U.S. Department of Agriculture
Soil Conservation Service
P.O. Box 50004
Honolulu, Hawaii 96850-0001

SUBJECT: LIHUE-HANAMAULU MASTER PLAN
RESPONSE: NOTICE OF PREPARATION OF AN EIS

Dear Mr. Kaneshiro:

Thank you for your comments of September 6, 1994 regarding the Notice of Preparation for an Environmental Impact Statement (EIS) for the Lihue-Hanamaulu Master Plan.

We concur that the loss of prime agricultural land is an important concern and that the future use of the project area for agriculture will be lost. However, we also believe that future population growth must be directed to locations adjacent to existing urban areas and not be allowed to occur in a scattered and unplanned manner. This unplanned growth could also utilize prime agricultural land and would involve greater commitments of land and energy for road and other infrastructure. Moreover, the Lihue-Hanamaulu lands are also difficult to manage due to the proximity of residential, hospital, and airport land uses which are directly impacted by harvesting activities.

To assess the quality and quantity of project related runoff, calculations were completed based on the current agricultural use of the property and future urban uses. These calculations, as described in Appendix D of the Draft EIS, found that the quantity of sediment will decline with project development and the quantity of runoff will remain essentially unchanged.

A series of on-site detention basins will be used to slow the discharge of runoff, detain sediment on-site, and facilitate the recharge of groundwater. Best management practices will also be employed to mitigate the loss of soil during the construction phases of development.

We appreciate your review and comment on the Notice of Preparation. We have addressed your concerns in the Draft EIS, Section 4.4 and Appendix 3. Thank you again for participating in the environmental review process.

Sincerely,

PBR HAWAII

Yukie Ohashi
Planner

APPENDICES

LIST OF APPENDICES

A Lihue-Hanamaulu Infrastructure Report - Wastewater System
Austin, Tsutsumi & Associates, Inc., January 1995

B Lihue-Hanamaulu Master Planned Community
Preliminary Engineering Report for Water Requirements
Kodani and Associates, Inc., September 1994

C Molokoa Hydrologic Study, Lihue, Kauai
Water Resource Associates, September 1994

D Lihue-Hanamaulu Master Planned Community
Preliminary Engineering Report for Drainage Requirements
Kodani and Associates, Inc., January 1995

E Traffic Impact Report for the Proposed Lihue-Hanamaulu Master Plan Development
Austin, Tsutsumi & Associates, Inc., January 1995

E-1 Lihue-Hanamaulu Infrastructure Report
Interior Roadway Network
Austin, Tsutsumi & Associates, Inc., January 1995

F Market Analysis of the Lihue-Hanamaulu Master Plan at Molokoa, Ahukini and Hanamaulu, Kauai, September, 1994
Arthur Andersen & Co., October 1994

G Agricultural Assessment of the Lands in the Proposed Lihue-Hanamaulu Master Plan
Evaluation Research Consultants, August 1994

H A Quantitative Assessment of the Marine Communities and Water Quality in Hanamaulu Bay, Kauai
Richard E. Brock, Environmental Assessment Co., December 1994

H-1 Report Addendum 1: Marine Communities and Water Quality in the Vicinity of Three Existing Ocean Discharges
Richard E. Brock, Environmental Assessment Co., December 1994

I Hanamaulu Stream Biological Survey, Kauai, Hawaii
BHP Environmental Technologies International, July 1994

I-1 Letter Report Regarding Stormwater Discharges to Hanamaulu Stream
Pacific Aquatic Environmental, December 29, 1994

J Botanical Survey Lihu'e-Hanama'ulu Master Plan
Char & Associates, June 1994

K Avifaunal and Feral Mammal Survey of Molokoa Lands for Amfac's Lihue - Hanamaulu Master Plan, Kauai
Phillip L. Bruner, August 1994

L Recommended Mitigative Measures to Reduce Bird Attractants Associated with the Proposed Lihue Debris Recycling Station and the Tropical Fruit Disinfestation Facility
Pacific Aquatic Environmental, September 1994

M Additional Archaeological Inventory Survey Molokoa Lands Project Area
Paul H. Rosendahl, Ph.D, Inc., June 1994

N Acoustic Study for the Lihue-Hanamaulu Master Plan, Lihue, Kauai, Hawaii
Y. Ebisu & Associates, September 1994

O Air Quality Impact Analysis
Ogden Environmental and Energy Services, September 1994

P Lihue-Hanamaulu Master Plan Social Impact Assessment
Earthplan, September 1994

Q Economic & Fiscal Analysis of the Lihue-Hanamaulu Master Plan at Molokoa, Ahukini and Hanamaulu, Kauai
Arthur Andersen & Co., October 1994

A

Lihue-Hanamaulu Infrastructure Report
Wastewater System

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

TED S KAWAHIGASHI, P.E.
GEORGE M NEUFFER, P.E.
KENNETH K. KUROKAWA, P.E.
THOMAS S OTAGURO
IVAN K. NAKATSUKA, P.E.

LIHUE-HANAMAULU INFRASTRUCTURE REPORT
WASTEWATER SYSTEM

I. EXISTING CONDITIONS

A. Collection System

Wastewater to the existing Lihue Wastewater Treatment Plant (WWTP) originates from two sources: the force main from the Westin Kauai Sewage Pump Station (SPS) and a gravity main from Lihue Town. The existing transmission lines within Lihue Town vary from 10 inches at the upper reaches of the system to 24 inches as it nears the WWTP. The major transmission mains run along Kuhio Highway, extending along Hardy, Umi, Rice and Lighthouse Roads to the Lihue WWTP. (See Figure 1.)

Currently, the only portion of the existing collection system within close proximity to the development area is a 21-inch sewer line along Kapule Highway near the entrance of the new Lihue Post Office Distribution Center, adjacent to the Lihue Airport. This 21-inch line continues southward towards Haoa Street, and then to the Lihue WWTP. There are no existing sewer mains along the balance of Kapule Highway or that portion of Ahukini Road which runs adjacent to the proposed Lihue development area.

In the Hanamaulu Triangle development area, there are no existing sewer lines along those portions of Kuhio Highway or Kapule Highway which front this development. However there is a sewer line within the existing Hanamaulu Subdivision, which abuts the Hanamaulu Triangle at its

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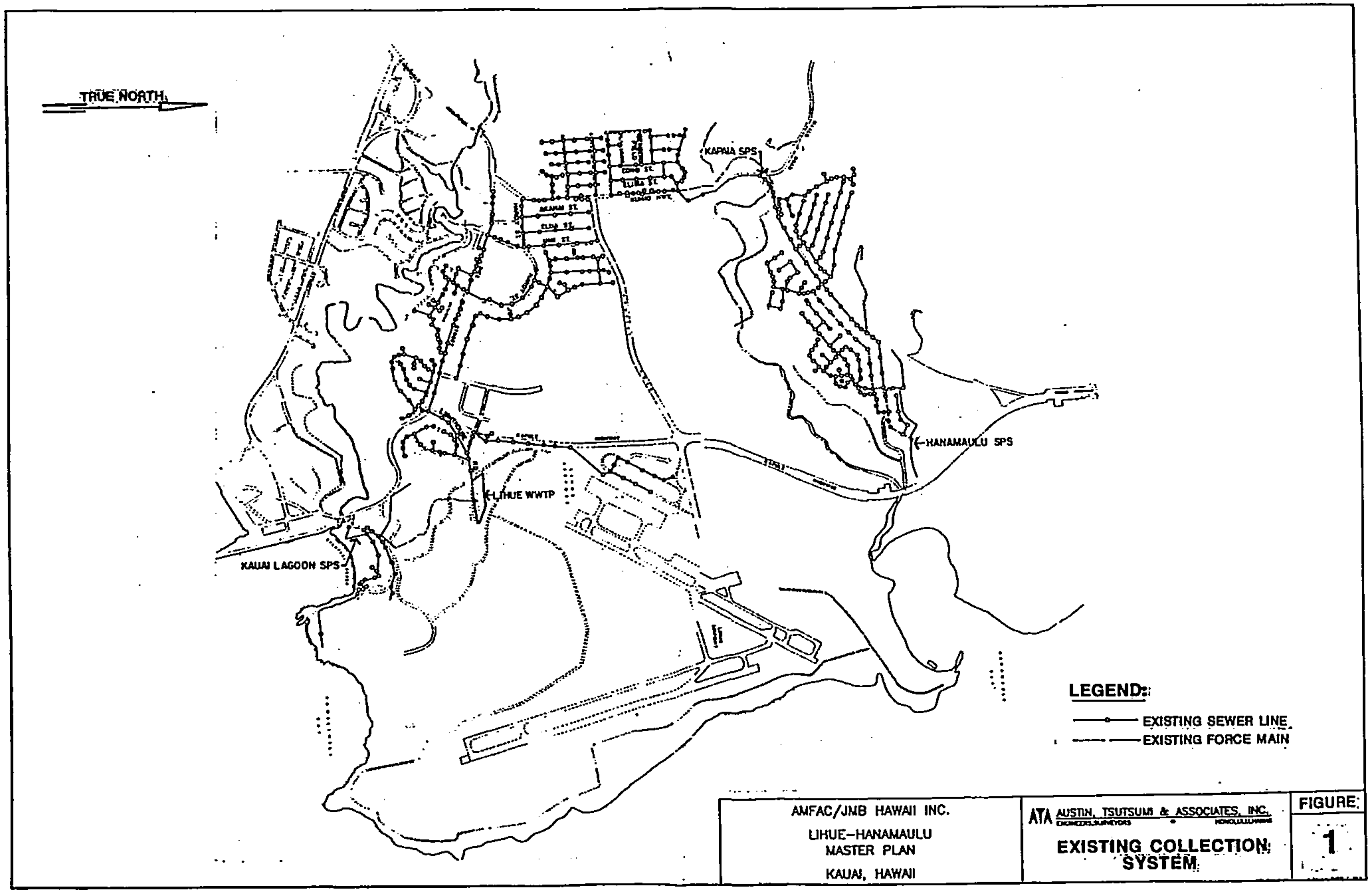
WAILUKU, MAUI, HAWAII • HILO, HAWAII


TRUE NORTH
KAPAIA SPS
HANAMAULU SPS
LIHUE WWTP
KAUAI LAGOON SPS
LEGEND:
EXISTING SEWER LINE
EXISTING FORCE MAIN
AMFAC/JMB HAWAII INC.
LIHUE-HANAMAULU
MASTER PLAN
KAUAI, HAWAII
ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
EXISTING COLLECTION SYSTEM
FIGURE:
1

southern-most boundary. The sewer lines within the existing Hanamaulu Subdivision gravity flow towards the County's existing Hanamaulu SPS located at the end of Hanamaulu Road. From here, a 10-inch force main conveys the wastewater along Kuhio Highway to the County's existing Kapaia SPS, and eventually to the existing Lihue WWTP.

B. Treatment and Disposal System

The existing Lihue WWTP is located on a five-acre parcel of land that is surrounded by the Westin Kauai. This WWTP is a conventional activated sludge type secondary treatment plant designed to treat an average flow of 1.5 million gallons per day (mgd) of domestic wastewater with a peak hydraulic capacity of 4.5 mgd. Prior to Hurricane Iniki, average influent flows were approximately 1.3 mgd. Current flows are slightly below this level, due to damages sustained by the sewered community during Hurricane Iniki.

Currently underway is an expansion of the existing Lihue WWTP from its current 1.5 mgd average daily flow capacity to 2.5 mgd. Initiated in February 1994, this plant expansion is scheduled for completion in February 1996.

Effluent from the Lihue WWTP is currently used for irrigation of the two Kauai Lagoon golf courses. An onsite rapid sand filter/injection well system is available as an alternate effluent disposal method.

Solids (sludge) disposal practice presently consists of disposal at the Kekaha Landfill after dewatering by sludge drying beds.

II. PROPOSED DEVELOPMENT AND ASSOCIATED FLOWS

The proposed Lihue-Hanamaulu development will add approximately 1,800 multi- and single-family units, as well as retail, office, public and park facilities. The associated flows generated from this development were derived using the County of Kauai design standards for wastewater systems. These standards were also used to evaluate the proposed wastewater collection and treatment system needs for the proposed development areas.

A. Design Flows

Design flow rates as set forth in the design standards for the County of Kauai were used to determine wastewater volume generation. The design flow rates used are shown in the following table. (Note: The design flow rates for wastewater generation and domestic water requirement standards for commercial and public zoned areas deviate slightly between these two standards.)

Zoning	Average Daily Flow
Estate/Single-Family (4 persons)	400 gallons/unit/day
Multi-Family (2.5 persons)	250 gallons/unit/day
Neighborhood Commercial/Village Mixed-Use	4,000 gallons/acre/day
Public/Quasi Public	4,000 gallons/acre/day
Light Industrial	4,000 gallons/acre/day
School (100 people/acre)	25 gallons/person/day
Park (400 people/acre)	5 gallons/person/day

The anticipated flows which will be generated from the proposed development areas are as follows:

Molokoa

Use	Dwelling Units or Area	Ave. Daily Flow
Single Family	328 units	131,200 gpd
Multi-Family	62 units	15,500 gpd
Village Mixed Use	57.5 acres	230,000 gpd
Public/Quasi Public	22.8 acres	91,200 gpd
Park	8.0 acres	16,000 gpd
Subtotal:		483,900 gpd

Upper Ahukini Mauka

Use	Dwelling Units or Area	Ave. Daily Flow
Single Family	230 units	92,000 gpd
Multi-Family	256 units	64,000 gpd
Village Mixed Use (Retail/Office)	10.0 acres	40,000 gpd
School	4.0 acres	10,000 gpd
Subtotal:		206,000 gpd

Lower Ahukini Mauka

Use	Dwelling Units or Area	Ave. Daily Flow
Single Family	498 units	199,200 gpd
Multi-Family	160 units	40,000 gpd
Village Mixed Use (Retail/Office)	2.5 acres	10,000 gpd
Village Mixed Use (Service/Light Industrial)	26.3 acres	105,200 gpd
School	4.0 acres	10,000 gpd
Park	14.0 acres	28,000 gpd
Subtotal:		392,400 gpd

Ahukini Makai

Use	Dwelling Units or Area	Ave. Daily Flow
Light Industrial	101.6 acres	406,400 gpd
Disinfestation Facility	4.1 acres	16,400 gpd
Recycling Center	35 acres	(negligible)
Subtotal:		422,800 gpd

Hanamaulu

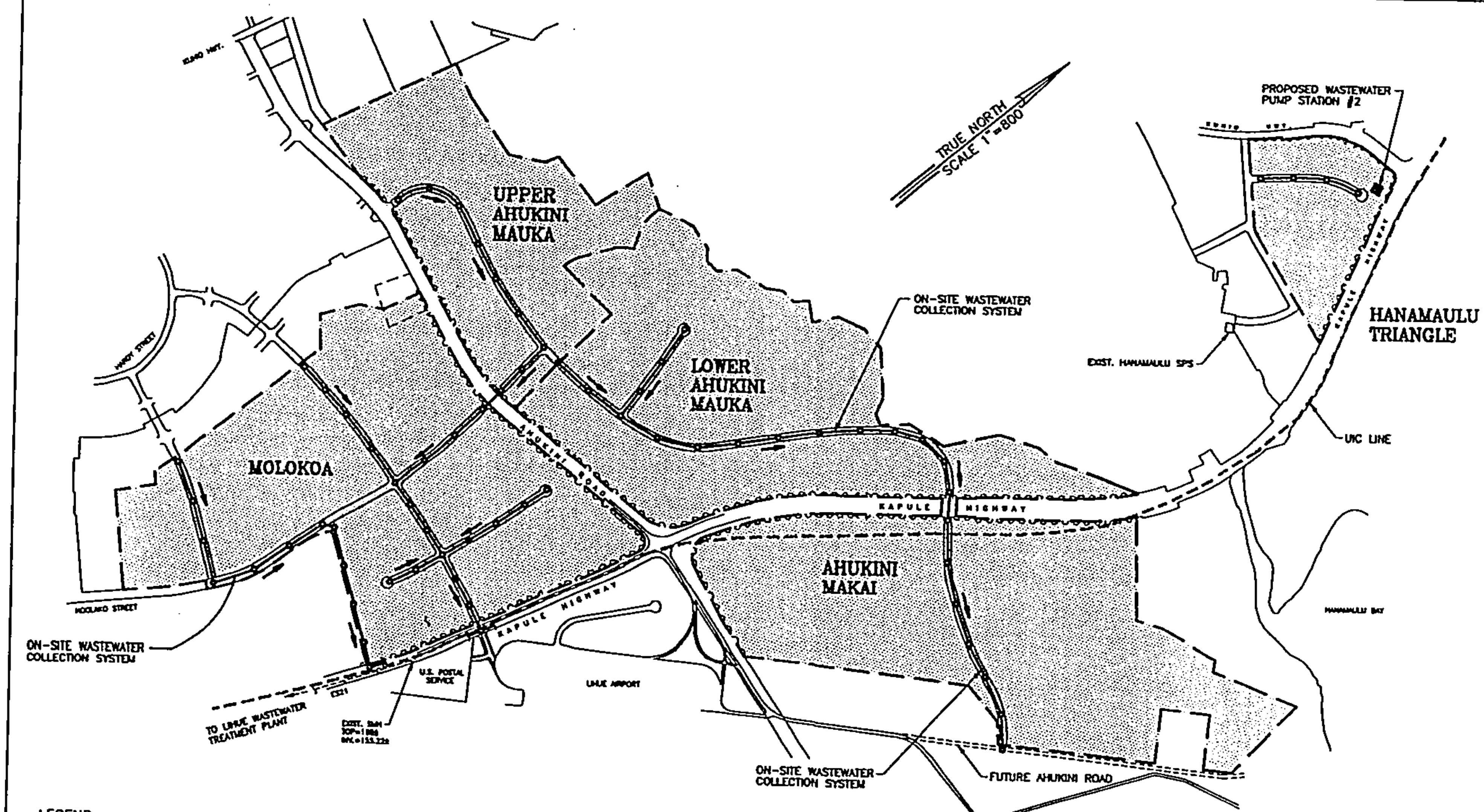
Use	Dwelling Units or Area	Ave. Daily Flow
Single Family	194 units	77,600 gpd
Multi-Family	72 units	18,000 gpd
Subtotal:		95,600 gpd
Total:		1,600,700 gpd
		(Say 1.60 mgd)

Wastewater flows generated from the proposed Hanamaulu development have been accounted for in the current WWTP expansion scheduled for completion in February 1996. As such, wastewater capacity for the Hanamaulu development will not be considered in this report. Therefore, with the full implementation of this proposed development, it is anticipated that additional treatment capability will be required for an average daily flow of 1.51 mgd (total of 1,600,700 gpd - 95,600 gpd for Hanamaulu).

III. PROPOSED IMPROVEMENTS

The proposed improvements will be divided into two major components: an On-Site Collection System and an Off-Site Collection and Treatment System. The On-Site system will consist of a primarily all gravity collection system which will remain the same regardless of the Off-Site alternative selected. (See Figure 2.) The off-site collection system, however, may vary depending on the ultimate location of the wastewater treatment system. There are presently four treatment alternatives being considered:

1. Expansion of the existing Lihue WWTP to accept the entire 1.51 mgd of wastewater flow generated from the proposed development with the liquid and solids processing facilities located on the current WWTP site.
2. Construct a new dedicable WWTP within Ahukini Makai to treat all of the 1.51 mgd wastewater flow.



LEGEND

DENOTES NO ACCESS PERMITTED

PROPOSED GRAVITY-FLOW SEWER SYSTEM

GRAPHIC SCALE

800 0 400 800 1600

1 inch = 800 ft.

AMFAC/JMB HAWAII INC.

LIHUE-HANAMAULU MASTER PLAN

KAUAI, HAWAII

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.

PROPOSED ON-SITE WASTEWATER SYSTEM

FIGURE

2

3. A combination of expansion of the existing Lihue WWTP and construction of a new, smaller WWTP facility within Ahukini Makai.
4. Expansion of the existing Lihue WWTP to accept the entire 1.51 mgd of wastewater flow generated from the proposed development with the liquid processing facilities maintained on the current WWTP site, but with the solids processing facilities relocated to an alternate site.

The following sections describe the on-site collection system and the off-site collector and treatment system alternatives.

A. On-Site Wastewater Collection System

Due to the topography of the area - i.e., gentle sloping grade from west to east - the majority of the wastewater generated by the proposed development would be collected and transported by means of a gravity collection system. The new on-site collection system would follow the alignment of the proposed street system outlined in the Conceptual Master Plan. To maintain a gravity flow condition, a section of the sewer line for the southern part of Molokoa would need to be installed near this development's southerly boundary in the vicinity of the proposed YMCA type facility and Veteran's building sites. This would require approximately 1250 linear feet of sewer easement.

Wastewater from the upper southwest portion of Ahukini Mauka would be collected and conveyed by a new gravity collection system that would traverse Ahukini Road into Molokoa. From there, the wastewater from both developments (i.e., Molokoa and Upper Ahukini Mauka) would gravity flow towards Kapule Highway near the Lihue Post Office Distribution Center, and into the proposed off-site wastewater collection system.

Wastewater collected from the lower portion of Ahukini Mauka would gravity flow toward the Kapule Highway and cross the road into Ahukini Makai. From there, the wastewater from both developments - i.e., lower Ahukini Mauka and Ahukini Makai - would gravity flow eastward toward the

airport and terminate at either a new wastewater pump station or a new WWTP. (A discussion of these options will be covered under the Off-Site Wastewater Collection and Treatment System portion of this report.)

The wastewater collected from the proposed Hanamaulu Triangle development would gravity flow toward a new wastewater pump station located near the Kuhio Highway/Kapule Highway intersection. From there, a new force main will convey wastewater from this new pump station to the existing Hanamaulu SPS located at the end of Hanamaulu Road. From the Hanamaulu SPS, flows will be fed into the existing sewerage system which terminates at the Lihue WWTP. The Hanamaulu and Kapala SPSs will probably require upgrading to handle the additional flows that will be generated by the Hanamaulu Triangle development, which would include the previously approved flows from the Hanamaulu Triangle, as well as flows from Kalepa Village. A detailed evaluation of this existing pump station will be conducted as part of a subsequent preliminary engineering report.

Although the majority of the wastewater from the proposed development areas can be collected and conveyed by gravity to the proposed off-site collection system, there are several tracts of land where individual wastewater pumping may be required. These individual wastewater pump stations would ultimately discharge into the proposed gravity collection system.

B. Off-Site Wastewater Collection and Treatment System

There are presently four alternatives being evaluated for the off-site wastewater collection and treatment system. The ultimate selection of the treatment alternative will determine the collection method to be implemented. All alternatives are currently being evaluated, and are being closely coordinated with the County.

(1) Alternative No. 1

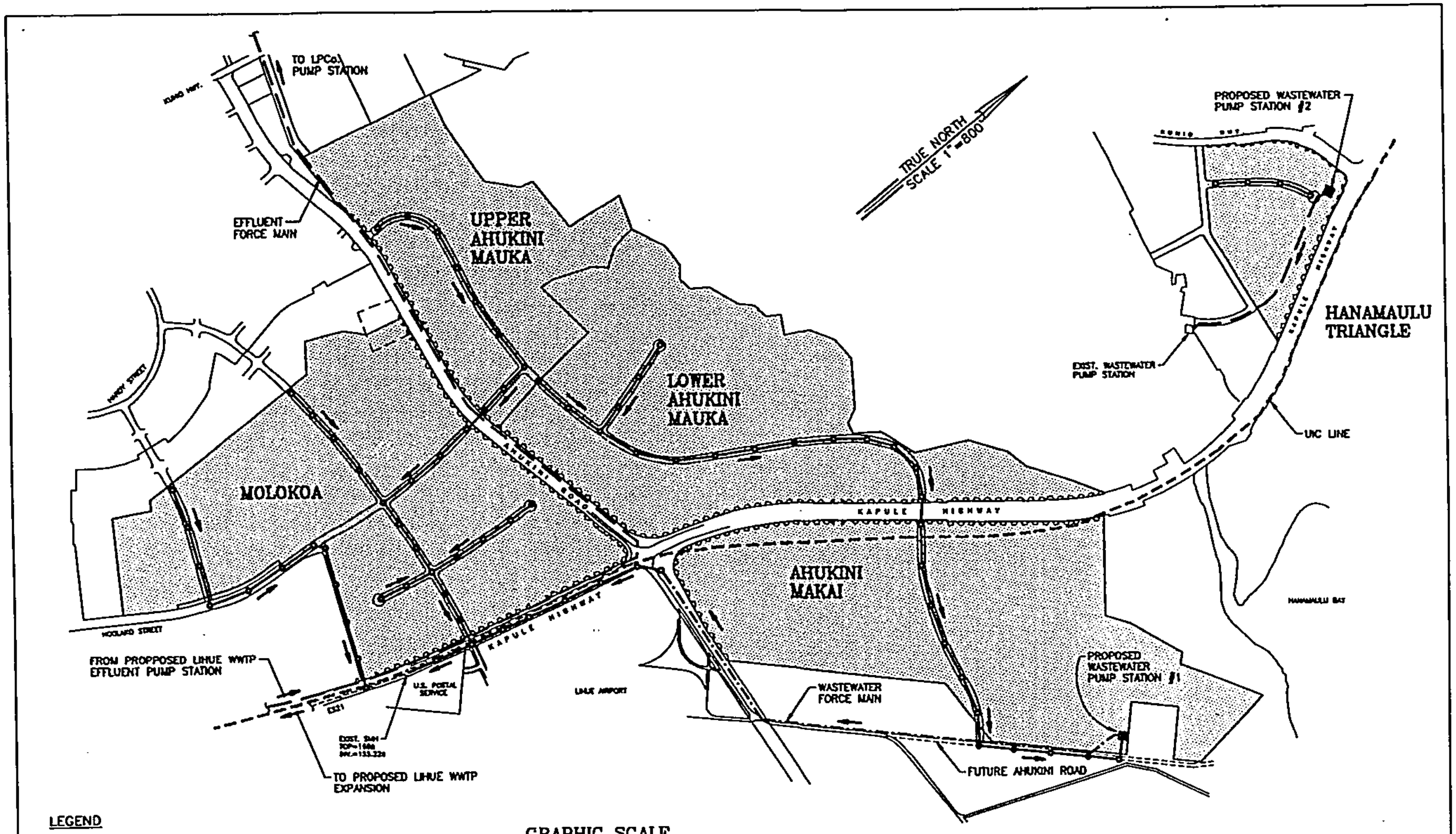
This alternative involves the expansion of the existing Lihue WWTP to accept the net estimated 1.51 mgd of wastewater from the proposed development. This expansion would incorporate the next incremental expansion of the WWTP and would ultimately be dedicated to the County. Design standards for this expansion would comply with the Department of Health's (DOH's) Hawaii State Administrative Rules, Title 11, Chapter 62, "Wastewater Treatment and Disposal". A phased implementation of this plant expansion would be sought to coincide with the major milestones of the project development.

To implement this alternative, the on-site sewer lines from Molokoa and Upper Ahukini Mauka would be connected to the existing 21-inch sewer line along Kapule Highway near the Lihue Post Office Distribution Center.

The wastewater from Lower Ahukini Mauka and Ahukini Makai would gravity flow to a new wastewater pump station (WWPS #1) located at the northeast corner of Ahukini Makai. From this wastewater pump station, a new force main would convey the wastewater to the beginning of a new sewer line near the Kapule Highway/Ahukini Road intersection, where the wastewater would then gravity flow to the existing 21-inch sewer line near the Lihue Post Office Distribution Center. (See Figure 3.)

(2) Alternative No. 2

Under this alternative, all the wastewater from the proposed developments, except Hanamaulu Triangle, would be collected and conveyed to a new WWTP to be constructed on Ahukini Makai. (See Figure 4.) As in Alternative No. 1, design standards for this new facility would comply with DOH's Hawaii State Administrative Rules, Title 11, Chapter 62 and would ultimately be dedicated to the County.



LEGEND

- DENOTES NO ACCESS PERMITTED
- PROPOSED GRAVITY-FLOW SEWER SYSTEM
- PROPOSED WASTEWATER FORCE MAIN
- PROPOSED EFFLUENT FORCE MAIN

GRAPHIC SCALE

800 0 400 800 1600

1 inch = 800 ft.

AMFAC/JMB HAWAII INC.

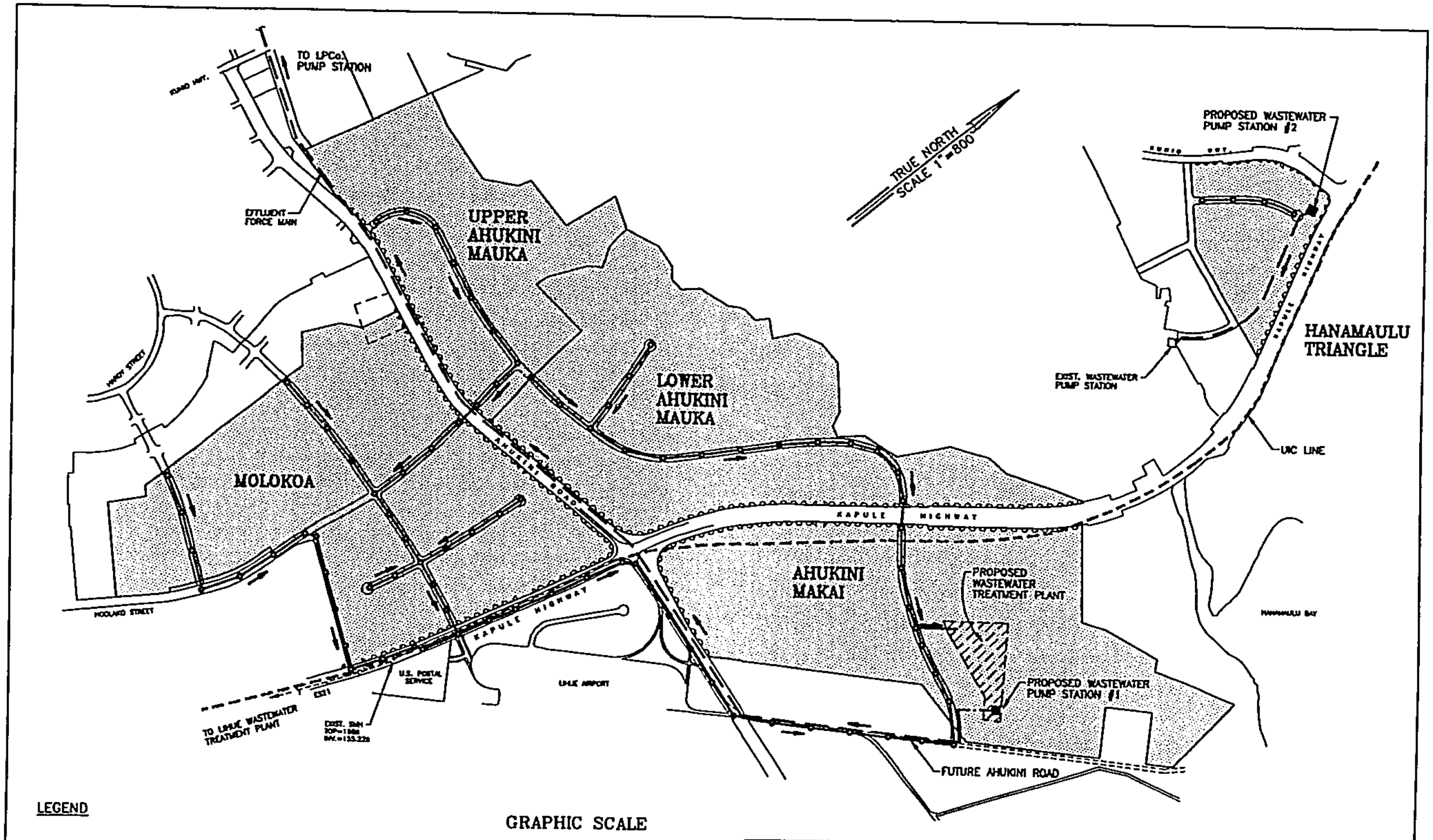
LIHUE–HANAMAULU MASTER PLAN

KAUAI, HAWAII

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS HONOLULU, HAWAII

ALTERNATE NO. 1

FIGURE 3



AMFAC/JMB HAWAII INC.
LIHUE-HANAMAULU MASTER PLAN
KAUAI, HAWAII

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.

ALTERNATE NO. 2

FIGURE 4

Wastewater collected from Molokoa and Upper Ahukini Mauka would be conveyed, via new gravity lines running northward along Kapule Highway, to the intersection of Kapule Highway and Ahukini Road, and then east and northeasterly to the new WWTP. Flows from Lower Ahukini Mauka and Ahukini Makai would also be conveyed by new gravity lines to the new WWTP site.

(3) **Alternative No. 3**

Alternative No. 3 would be a combination of both Alternatives No. 1 and No. 2. Under this alternative, wastewater flows from Molokoa and Upper Ahukini Mauka would be conveyed to the existing 21-inch sewer line along Kapule Highway. The flows generated from these two areas would be directed to the existing Lihue WWTP. The plant would be expanded to accommodate this increased volume of wastewater flow of approximately 0.7 mgd. This expansion of the existing WWTP would ultimately be dedicated to the County.

The balance of the flows from Lower Ahukini Mauka and Ahukini Makai would be conveyed to a new WWTP site within Ahukini Makai with a capacity of approximately 0.8 mgd. This smaller WWTP would remain a private facility which would be owned and operated by Amfac and/or the Association.

(4) **Alternative No. 4**

This alternative, which is similar to Alternative No. 3, involves the expansion of the existing Lihue WWTP to accept the liquid stream portion of the net estimated 1.51 mgd of wastewater generated flows from the proposed development. Under this alternative, however, the solids stream portion of the new and old flows would be pumped to an alternate site approximately two miles away in Ahukini Makai. Here, the solids stream would be processed and disposed of off site, with the liquid stream being return back to the existing WWTP. As in all of the

alternatives previously discussed, design standards for these facilities would also comply with DOH's Hawaii State Administrative Rules, Title 11, Chapter 62. Similar to Alternative Nos. 1 and 2, these facilities would ultimately be dedicated to the County.

The implementation of the on-site sewer lines for this alternative would be identical with that of Alternative No. 1.

All alternatives are currently being evaluated, and are being closely coordinated with the County.

C. Effluent Disposal/Reuse Options

Several alternatives were considered for the disposal and/or reuse of effluent. Any such program would comply with DOH's "Guidelines for the Treatment and Use of Reclaimed Water", dated November 22, 1993.

A near-term, as well as a potential long term solution for effluent reuse involves the pumping of the treated effluent to the existing Lihue Plantation Company (LPCo) hydro-separator and pump station located just mauka of the Kuhio Highway/Ahukini Road intersection. Here, the effluent would be blended with mill wash water and reused to irrigate LPCo sugar cane fields. LPCo would control and be responsible for the effluent after it is pumped to the hydro-separator. This scenario could continue as long as sugar remains a viable alternative for LPCo. Should the sugar industry become a non-viable alternative, Amfac will work with the County to develop a permanent effluent disposal system.

The permanent long-term solutions for effluent reuse may include one or more of the following options:

(1) Pastureland irrigation;

(2) Landscape irrigation along roadways and/or public areas within the project area;

(3) Landscape irrigation around Lihue Airport Terminal and/or runways; and

(4) Golf course landscaping, if available in the future, within close proximity to the project area.

To accomplish this long-term goal of effluent reuse, R-2 reclaimed water would be used for one or several of these reuse options. (R-2 water is defined in the DOH "Guidelines for the Treatment and Use of Reclaimed Water" as secondary treatment with disinfection to achieve a fecal coliform limit of 4 cfu/100 ml.) Existing force mains and holding systems which would be installed as a part of the agricultural irrigation system for LPCo may be retrofitted to accommodate some of these long-term options. Application of the R-2 reclaimed water would likely be by drip or subsurface irrigation at an application rate which would be dependent upon the type of vegetation used. A detailed evaluation of these reuse options will be conducted as part of a subsequent preliminary engineering report.

Given the four treatment alternatives, the transporting of the effluent for reuse by LPCo would be accomplished in the following manner:

(1) Alternative No. 1

Since Alternative No. 1 involves the expansion of the existing Lihue WWTP facility, a new effluent pump station, suitably sized and located at the WWTP site, would be provided. A new effluent force main would be constructed northward along Kapule Highway until its intersection with Ahukini Road, and then westward along Ahukini Road to the LPCo hydro-separator and pump station. Depending on how much effluent LPCo can use, the pump station and force main would, at a minimum, be sized to accommodate the additional flow of 1.51 mgd from the master planned development. It could also be sized to accommodate effluent from the nearly completed 2.5 mgd expansion that cannot be used by the Kauai Lagoons, pending agreement with the County.

Additional injection wells at the Lihue WWTP may be needed to handle emergency disposal of treated effluent. All wastewater treatment plant and pump station works are to be designed and constructed to current County standards.

(2) Alternative No. 2

Under this alternative, effluent from the new WWTP would be pumped from the plant – via a new force main running westward along Ahukini Road, crossing under Kapule Highway and later Kuhio Highway – to the existing LPCo hydro-separator and pump station. This pump station and force main would be sized to accommodate only the 1.51 mgd of effluent generated by the master planned development since it is independent of the existing Lihue WWTP.

As in Alternative No. 1, the new WWTP would have on-site injection wells designed to handle emergency disposal of treated effluent. Both the treatment plant and pump station would be constructed to current County standards.

(3) Alternative No. 3

Alternative No. 3, which is a combination of both Alternatives No. 1 and No. 2, would include a new effluent pump station, suitably sized and located at the existing Lihue WWTP site. The pump station and force main would be sized, at a minimum, for the approximate 0.7 mgd of effluent directed to this plant from the master plan development. If LPCo can use additional effluent, the sizing could be increased to convey some of the effluent from the nearly completed 2.5 mgd plant, pending agreement with the County. The new effluent force main would follow the same route as in Alternative No. 1.

That portion of the wastewater flows that is directed to the Ahukini Makai WWTP site (approximately 0.8 mgd) would be used for irrigation of areas in the vicinity of the WWTP (such as the Airport landscape), or disposed of in an injection well.

(4) **Alternative No. 4**

Alternative No. 4 would have an identical method of transporting effluent for reuse by LPCo as in Alternative No. 1.

D. Preliminary Construction Cost Estimate

The preliminary construction cost for the proposed Lihue-Hanamaulu development can be broken down into three major components: On-Site Collection System, Off-Site Collection and Treatment System and Effluent Disposal/Reuse Options. For the purposes of this report, only the first two components will be discussed. The third component, because of its yet undetermined nature, will be deferred until such time that a disposal option is selected.

Please note that this preliminary estimate does not include the cost for any land acquisition, engineering, construction management or County Administration costs. All costs are in 1994 dollars.

(1) On-Site Collection System

The following is a preliminary estimated construction cost for the on-site collection system:

Project Area	Item	Construction Cost
Molokoa	Collection System	$ 895,500
Ahukini Mauka	Collection System	780,000
Ahukini Makai	Collection System	248,000
Hanamaulu	Collection System	87,000
Total:		$2,010,500

(2) Off-Site Collection System

The following is a preliminary estimated construction cost for the off-site collection system. Since the estimated cost will vary with the alternative, pricing for each of the four alternatives is provided.

Alternative No. 1

Item	Construction Cost
Gravity Sewer	$ 462,000
Force Main	1,493,500
Effluent Pump Station	4,000,000
WWPS #1	1,750,000
WWPS #2	1,100,000
Expand Existing WWTP	13,600,000
Total	$22,405,500

Alternative No. 2

Item	Construction Cost
Gravity Sewer	$ 888,500
Force Main	1,063,500
Effluent Pump Station	4,000,000
WWPS #2	1,100,000
New WWTP (Ahukini Makai)	10,600,000
Total	$17,652,000

Alternative No. 3

Item	Construction Cost
Force Main	$ 1,493,500
Effluent Pump Station	4,000,000
WWPS #1	1,750,000
WWPS #2	1,100,000
Expand Existing WWTP	8,400,000
New WWTP (Ahukini Makai)	5,600,000
Total	$22,343,500

Alternative No. 4

Item	Construction Cost
Gravity Sewer	$ 462,000
Force Main	1,493,500
Effluent Pump Station	4,000,000
WWPS #1	1,750,000
WWPS #2	1,100,000
Expand Existing WWTP (Liquid Stream Only)	8,200,000
New Solids Handling Facility	6,600,000
Total	$23,605,500

B

Lihue-Hanamaulu Master Planned Community
Preliminary Engineering Report for Water Requirements

LIHUE - HANAMAULU MASTER PLANNED COMMUNITY

PRELIMINARY ENGINEERING REPORT FOR WATER REQUIREMENTS

SEPTEMER 16, 1994

KODANI AND ASSOCIATES, INC.
LIHUE, KAUAI, HAWAII 96766

PRELIMINARY ENGINEERING REPORT
FOR WATER REQUIREMENTS

TABLE OF CONTENTS

INTRODUCTION.......... 1
PROJECT DESCRIPTION.......... 4
EXISTING WATER SYSTEM.......... 5
PROPOSED WATER SYSTEM.......... 6
ESTIMATED ORDER-OF-MAGNITUDE, COSTS.......... 17
OVERVIEW OF PROPOSED WATER SYSTEM.......... 19

INTRODUCTION

This engineering report was prepared in conjunction with Amfac/JMB Hawaii, Inc.'s preparation and processing of an Environmental Impact Statement, State LUC Boundary Amendment, and County of Kauai General Plan Amendment for the 555 acre Lihue-Hanamaulu Master Planned Community in the Lihue District on the Island of Kauai.

Amfac/JMB Hawaii, Inc.'s Lihue-Hanamaulu Master Planned Community, displayed in Figure No. 1, is located between the northeastern edge of the developed portion of Lihue and the southern edge of the developed portion of Hanamaulu. A closer look at this Master Planned Community (see Figure No. 2), reveals that it is composed of four specific geographic areas which will be identified as Molokoa, Ahukini Mauka, Ahukini Makai and Hanamaulu. The development of each geographic area will be flexible and responsive to the future needs of the community.

The Lihue-Hanamaulu Master Planned Community includes a mixture of single and multi-family residential, commercial, industrial and public land uses, as well as parks, open spaces and an elementary school. The Master Planned Community would abut or be in close proximity to existing residential, commercial, industrial and public land uses. The land used to build this proposed Master Planned Community is presently being used to grow sugar cane by Lihue Plantation Company, Limited and has no infrastructure that satisfies County of Kauai standards.

A critical infrastructure requirement that should be addressed for any planned community is assurance that its water system will support full development. This report will evaluate the water demand generated by the proposed Master Planned Community and identify engineering requirements for the design of water sources, storage facilities, and distribution systems. The proposed water facilities will be built to Department of Water standards and is intended to be dedicated to the Department of Water prior to connection to the Lihue Water System. This expanded system will provide better service to the entire Lihue district.

The analysis and findings contained herein are at a general concept level and reflect the preliminary nature of Amfac/JMB Hawaii, Inc.'s proposal at this early stage of the planning process for their Lihue-Hanamaulu Master Planned Community.

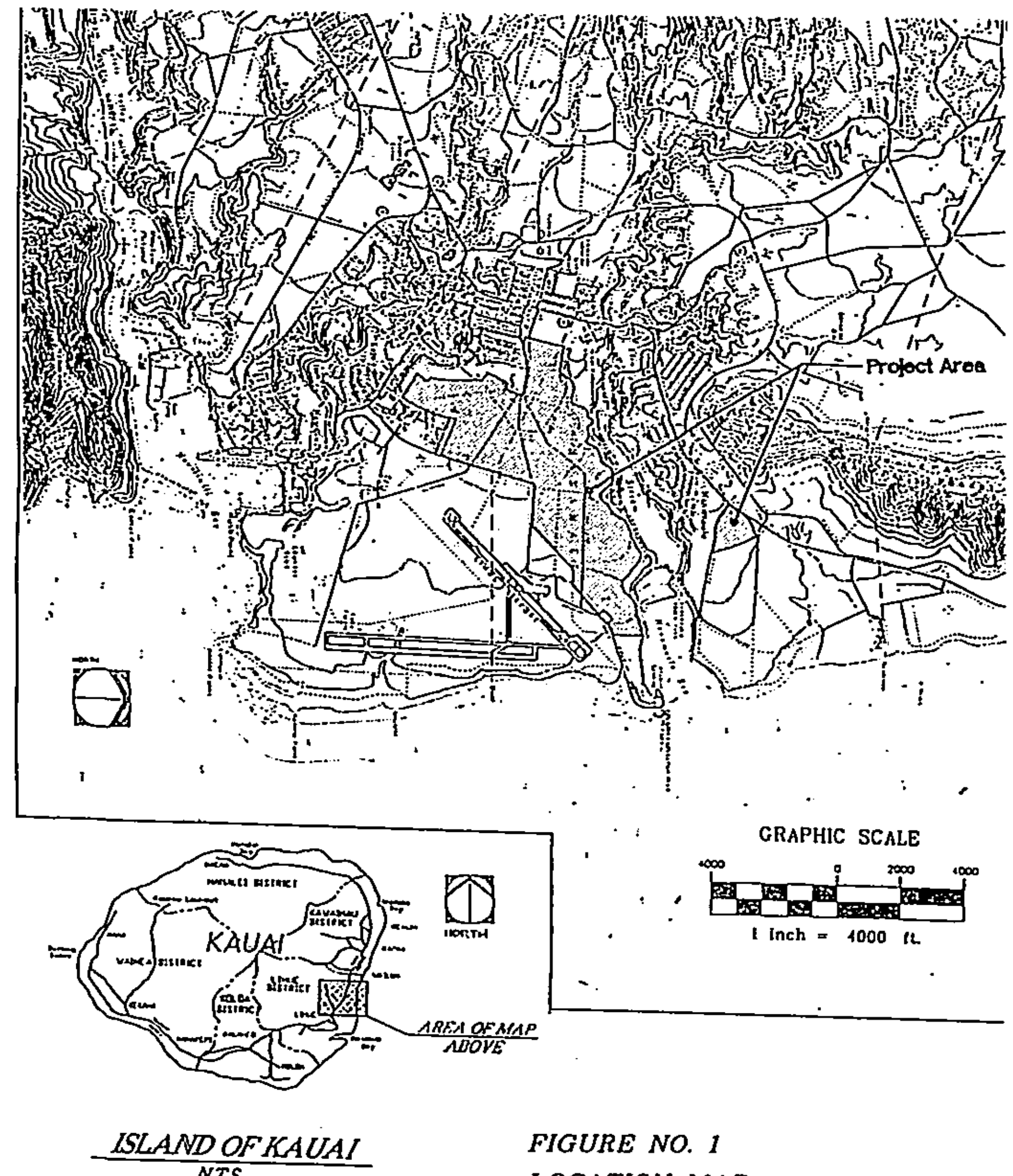


FIGURE NO. 1
LOCATION MAP
LIHUE-HANAMAULU
AMFAC/JMB HAWAII LIHUE DISTRICT, ISLAND OF KAUAI
KODANI AND ASSOCIATES, INC.

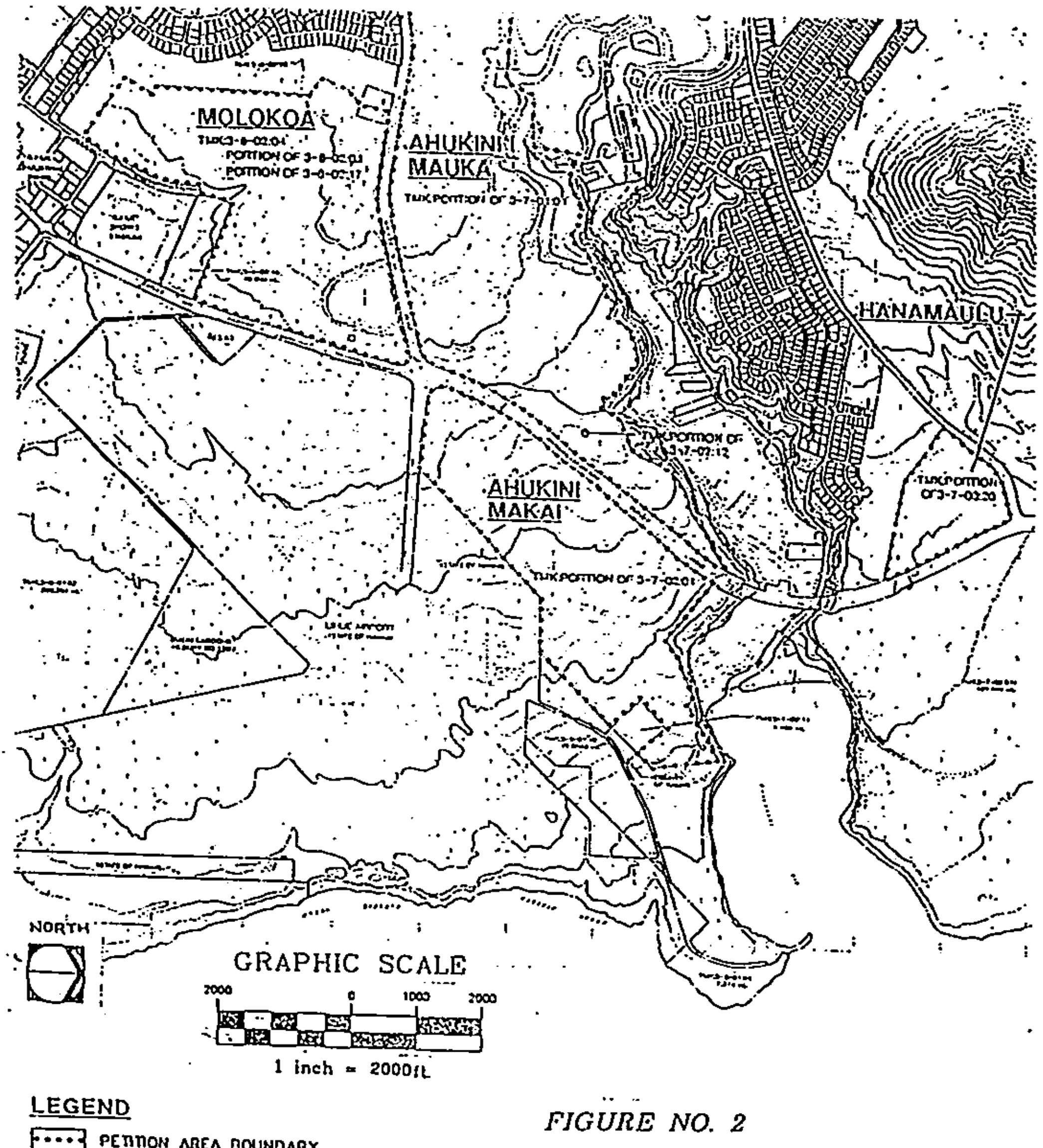


FIGURE NO. 2
PROJECT AREA MAP
LIHUE-HANAMAULU
AMFAC/JMB HAWAII LIHUE DISTRICT, ISLAND OF KAUAI
KODANI AND ASSOCIATES, INC.

PROJECT DESCRIPTION

The Lihue-Hanamaulu Master Plan provides for a range of residential and village mixed uses on 555 acres of land located at Lihue and Hanamaulu, Kauai. Four geographic areas of the Master Plan include Molokoa, Ahukini Mauka, Ahukini Makai and Hanamaulu. Development is projected to be over a 15 to 20 year period and is planned to be flexible in responding to future community needs. The Master Plan components include single and multi-family residential uses, public and quasi-public facilities, village mixed use, service/light industrial development, industrial development, parks, and open spaces. The village mixed use areas within Molokoa and Ahukini Mauka envision a variety of retail and office uses that would form the village core of the community.

The general land use allocation is summarized below:

LAND USE	ACRES
Residential	
Single-Family (1,000 - 1,250 units)	180
Multi-Family (400 - 550 units)	35
Village Mixed Use	
Retail/Office	70
Service/Light Industrial	26
Industrial	102
Public/Quasi-Public Facilities	70
Parks/Open Spaces	48
Major Roadways	24

Residential development will provide approximately 1,400 to 1,800 units in a mix of product type, densities and range of prices including affordable, gap, and market prices. Densities for single family homes will range from 5.6 to 7 units per acre and multi-family homes will range from 11.7 to 16.2 units per acre. Potential public and quasi-public facilities include a Veterans Center, state judiciary complex, police headquarters, YMCA/teen center-type facility, an elementary school, a debris recycling station, and a fruit disinfestation facility.

The initial land use approvals to allow implementation of the proposed Master Plan include a State Land Use Boundary Amendment to reclassify State Agricultural and Conservation land to the State Urban District and a County General Plan Amendment to designate Agricultural and Public Facility land as Urban Mixed Use.

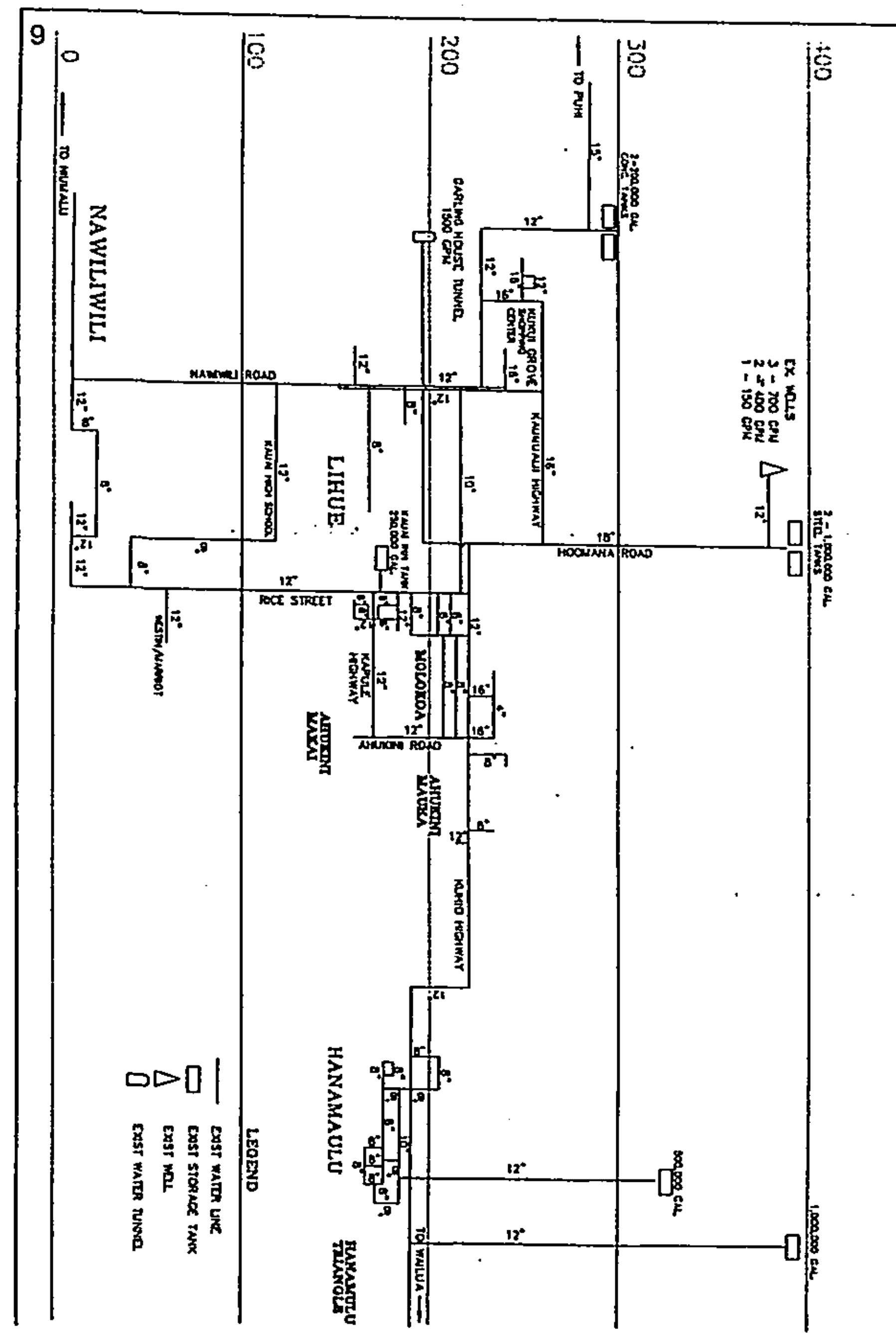
EXISTING WATER SYSTEM

Amfac/JMB Hawaii Inc.'s Lihue-Hanamaulu Master Planned Community, will be served by the Department of Water's Lihue Water System. The Lihue Water System is one of the largest public water systems on the island of Kauai and presently serves an area that stretches west of Lihue to Puhi and east of Lihue to Hanamaulu, including Kapaia. The system services resort, commercial, industrial, public and residential uses.

The Lihue Water System is supplied by 8 wells and 2 tunnels located mauka of Lihue and Hanamaulu that provide an average daily flow of 3.34 million gallons. Major storage facilities include two 1.0 million gallon tanks located above the German Hill area in Lihue and a 1.0 million gallon and 0.5 million gallon tank located on Kalepa Ridge above Hanamaulu. Transmission mains, which transport water from the storage tanks to the various service areas, range in size from a diameter of 18 inches to a diameter of 6 inches. A schematic of the existing Lihue Water System can be seen in Figure No 3.

The Department of Water has stated that the Lihue Water System is presently at or near capacity in its supply, storage, and transmission systems and has no projects funded for major expansion of the system at this time. In order for Amfac/JMB Hawaii, Inc. to develop the Lihue-Hanamaulu Master Planned Community in a timely manner, major improvements to the Lihue Water System will have to be designed and constructed by Amfac/JMB Hawaii, and dedicated to the Department of Water.

FIGURE NO. 3
LIHUE WATER SYSTEM (EXISTING)



PROPOSED WATER SYSTEM

The existing Lihue Water System cannot support Amfac/JMB Hawaii, Inc.'s Lihue-Hanamaulu Master Planned Community without major improvements to the system. The following sections will discuss projected water demand and the facility improvements necessary to support the Lihue-Hanamaulu Master Planned Community.

1. Water Demand. The water demand for the proposed development was calculated according to the following criteria listed in the Water System Standards, Department of Water, County of Kauai, 1985 published by the Department of Water County of Kauai:

Average Daily Demand	= 500 gallons/unit	Single Family
	= 350 gallons/unit	Multi Family
	= 3000 gallons/acre	Commercial
	= 4000 gallons/acre	Industrial
	= 2500 gallons/acre	School/Park
Maximum Daily Demand	= 1.5 x Average Daily Demand	
Peak Hour Demand	= 3.0 x Average Daily Demand	

Using the aforementioned criteria, calculations were performed to determine the projected average daily water demand for each of the four geographic areas. Demand for the public facilities was calculated at the commercial rate.

The Molokoa area of the Master Planned Community is composed of single family, multi-family and commercial land uses. The projected average daily water demand for the Molokoa area when it is fully developed is 446,600 gallons per day (gpd).

The Ahukini Mauka area of the Master Planned Community is composed of single family, multi-family, commercial, school, park, and service/light industrial land uses. The projected average daily water demand for the Ahukini Mauka area when it is fully developed is 707,300 gallons per day (gpd).

The Ahukini Makai area of the Master Planned Community is composed of industrial and public land uses. The projected average daily water demand for the Ahukini Makai area when it is fully developed is 510,300 gallons per day (gpd).

The Hanamaulu area of the Master Planned Community is composed of single family and multi-family land uses. The projected average daily water demand for the Ahukini Makai area when it is fully developed is 122,200 gallons per day (gpd).

The total projected average daily water demand for the entire Master Planned Community (Molokoa, Ahukini Mauka, Ahukini Makai and Hanamaulu) is 1,786,400 gallons per day (gpd). A summary of the water demand by geographic area is provided in Table No. 1 below. A more detailed breakdown of water demand is found in Table No. 2.

TABLE No. 1

GEOGRAPHIC AREA	AREA (Acres)	AVERAGE DAILY DEMAND (gpd)	MAXIMUM DAILY DEMAND (gpd)
Molokoa	159.50	446,600	669,900
Ahukini Mauka	221.70	707,300	1,060,950
Ahukini Makai	143.80	510,300	765,450
Hanamaulu	30.00	122,200	183,300
TOTAL	555.00	1,786,400	2,679,600

2. Storage Requirements. The Department of Water requires that storage be provided to meet the following criteria:

   a. Meet maximum daily demand. Reservoir full at the beginning of the 24 hour period with no source input to the reservoir.

   b. Meet maximum daily rate plus fire flow for the duration of the fire. Reservoir 3/4 full at start of fire, with credit for incoming flow from pumps, one maximum size pump out of service.

The projected maximum daily water demand (1.5 x Average Daily Demand) for the entire Lihue-Hanamaulu Master Planned Community (Molokoa, Ahukini Mauka, Ahukini Makai and Hanamaulu) is 2.68 million gallons per day (mgd), see Table No. 1. Therefore, to meet the first criteria, storage facilities must be constructed to store 2.68 million gallons of water. To satisfy the majority of the storage requirement, 2 - 1.0 million gallon tanks and 1 - 0.5 million gallon tank will have to be built by Amfac/JMB, Hawaii, Inc.. It is assumed that the remaining 0.18 mgd of water storage will be provided by

WATER DEMAND
LIHUE - HANAMAULU

SERVICE AREA NO.	AREA Acres(Units)	LAND USE Description	LAND USE Unit Demand	AVERAGE DAY DEMAND
Molokoa	57.8(328)	Single Family	500 gal/unit	164,000
	3.8(62)	Multi-Family	350 gal/unit	21,700
	57.5	Commercial	3000 gal/acre	172,500
	22.8	Public	3000 gal/unit	68,400
	8.0	Park	2500 gal/acre	20,000
	9.6	Road Kauai Gateway	None	0
			Sub-total	446,600
Ahukini-Mauka	98.2(728)	Single Family	500 gal/unit	364,000
	26.2(416)	Multi-Family	350 gal/unit	145,600
	12.5	Commercial	3000 gal/acre	37,500
	22.0	Park, School	2500 gal/acre	24,000
	26.3	Industrial	4000 gal/acre	105,200
	36.5	Road, Open Kauai Gateway	None	0
			Sub-total	707,300
Ahukini-Makai	101.60	Industrial	4000 gal/acre	364,000
	4.1	Disinfestation	4000 gal/acre	16,400
	35.0	Recycling Fac.	2500 gal/acre	87,500
	3.1	Road Kauai Gateway	None	0
			Sub-total	510,300
Hanamaulu	25(194)	Single Family	500 gal/unit	97,000
	4.0(72)	Multi-Family	350 gal/unit	25,200
	1.0	Road	None	0
			Sub-total	122,200
			TOTAL	1,786,400

facilities constructed by the Department of Water Supply. This is a reasonable assumption given the 15-20 year development time for this project.

The second criteria for water storage requirement is mathematically expressed in the General Plan For Domestic Water / Island of Kauai, published by the Department of Water County of Kauai and is as follows:

$V = (4/3) \times (Tf) \times (Qm + Qf - Qp)$

where: V = Storage Volume Required, million gal.
Tf = Fire Duration, day
Qm = Peak Hour Demand, mgd
Qf = Fire Flow, mgd
Qp = Pump Input, mgd

Fire flow requirements found in the General Plan For Domestic Water / Island of Kauai sets Qf and Tf to 4.320 mgd (3000 gallons/minute) and .25 day (6 hours), respectively. The peak hour demand, Qm, is 3 times the average daily demand or 5.36 mgd. The final unknown, pump input (Qp), is discussed in the next section and is computed to be 2.69 mgd (eight wells at 336,000 gallons per day). Substituting the data into the above formula results in the following storage Volume.

$V = (4/3) \times (.25) \times (5.36 + 4.32 - 2.69)$
$V = 2.32$ million gallons

The proposed 2.5 million gallon storage facility clearly exceeds 2.32 million gallon storage volume required to satisfy the second storage requirement criteria.

The proposed water storage facility, 2 - 1.0 million gallon tanks and 1 - 0.5 million gallon tank, will be located on the slopes of Kilohana Crater near the 390 foot elevation and can be accessed from an existing cane haul road that is currently being used by Lihue Plantation Company, Limited. The elevation of this proposed water storage facility will be at the same elevation as the Department of Water's existing water storage tanks.

3. Source Requirements. The main criteria for water source (i.e. pump capacity) is that well pumps be sized to operate at a rate equal to the maximum daily demand over a 16 hour period with the largest pump considered on standby. In calculating this requirement, each well is assumed to have an estimated yield of 0.5 mgd (350 gallons per minute) if pumped continuously over a 24 hour period or 0.336 mgd when pumped for 16 hours a day. Well yields were conservatively estimated based on the Molokoa Hydrology Study performed by Water Resources

Associates. Using this conservative yield, the number of wells required for this Master Planned Community is:

Well Quantity = 2,630,000 gal (336,000 gal/well)
= 7.83 (Say 8 wells)

There would also be one well on standby for a total theoretical requirement of 9 wells. The actual number of wells will be determined as the initial wells are drilled and tested. If the yields are higher than expected, the total number of wells may be reduced. If the yields are lower than expected, more wells would be needed.

The Molokoa Hydrologic Study concluded that the Hanamaulu Aquifer System had a sustainable yield of 40 mgd. An aquifer yield of 40 mgd is sufficient to meet existing demands of 5 million gallon per day for the Department of Water and private users plus the 1.79 million gallon per day water demand of the proposed Lihue-Hanamaulu Master Planned Community. The Molokoa Hydrologic Study is included as part of the Environmental Impact Statement for the Master Planned Community.

The wells would be located near the storage tanks on the slopes of Kilohana Crater, between the 300 and 400 foot elevation. Refer to Figure No. 4 for the proposed location of the source and storage facilities.

4. Transmission Requirements. Transmission mains are sized based on the following Department of Water criteria:

a. Maximum daily flow plus fire flow with a residual pressure of 20 psi at critical fire hydrant.

b. Peak hour flow with a minimum residual pressure of 40 psi.

Improvements to the existing transmission mains must be performed in order to support the Lihue-Hanamaulu Master Planned Community. Using a water distribution model of the Lihue Water System, it was determined that the following improvements must be made to the existing transmission mains in order to support the Molokoa, Ahukini Mauka and Ahukini Makai areas:

1. A 16" transmission main from the storage tanks on the slope of Kilohana Crater to Kuhio Highway in Lihue. The transmission main would follow an existing cane haul road to Lihue.

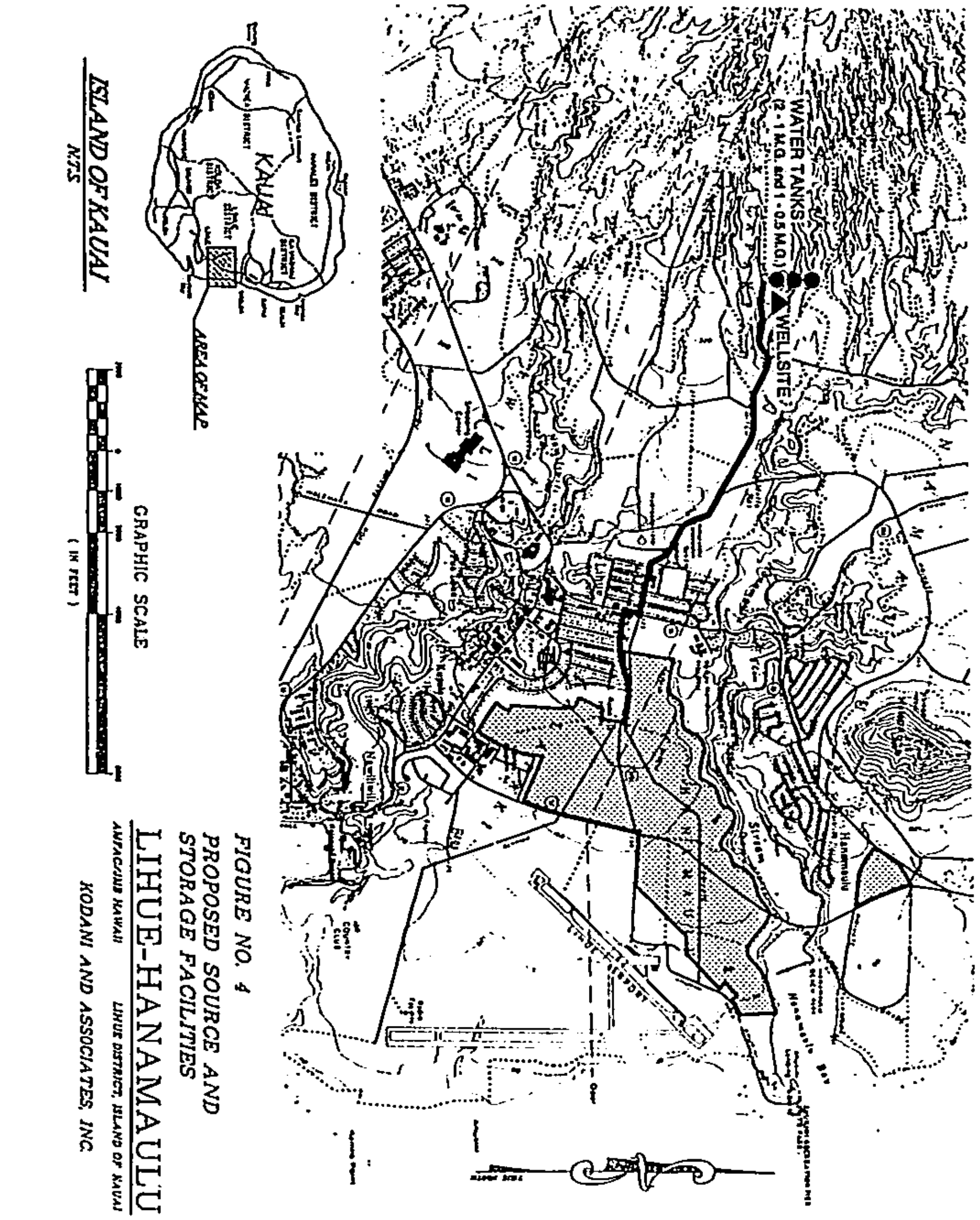


FIGURE NO. 4
PROPOSED SOURCE AND STORAGE FACILITIES
LIHUE-HANAMAULU
AMFAC/JMB HAWAII LIHUE DISTRICT, ISLAND OF KAUAI
KODANI AND ASSOCIATES, INC.

2. A 12" transmission main along Ahukini Road from Kuhio Highway to the project area.

3. 12" transmission mains along the main roadways of the project area. 8" transmission mains along the collector roads within the project area.

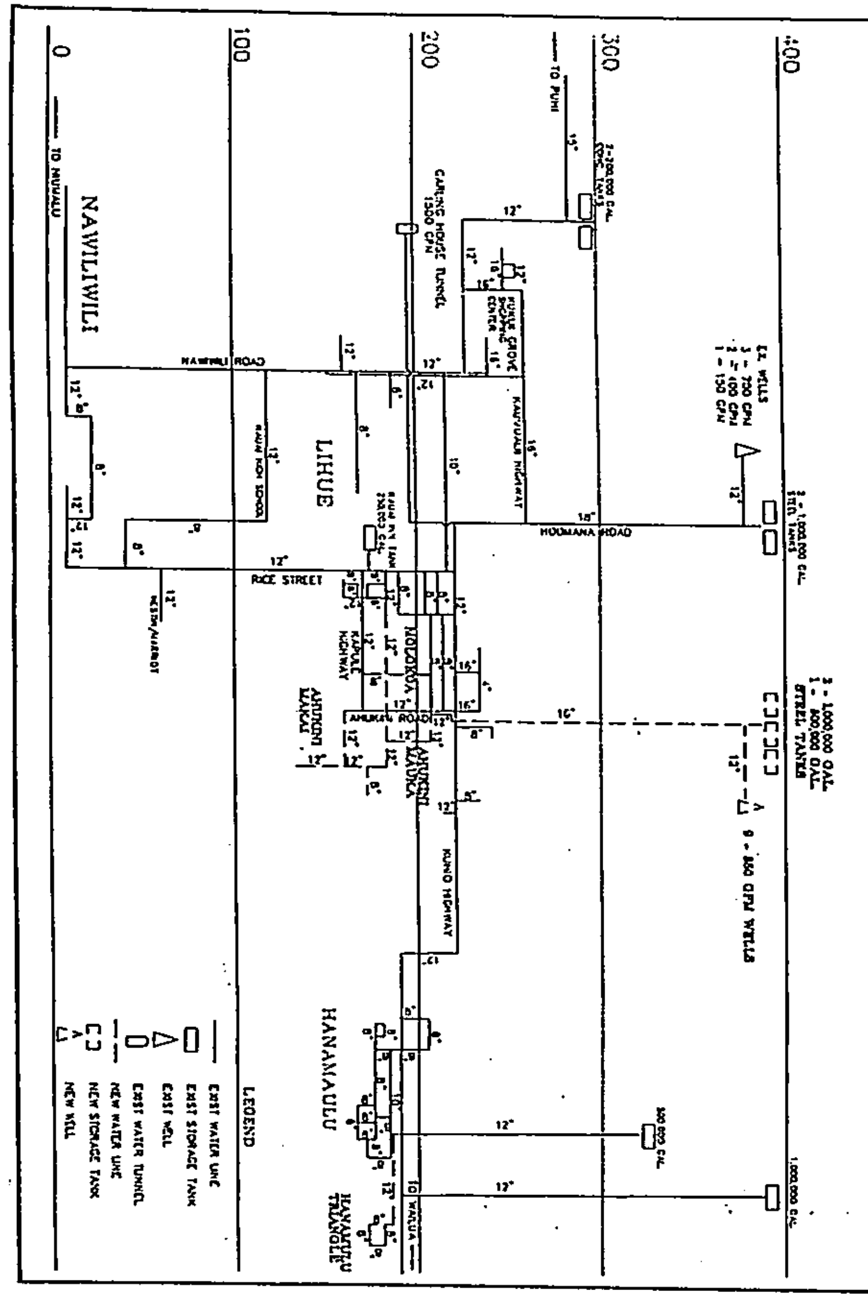
Likewise, the following improvements must be made to the existing transmission mains in order to support the Hanamaulu area:

1. A 12" transmission main along Kuhio Highway tapping off the existing 12" Kalepa Tank transmission main to the project area.

2. 8" transmission mains along the collector roads within the project area.

A schematic showing the proposed transmission main improvements is displayed in Figure No. 5. Transmission main improvements are shown along the major roadways of the Master Planned Community only. As interior roadways are constructed, additional transmission mains will be required.

FIGURE NO. 5
LIHUE WATER SYSTEM (PROPOSED)



Estimated Order-of-Magnitude Cost. The order-of-magnitude cost of the water system improvements for Amfac/JMB Hawaii, Inc.'s Lihue-Hanamaulu Master Planned Community is estimated at $10,800,000 dollars in 1994 dollars. The estimate assumes that the water system would be constructed to Department of Water standards and includes off-site improvements for source development, storage, and transmission. The estimate does not include the cost for distribution lines along the minor roadways since the planning of those roadways will be performed at a later stage of the development. See Table No. 3 for a breakdown of the costs.

TABLE NO. 3
WATER SYSTEM
CONSTRUCTION COST ESTIMATE

PROJECT AREA	DESCRIPTION	UNITS	UNIT PRICE	TOTAL COST
MOLOKOA	8" D.I.	3900 LF	$60/LF	$234,000
	12" D.I.	3700 LF	$80/LF	$296,000
			TOTAL	$530,000
AHUKINI MAUKA	8" D.I.	900 LF	$60/LF	$54,000
	12" D.I.	6900 LF	$80/LF	$552,000
			TOTAL	$606,000
AHUKINI MAKAI	12" D.I.	2000 LF	$80/LF	$160,000
HANAMAULU	8" D.I.	1900 LF	$60/LF	$114,000
OFF-SITE	12" D.I.	4000 LF	$80/LF	$320,000
	16" D.I.	10000 LF	$90/LF	$900,000
	0.5 M.G. TANK	1 TANK	$900,000/TANK	$900,000
	1.0 M.G. TANK	2 TANKS	$1,600,000/TANK	$3,200,000
	0.5 M.G WELL	9 WELLS	$ 250,000/WELL	$2,250,000
			TOTAL	$7,570,000
			SUB-TOTAL	$8,980,000
	ENGINEERING AND CONTINGENCY (20%)			$1,796,000
			TOTAL	$10,776,000

Overview of Proposed Water System. Because the Lihue Water System is currently at or near capacity, Amfac/JMB Hawaii, Inc.'s Lihue-Hanamaulu Master Planned Community must construct significant upgrades to the Lihue Water System in order to develop in a timely manner. Upgrades to the Lihue Water System include, nine new wells, three large storage tanks, and a network of transmission mains ranging from 8-inches to 16-inches in size.

The water system improvements derived in this engineering report are based on the expanded water needs due to Amfac/JMB Hawaii, Inc.'s Lihue-Hanamaulu Master Planned Community only, and does not include additional water system improvements due to other developments or subdivisions. Amfac/JMB Hawaii, Inc. is committed to working closely with the Department of Water in the design and construction of improvements to the Lihue Water System.

C

Molokoa Hydrologic Study

MOLOKOA HYDROLOGIC STUDY

Lihue, Kauai

Prepared for

AMFAC/JMB Hawaii

Water Resource Associates

Honolulu, Hawaii
August 1994

CONTENTS

	Page
INTRODUCTION	1
REGIONAL GEOLOGIC SETTING	
Waimea Canyon Volcanic Activity	2
Koloa Volcanic Activity	2
Sedimentary Deposits	3
Topography	3
REGIONAL HYDROLOGIC SETTING	
Rainfall and Runoff	4
High-Level Groundwater Occurrence	4
Basal Groundwater Occurrence	5
Regional Groundwater Movement	5
Hanamaulu Aquifer System	6
HIGH-LEVEL AQUIFER (KOLOA LAVAS)	
Subsurface Geology	8
Water Levels and Groundwater Movement	10
Specific Capacity and Sustainable Yield of Wells	11
Water Quality	14
BASAL AQUIFER (KOLOA LAVAS)	
Subsurface Geology	15
Water Levels	16
Specific Capacity of Wells	16
Water Quality	17
BASAL AQUIFER (WAIMEA LAVAS)	18
HYDROLOGIC SUMMARY AND CONCLUSIONS	19
HISTORY OF POTABLE WATER DEVELOPMENT	20
EXISTING WELLS AND WATER USE	21
Lihue Water System	22
Private Users	23

CONTENTS (Cont'd)

Page

PROJECT WATER REQUIREMENTS 23

PROPOSED WATER SUPPLY

- Availability of Ground Water 24
- Proposed Well Sites 26

POTENTIAL IMPACT ON GROUNDWATER RESOURCES

- Source Alternatives 27
- Impact on Sustainable Yield 28
- Impact on Existing Potable Water Sources 28
- Impact on Groundwater Quality 28

REFERENCES 30

APPENDIX

- Water Quality Analyses A1
- Well Records A3
- Drilling Log for Old Lihue Grammar School Well A4

TABLES

Page

Table 1. Log of Cores of Selected Test Holes 9

Table 2. Head in Test Holes Drilled in Lihue Area 10

Table 3. Specific Capacities of Selected Wells & Test Holes 13

Table 4. Producing Potable Wells 22

Table 5. Potable Water Requirements 24

FIGURES

Figure 1. Location of Study Area and Hanamaulu Aquifer System 7

Figure 2. Interpretive Hydrologic Section, Kilohana-Lihue 12

Figure 3. Pumping Test Record, Puhi 2 14

Figure 4. Potable Water Requirements 25

Figure 5. Water Supply vs Demand 27

MAPS

Map 1. Regional Hydrogeology 30

Map 2. Existing Wells and Test Holes 31

Map 3. Proposed Water Development 32

INTRODUCTION

Amfac/JMB Hawaii, Inc., through its subsidiaries, The Lihue Plantation Company, Ltd. and Amfac Property Development Corporation, is proposing to develop approximately 555 acres of land in the Lihue-Hanamaulu area situated in the southeastern coastal part of Kauai. The development is expected to consist of a mix of single and multi-family residential, commercial, industrial, and public land uses. The proposed project is surrounded by the urban areas of Lihue, Hanamaulu, and the Lihue Airport.

The planned development will require new potable water sources for municipal use. The County's Lihue Water System serves the study area, but does not have the source capacity or infrastructure to serve the development's water needs.

This report describes and evaluates the hydrology and availability of water resources, existing and potential sources of water supply, and potential impacts on water resources for Amfac's proposed project. It has been prepared in support of the preparation and processing of an EIS, State LUC Boundary Amendment, and County General Plan Amendment.

The study area embraces an area of approximately 35 square miles in the southeastern quadrant of Kauai (Figure 1). It extends roughly 6½ miles in a west-to-east direction, from Kilohana Crater to Hanamaulu Bay, and 5¼ miles in a north-to-south direction, from the mid-section of Kalepa Ridge to Haupu Ridge.

REGIONAL GEOLOGIC SETTING

Waimea Canyon Volcanic Activity

The study area is situated in the Lihue Depression, a large buried, somewhat circular geologic feature in the eastern part of the island, bounded by the high, steep slopes of Waialeale-Kahili Mountains on the west (outside of the study area), Makaleha Mountain on the north (outside of the study area), Kalepa Ridge on the east, and Haupu Ridge on the south. The Depression, formed by collapse on the eastern slopes of Kauai, occurred during the shield-building period of the island more than two million years ago (Waimea Canyon volcanic series).

A long period of erosion followed the shield-building period and the island became deeply eroded. Kalepa Ridge and Haupu Ridge are outlying remnants of thin-bedded Waimea Canyon lavas (Napali formation). The now-buried deep erosional gap between Kalepa and Haupu Ridges was cut by a major stream drainage system with headwaters reaching some 8 to 10 miles west in the high, rugged interior of the Lihue Depression.

Koloa Volcanic Activity

Volcanic activity resumed with the widespread eruption of the Koloa volcanic series of basalts, comprised of lava flows more massive and less permeable than the Napali formation. The Koloa series was deposited upon the deeply eroded Waimea basalts, burying much of it in the eastern half of the island.

In the Lihue Depression, a small subsidiary shield volcano developed from Kilohana Crater, located four miles northwest of Lihue town. Lava flows and associated ash deposits gradually filled the southern half of the Depression, flowing seaward around the southern end of Kalepa Ridge and building the gentle slopes on which the proposed development is situated. During the eruption of lavas from Kilohana Crater, the sea probably invaded the Lihue area at lease twice due to glacio-eustatic changes in sea level.

Sedimentary Deposits

Sedimentary deposits consist predominantly of recent alluvium deposited in the channels of Hanamaulu, Nawiliwili, and Huleia Streams and older slope wash alluvium deposited on the sides of Kalepa Ridge. These alluvial deposits are poorly permeable, carry small amounts of water, and have no hydrologic significance.

Topography

The dome-shaped slopes of Kilohana Crater dominate the western half of the study area and merge with the more gentle upland slopes of Koloa basalts that filled the rest of the Lihue Depression.

Erosion has carved many youthful stream channels in a striking radial pattern down the slopes of Kilohana Crater. Runoff in these streams are captured by three major streams which drain the Lihue area: Hanamaulu Stream which drains the northeastern slopes and empties into Hanamaulu Bay on the north side of the proposed development; Nawiliwili Stream which drains the southeastern slopes and empties into Nawiliwili Bay on the south side; and Huleia Stream which drains the southwestern slopes and also empties into Nawiliwili Bay.

REGIONAL HYDROLOGIC SETTING

Rainfall and Runoff

Rainfall in the southern half of the Lihue Depression is the principal source of ground water in the Lihue area. This rainfall ranges from 50 inches a year in the proposed development area to 200 inches a year seven miles west in the rugged mountains of the Lihue Depression. Roughly, a third of the rainfall percolates deep enough into the ground to become ground water and a third ends up as runoff in streams.

A number of youthful streams on the slopes of Kilohana have perennial flows, depending on how deeply they have cut into the weathered basaltic slopes, but many become intermittent during dry periods. The perennial flows are small, fed by ground water perched on ash layers interbedded with the dipping lava beds.

Below an elevation of about 200 ft., the perennial flows in the lower reaches of Hanamaulu, Nawiliwili, and Huleia streams are larger because they drain larger areas.

High-Level Groundwater Occurrence

High-level water in Koloa lavas is the most extensive occurrence of ground water in the study area (Map 1). Its occurrence results from the combination of high rainfall and overall low permeability of the lavas. High-level water occurs as bodies of water perched on beds of weathered soil, ash, and dense lavas and as bodies of water constrained at high levels by the permeability of the aquifer. On the slopes of Kilohana high-level water is evidenced by springs, seepages, and gaining flows in the streams.

Constrained bodies of high-level water was first confirmed in a deep exploratory well drilled in 1961 at the site of the old Lihue Grammar School. Based on a series of measurements of head (groundwater elevation) in the well during drilling, a 438-foot thick body of fresh high-level ground water was encountered to a depth of 248 ft. below mean sea level. About 1.5 miles mauka of this exploratory well, a number of wells and test holes also confirmed the occurrence of high-level water in an aquifer made complex by deep weathering and the heterogeneity of near-vent lava flows and pyroclastic deposits (Map 2). Elsewhère, unexplored high-level water in Koloa lavas undoubtedly occurs.

High-level ground water is not known to occur in the Waimea lavas (Napali formation) of Kalepa and Haupu Ridges, largely due to insufficient rainfall.

Basal Groundwater Occurrence

Basal ground water occurs in a lower sequence of Koloa lavas underlying the high-level aquifer. It was discovered in 1961 in the same exploratory well (old Lihue Grammar School site) in which the 438-foot thick body of constrained high-level water was confirmed. Other deep wells in the area between the Kauai Community College and Nawiliwili Bay have confirmed the occurrence of the basal aquifer underlying the high-level aquifer in the area between the Kauai Community College and near Nawiliwili Bay. The top of the basal aquifer lies 180 to 248 feet below mean sea level, based on data from two of the basal wells.

Regional Groundwater Movement

The general movement of ground water in the study area is eastward and southeastward through Koloa lavas which have filled the gap between Kalepa and

Haupu Ridges (Map 1). The ridges, comprised of dike-intruded Waimea lavas, probably impede the seaward discharge of ground water in the Koloa lavas.

Groundwater movement from the high rainfall area west of Kilohana Crater probably is deflected to some extent around the central core of Kilohana dome, through its northern and southern flanks toward the Lihue area. Ground water in the northern part of the study area is shown to move mostly southward toward Lihue, but some may move northward toward Wailua River.

Hanamaulu Aquifer System

As shown in Figure 1, the study area embraces most of the area designated as the Hanamaulu Aquifer System by the State Commission on Water Resource Management (1990). This aquifer system embraces a 55 square mile area delineated on the north by the Wailua River basin, on the west by the western boundary of the Lihue Depression (Kahili Mountains), and on the south by the crest of Haupu Ridge. The seaward boundary of the aquifer system includes the coastline from the east end of Haupu Ridge northward to a point just south of Wailua River.

Koloa lava flows dominate the aquifer system and rainfall ranges from 50 inches a year near the coast to about 200 inches a year in the mountainous western interior part of the system. The system includes both basal and high-level aquifers, but the high-level aquifer is predominant. Basal aquifers occur deep below the surface in Koloa lavas underlying the high-level aquifer and in outcrops of Waimea lavas (Napali formation) in Kalepa and Haupu Ridges.

The system receives an average rainfall volume of 217 mgd, of which 105 mgd (48%) is lost to evapotranspiration and 34 mgd (16%) is lost to runoff to the sea, leaving an average of 79 mgd (36%) to become groundwater recharge (State CWRM, 1990). The sustainable yield of ground water in the system has been estimated at roughly 40 mgd.

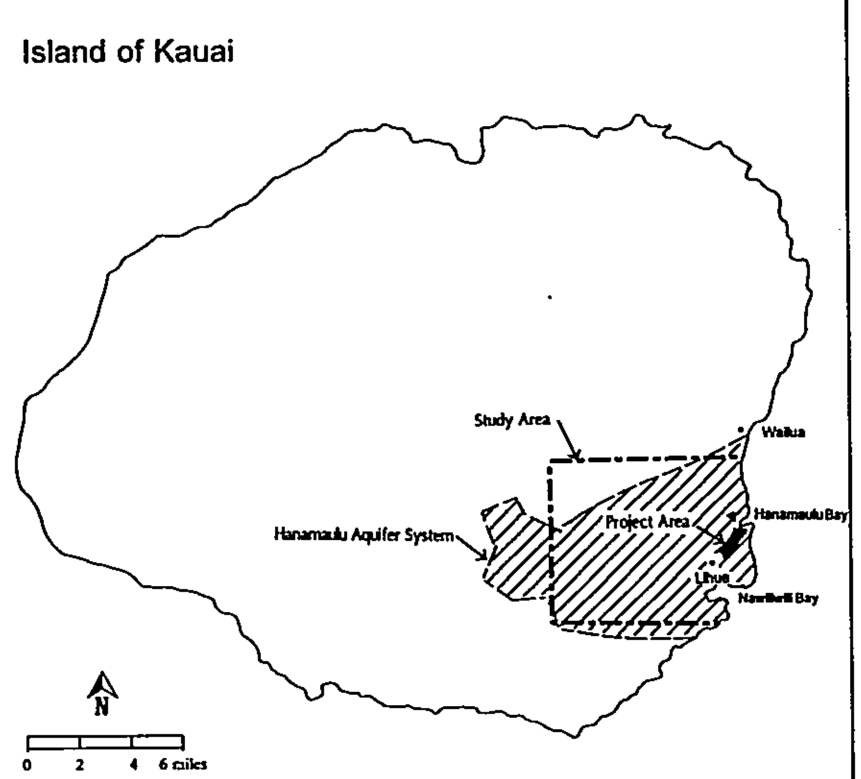


Figure 1. LOCATION OF STUDY AREA AND HANAMAULU AQUIFER SYSTEM

HIGH-LEVEL AQUIFER (KOLOA LAVAS)

Subsurface Geology

The Koloa lavas are notably heterogeneous and weathered, based on the logs of a number of wells and test holes drilled in the study area. Core samples from eight test holes, each approximately 200 feet deep, indicate that the area mauka of Lihue town is underlain by 30 to 144 ft. of soil and saprolite (basalt rock which has been deeply weathered to clay, but with basaltic texture preserved). Below the saprolite, the Koloa lavas range widely from dense-to-vesicular-to-clinkery and from unweathered-to-moderately weathered-to-highly weathered, especially in clinkery zones.

The subsurface is not uniform and can vary greatly over short distances of several hundred feet. Some test holes penetrated mostly dense basalts such as Kilohana Test Hole C and some showed alternating layers of vesicular and dense basalts such as Kilohana Test Hole E (Table 1).

Koloa lava flows are known throughout the island for their massive, dense characteristic and attendant low to moderate permeability and the Lihue area is no exception. On the whole, the test holes penetrated mostly dense basalt and often deep weathering was found to have reduced the inherent permeability of thin clinkery and vesicular layers, based on a comparative study of the core samples and pumping test results of wells at corresponding locations. The thin interflow zones of vesicular and clinkery basalt appear to be most responsible for the water yield of wells.

Table 1. LOG OF CORES OF SELECTED TEST HOLES
Lihue, Kauai

	Depth (ft.)	Description
Kilohana Test Hole A	0 - 30	SOIL & SAPROLITE: Reddish brown
	30 - 65	DENSE BASALT: Mod. to slightly weath'd, slightly vesic. in places, mod. perm.
Elev. = 372 ft.	65 - 86	DENSE BASALT: Mod. weath'd, slightly vesic. in places, poorly permeable.
	86 - 136	DENSE BASALT: Unweath'd, scattered vesicles, tightly fractured, poor perm.
	136 - 145	VESICULAR BASALT: Mod. weath'd, dense in places, mod. perm.
	145 - 189	VESICULAR BASALT: Slightly weath'd, dense in places, some tight fractures, mod. perm.
	189 - 200 T.D.	DENSE BASALT: Mod. weath'd, with scattered brown vesic. layers containing inclusions of gray dense basalt fragments, poor perm.
Kilohana Test Hole C	0 - 56	SOIL & SAPROLITE: Reddish brown, little perm.
	56 - 73	SAPROLITE: Gray & brown, dense, little perm.
	73 - 93	SAPROLITE: Gray, dense, little perm.
Elev. = 284 ft.	93 - 101	ASH & CINDER: Red, highly weath'd.
	101 - 114	SAPROLITE: Brown, dense, little perm.
	114 - 129	SAPROLITE: Gray, dense, little perm.
	129 - 144	SAPROLITE: Brown, dense, little perm.
	144 - 151	DENSE BASALT: Gray, slightly weath'd, tightly fractured, little perm.
	151 - 158	DENSE BASALT: Brownish gray, mod. weath'd, scattered vesic., poor perm.
	158 - 161	VESIC. BASALT: Gray, unweath'd fractured, mod. perm.
	161 - 186	DENSE BASALT: Gray, slightly to unweath'd, tighly fractured, slightly vesic. in places, little perm.
	186 - 191	ASH: Red, weath'd, imperm.
	191 - 201	DENSE BASALT: Brown, mod. weath'd, vesic. in places, poor perm.
	201 - 211 T.D.	DENSE BASALT: Gray, mod. to unweath'd, poor perm.
Kilohana Test Hole E	0 - 26	SOIL & SAPROLITE: Brown, little perm.
	26 - 66	VESIC. BASALT: Brownish gray, mod. weath'd, fractured, mod. perm.
	66 - 78	DENSE BASALT: Gray, mod. weath'd, with highly weath'd reddish brown vesic. layers, mod. perm.
Elev. = 408 ft.	78 - 96	DENSE BASALT: Gray, slightly weath'd, scattered vesic., fractured, mod. perm.
	96 - 108	VESIC. BASALT: Brown, mod. weath'd with highly weath'd vesic. layers, mod. perm.
	108 - 121	DENSE BASALT: Gray, slightly weath'd, fractured, poor perm.
	121 - 134	VESIC. BASALT: Brownish gray, mod. weath'd, poor perm.
	134 - 184 T.D.	DENSE BASALT: Gray, unweath'd, fractured, slightly weath'd vesic. layers in places, mod. perm.

mod. - moderate, moderately
perm. - permeable, permeability
vesic. - vesicular, vesicles
weath'd - weathered

Water Levels and Groundwater Movement

The high-level aquifer heads (water level elevations) are fairly well known in the Lihue and Puhi areas based on approximately 30 wells and test holes (see Map 2). Whether or not the high-level aquifer consists of one or more bodies of water, head measurements indicate that the principal movement of ground water is toward the sea in Koloa lavas between Haupu Ridge and Kalepa Ridge. Although some of the reported water levels may not be representative of true aquifer head, the data has been contoured to show the high-level aquifer head in Map 2.

Interestingly, the indentation in the 200-foot contour of high-level head correlates with a hydrologic sink, or area in which ground water discharges into Nawiliwili Stream. Based on the head in Test Hole F (Table 2), the 250-foot contour (not shown in Map 2) has a much more pronounced indentation suggesting that the hydrologic sink extends mauka from Garlinghouse Tunnel to a very productive wellfield (Kilohana Wells A, B, F, and I).

Table 2. HEAD IN TEST HOLES DRILLED IN LIHUE AREA

Test Hole (Location, Map 2)	Ground Elev. (ft.)	Well Depth (ft.)	Approx. Head (ft.)
Test Hole A (near Kilohana B)	372	200	226
Test Hole B (near Kilohana G)	390	242	325
Test Hole C (see Map 2)	284	211	227
Test Hole D (near Kilohana D)	490	184	421
Test Hole E (near Puhi 2)	408±	190	343
Test Hole F (see Map 2)	325	154	258
Test Hole I (see Map 2)	353		263±
Test Hole J (see Map 2)	380		230

A plausible explanation of the coincidence is that the tunnel and wellfield tap perched water in a permeable layer of vesicular basalts deposited in a broad drainage area underlain by an impermeable clay layer. The clay layer is red in the Garlinghouse Tunnel and brown in the wellfield. Core samples of the clay layer in the wellfield contain rounded basalt fragments, suggesting a re-worked ash deposit or alluvium.

In many of the wells, measurements taken during the drilling showed progressive declines in head of 20 to 30 feet as the aquifer was penetrated, suggesting perched and/or constrained water conditions. However, there were no indications of unsaturated zones. A few wells, such as Puhi Well 2 and Kilohana Well D, showed no decline in head as up to 120 ft. of the aquifer was penetrated, suggesting a single body of water constrained at high level.

A profile of heads in the high-level aquifer is shown in Figure 2. The profile confirms the seaward movement of ground water toward the Lihue Airport. The rather abrupt drop in head (191 feet) between Kilohana Well D and Test Hole J has no obvious geologic explanation, but it does suggest possible compartmentalization of the high-level aquifer by some type of vertical impediment to groundwater flow.

Specific Capacity and Sustainable Yield of Wells

The specific capacity of a well is a term often used to indicate its performance and is obtained by dividing the pumping rate in gallons per minutes (gpm) by the corresponding drawdown (feet) of water level in the well. Specific well capacity is a relative term which varies, depending on the rate and duration of pumping.

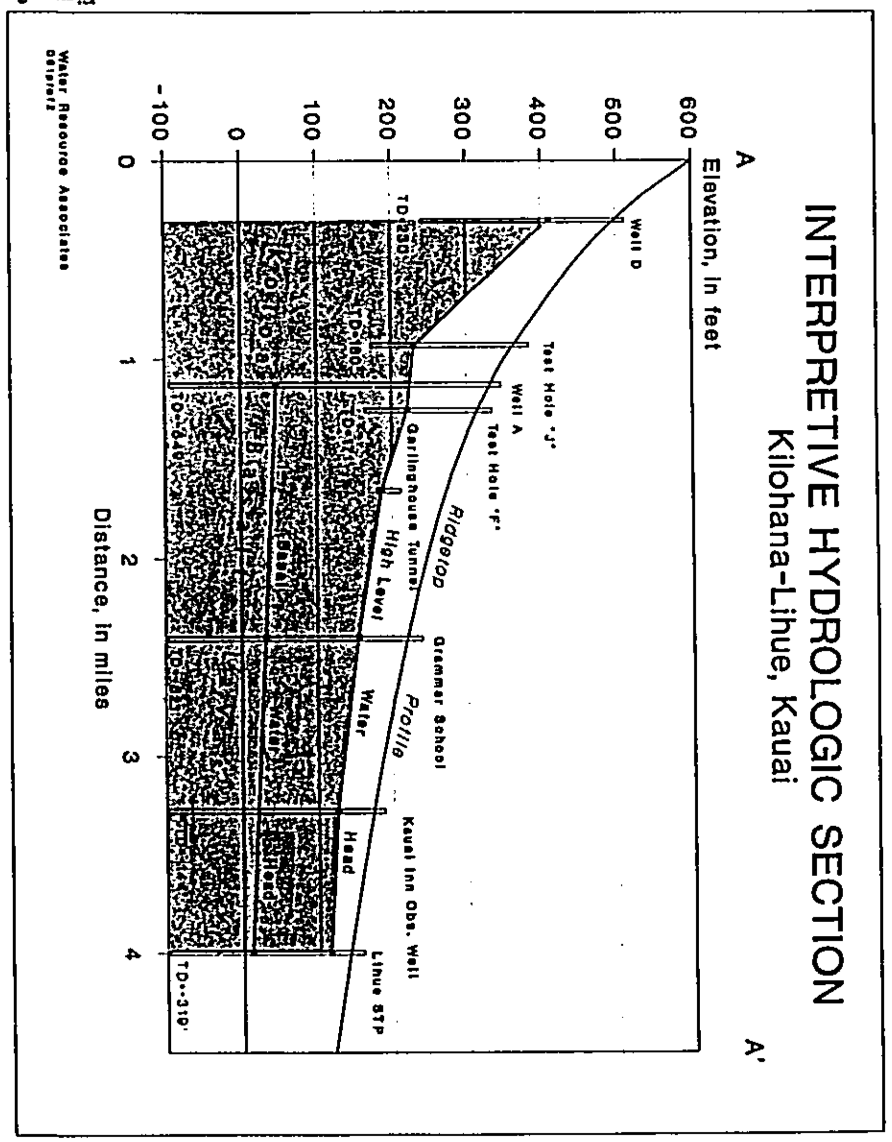


Figure 2.

The specific capacities of the high-level wells in the study area typically range from approximately 1 to 7 gpm/ft., except for the unique cluster of Kilohana Wells A, B, F, and I (see Table 3). Their specific capacities of approximately 140 to 210 gpm/ft. are unusually high for wells in Koloa lavas and are comparable to the specific capacities of wells in Waimea Canyon basalts (Napali formation).

Table 3. SPECIFIC CAPACITIES OF SELECTED WELLS & TEST HOLES IN THE LIHUE AREA, KAUAI

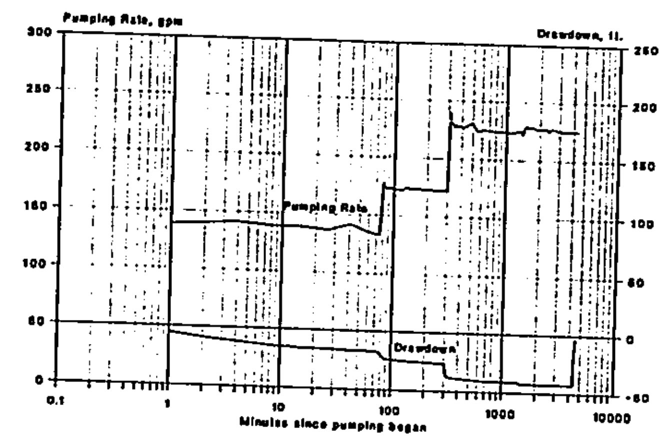
Name	State Well No.	Pumping Rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/ft.)
Kalepa Ridge Expl.	0021-01	100	16	6.2*
Sugar Mill	5822-01	130	264	0.5*
Lihue Grammar School	5822-02	200	20	10.0*
Kalepa Ridge I	5921-01	100	19	5.3*
Kilohana A	5923-01	500	72.8	6.9*
Kilohana B	5923-02	400	2.9	138
Kilohana C	5923-03	250	55	4.5
Puhi 2 (Well E)	5824-03	225	36.5	6.2
Kilohana F	5923-04	418	2.0	209
Kilohana G	5923-05	200	27	7.4
Kilohana H	5923-06	95	100	0.9
Kilohana I	5923-07	955	4.9	195
Test Hole D		40	31	1.3
Test Hole B		35	55	0.6
Test Hole C		10	120	0.1

*Basal water well.

The sustainable yield of individual high-level wells can vary considerably over short distances and depend primarily on well drawdown characteristics, rather than salt water intrusion, or sustainable yield of the aquifer (which far exceeds current withdrawals). The sustainable yield of some wells can be easily estimated when they show a stabilized drawdown after several days of constant pumping and a good recovery of water level (Figure 3). For other wells, estimates are difficult when pumping test results show an unstabilized drawdown and poor recovery of water level.

Figure 3. PUMPING TEST RECORD, PUHI 2

Date of Test: July 8-11, 1980



Water Quality

The high-level aquifer is not subject to salt water intrusion and all wells that tap into it show pristine values of chlorides (16 to 24 mg/l) (see Appendix, Water Quality Analyses). All other constituents tested meet safe drinking water standards.

Some of the wells, however, are located in sugarcane fields and are, consequently, subject to potential contamination from the leaching of fertilizers and herbicides used in cultivation. Nitrate, a good indicator of contamination by fertilizers, occurs in almost pristine amounts of 1.1 mg/l, or less, in all existing wells. These amounts are well within the primary drinking water standard of 10 mg/l.

Atrazine, a herbicide, has been reported in the Garlinghouse Tunnel and in Kilohana Wells C and I. The 1991 reported amounts ranging from 0.00006 to 0.0002 mg/l, however, are well below the maximum contaminant level of 0.003 mg/l (State CWRM, Water Quality Plan, 1992, p. III-19, and Department of Health, 1989, p. 7).

BASAL AQUIFER (KOLOA LAVAS)

Subsurface Geology

A basal groundwater aquifer occurs deep below the surface in a lower sequence of Koloa lavas underlying the high-level aquifer. The deep basal aquifer has been confirmed in five wells: Puhi 2, Kiiohana A, Old Lihue Grammar School, Sugar Mill, and Kauai STP. However, the depth of the boundary between the two aquifers has been confirmed only in Kilohana Well A and the Grammar School well: 180 feet below mean sea level and 248 feet below mean sea level, respectively.

A fairly complete record of the subsurface formations is found in the Summary of Drilling Logs and Pumping Test of the Old Lihue Grammar School Well (State Division of Water and Land Development, 1962). The drilling log is included in the appendix and it shows a complex sequence of geologic formations to a total depth of 745 feet (–521 ft., msl). The driller reported blue, gray, and black lavas; red, brown, yellow, and green clays; coral; sand; and cinders. The boundary between the high-level aquifer and the underlying basal aquifer consists of 34 feet of coral limestone and sand underlain by 12 feet of hard brown sand. Below the boundary, the Grammar School well penetrated 273 feet of Koloa basalt before bottoming out in 26 feet of coral limestone and sand. The basal aquifer is believed

to be in Koloa lavas (1.4 million years old) deposited during Pleistocene time in the Lihue Depression which was invaded at least twice by the sea, as a result of glacio-eustatic changes in sea level.

Water Levels

During drilling, the water level in the Grammar School Well dropped abruptly to a basal head of 32 ft. when a depth of 472 ft. (–248 ft. mean sea level) was reached. In the Sugar Mill Well a head of 120 feet was reported. However, this value may not be representative of the high-level or basal head. The depth at which the water level dropped was not reported. The Lihue STP Well, located 1½ miles makai of the Grammar School Well, encountered a high-level head of 115 ft. and a basal head of 11.2 ft. The basal/high-level boundary was not reported, but it must be shallower than the total depth of the well, or –320 ft., msl. In Kilohana Well A, located 1.3 miles mauka of the Grammar School Well, the basal head is approximately 47 feet.

Specific Capacity of Wells

The specific capacity of Kilohana Well A is 6.9 gpm/ft., which is comparable to wells in the high-level aquifer (Table 3). The Grammar School Well, which was designed to produce both basal and high-level water, had a specific capacity of 10.0 gpm/ft. when completed, but in 1970, the well's specific capacity was only 5.2 gpm/ft. The loss of capacity probably reflects loss of yield in the high-level cased section, rather than the basal open-hole section of the well. An analysis of the pumping test records indicate that deepening the well 200 feet increased basal water production by only 15 percent.

Water Quality

The basal water quality in Koloa lavas is excellent, based on Kilohana Well A. However, toward the ocean in the Grammar School well the basal aquifer may be minimally affected by salt water intrusion, based on the well's chloride content of 41 mg/l, which suggests very slight salt water mixing when compared to the corresponding pristine value of 16 mg/l chlorides in Kilohana Well A located 1.3 miles mauka.

Radon, a radioactive gas, was detected in a water-sample collected from the basal aquifer in Kilohana Well A (presently out of service due to pump problems) by the State Department of Health in August 1987 (DOH News Release, October 21, 1987). The well sample contained 983 picoCuries per liter, a level slightly higher than the national average, but with low health risk. "The primary health risk associated with radon in water results from inhaling the gas that is released into the air from the water and not from drinking the water with radon", according to the news release. Most of the radon dissolved in water will escape into the air in a few seconds.

Radon is a naturally occurring gas found in rocks (including basalts) which contain uranium or radium. The Environmental Protection Agency (EPA) has not set a drinking water standard for radon in the United States, but is currently considering 300 picoCuries per liter (Jay Vasconcelos, Microbiologist, EPA, in a presentation at the 1994 Hawaii Waterworks Association Annual Conference, Kauai Coconut Beach Resort, November 16-19).

Kilohana Well G, which taps the high-level aquifer, was found to contain no radon in the 1987 survey (Bill Wong, DOH, personal communication, November 1994). The high-level aquifer is being proposed as the source of water supply for

the Amfac Lihue-Hanamaulu project. Two sites for proposed wells are located approximately 3/4 to 1 mile away from the existing Kilohana wells.

BASAL AQUIFER (WAIMEA LAVAS)

Only two wells in the study area have been drilled in Waimea Canyon lavas (Napali formation). They are located in Kalepa Ridge (see Map 2). Their reported heads of 13 and 15 feet belie their sensitivity to salt water intrusion under pumping conditions. Also, in spite of being located in lava flows of the Napali formation which is typically very permeable, the wells have low yields. Dikes and deep weathering are probably responsible. Kalepa Ridge Well No. 1 on the south end of the ridge has a specific capacity of only 5.3 gpm/ft. and Kalepa Ridge Exploratory Well on the makai side of the ridge has a specific capacity of only 6.2 gpm/ft. These values are much lower than expected for wells tapping the Napali formation.

Geologically, the basalts in Kalepa Ridge may be somewhat isolated from significant recharge moving eastward from the high rainfall interior areas because of dikes and impermeable slope wash deposits extending below the surface on the mauka side of Kalepa Ridge. This hypothesis is supported by pumping test results in the two Kalepa Ridge wells.

The basal water in Kalepa Ridge Well No. 1 meets all safe drinking water standards, based on chemical analyses performed in 1991.

HYDROLOGIC SUMMARY AND CONCLUSIONS

The principal movement of ground water is east and southeast toward the ocean between Kalepa and Haupu Ridges. This coastal stretch represents the principal discharge area for the Hanamaulu Aquifer System which has an estimated recharge of 79 mgd and sustainable yield of 40 mgd.

Groundwater in the Lihue area occurs predominantly in the Koloa formation, an extensive, widespread, and thick sequence of basaltic lava flows which, in the study area, erupted from Kilohana Crater. The formation extends to a depth of at least 500 feet below sea level. A high-level aquifer occurs in the upper part of the formation to a depth of 180 to 250 feet below sea level. Underlying the high-level aquifer is a basal aquifer in the lower part of the Koloa formation. The two aquifers are separated by an impermeable sedimentary interval consisting of 34 feet of coral and sand underlain by 12 feet of alluvial brown sand in the Old Lihue Grammar School Well.

Basal aquifers occur in Kalepa Ridge and probably Haupu Ridge. These two ridges are comprised of Napali formation lava flows of the Waimea Canyon volcanic series which are normally very permeable and yield water readily to wells. However, two drilled wells indicate that the basal aquifer in Kalepa Ridge has low recharge and cannot sustain potable well yields much greater than 100 gpm (0.14 mgd) due to rising chloride contents.

The high-level aquifer in Koloa lavas represents the most extensive occurrence of ground water in the study area. Although wells drilled into this aquifer have unpredictable and modest yields, it is the most feasible source of potable water supply because wells can be less than 400 feet deep and located such that they are reasonably close to the proposed development, yet protected by the watershed area of Kilohana's steep slopes.

The basal aquifer underlying the high-level aquifer is a less feasible source of potable water supply primarily because wells would have to be twice as deep as high-level wells with consequent increase in capital and pumping costs. The specific capacity of such basal wells would not be much greater than high-level wells.

Basal wells located in Waimea lavas in Kalepa Ridge can be expected to have small capacities and be subject to salt water intrusion. Potable wells for municipal supply should be located mauka of Kuhio Highway to avoid existing urban areas and potential salt water intrusion.

HISTORY OF POTABLE WATER DEVELOPMENT

One of the earliest recorded developments of high-level ground water for potable water use in the study area was the construction of the 1600 ft. Kokolau Tunnel (outside of study area, 3.8 miles west of Lihue town) by Kauai County in 1928 to intercept water flowing from springs in a tributary of Huleia Stream (Macdonald, Davis, and Cox, 1960) located at an elevation of about 300 feet. The tunnel develops high-level groundwater in Koloa lavas perched on a red soil layer and continues to supply about 0.5 mgd of gravity-flow water to the County's Lihue Water System.

Seven years later, in 1935, Lihue Plantation Co. excavated a 790 ft. tunnel less than a mile west of Lihue on Nawiliwili Stream at an elevation of about 200 ft. to supply 1.2 mgd of pumped water to the plantation's potable water system. The tunnel site was selected by W.O. Clark to capture high-level ground water that was discharging into a 1000-foot stretch of Nawiliwili Stream and creating a gain in flow from 0.2 to 2.4 mgd (Macdonald, Davis, and Cox, 1960). Known as the Garlinghouse Tunnel, it develops high-level ground water perched on a layer of red clay and currently is a major source of supply (2.0 mgd capacity) for the County's Lihue Water System.

In 1972, in anticipation of the growing demand for potable water in the Lihue area, a general plan for domestic water was prepared for the Kauai Department of Water (State Division of Water & Land Development, 1972). In the plan, prospective well sites were identified on the southeastern slopes of Kilohana dome one to 1½ miles mauka of Puhi and Lihue towns. Subsequently, during the 1970's the State Department of Land and Natural Resources and the Kauai Department of Water (DOW) in a joint effort initiated a groundwater exploration program in which a number of Nx-size core holes and exploratory wells were drilled. As a result of the program, a total of eight well sources have been developed in the Kilohana and Puhi areas for the Lihue Water System.

The DOW currently (1994) plans to drill two exploratory wells in the Hanamaulu area and one in the Puhi area in search of new sources of supply for the Lihue Water System (see Map 3). In addition, several observation wells are being planned, in cooperation with the U.S. Geological Survey, to collect geologic and hydrologic data in the study area and vicinity.

EXISTING WELLS AND WATER USE

The location, heads, and chloride content of all wells located in the study area are shown on Map 2. The location of four test holes are also shown. The complete well record, including ownership, physical dimensions, installed pump capacity, and status, are shown in the appendix. Wells which currently produce potable water are listed in Table 4 and all but one supply the County's Lihue Water System.

Table 4. PRODUCING POTABLE WELLS

Name	State Well No.	Aquifer	Pump Cap. (mgd)	1991 Water Use (mgd)
Kauai County Department of Water:				
Garlinghouse Tunnel	5823-01	High-Level	2.00	
Kilohana A	5923-01	Basal	0.60	
Kilohana B	5923-01	High-Level	1.00	
Kilohana C	5923-03	*	0.14	
Kilohana F	5923-04	*	0.57	
Kilohana G	5923-05	*	0.25	
Kilohana I	5923-07	*	1.00	
Kokolau Tunnel*	5725-01	*	0.43	
Old Grammar School	5822-02	Basal	0.21	
Puhi 1 (KCC)	5824-01	*	0.17	
Puhi 2 ("E")	5824-03	High-Level	0.29	
Puhi 3**	5824-05	*	0.43	
TOTAL			7.05	3.34
Lihue Plantation Company:				
Sugar Mill	5822-01	Basal	0.53	0.30

*Tunnel located outside of study area.
**Well to be on-line soon.

Lihue Water System

The Lihue Water System is currently supplied by eight wells and two tunnels (see Table 4 and Map 3). All of the sources develop high-level water perched and/or constrained in Koloa lavas, except for Kilohana Well A, Old Lihue Grammar School Well, and Puhi Well 1, which primarily develop basal water below the high-level aquifer. Most of the high-level wells are only 200 to 300 ft. deep, while the basal wells are 745 to 920 ft. deep and develop water 180 to 250 ft. below sea level.

Major reservoir storage include one 0.5 MG (million gallons) and two 1.0 MG tanks located in the Kilohana and Puhi source areas and one 0.5 MG and one 1.0 MG tank located on the southern end of Kalepa Ridge. Water is transmitted from the Kilohana and Puhi source areas via 18-inch and 16-inch diameter pipelines to the various service areas (Map 3).

Average water use (1991) is 3.34 mgd (million gallons per day) (Table 6, State CWRM, Kauai Water Use & Development Plan, 1992). Monthly and annual water use data are not available. However, it is estimated that current (1993-94) water use does not exceed the estimated water use for 1991 because of Hurricane Iniki in 1992 and the closure of the Westin Kauai Resort complex, a previous large user of potable water from the Lihue Water System.

Private Users

Private use of potable ground water in the study area is limited to Lihue Plantation Company's Sugar Mill well which uses roughly 0.3 mgd, primarily for boiler make-up water (Mike Furukawa, personal communication, June 1994). Nonpotable ground water use is limited to wells owned by the Westin Kauai Resort complex. Three wells are used for irrigation and two wells are used to supply made-made lagoons. Estimates of current water use are not available.

PROJECT WATER REQUIREMENTS

The water requirements (average day demand) for the proposed development has been estimated at 1.78 mgd and are shown in Table 5 and Figure 4. This estimate is based on the master plan prepared by PBR Hawaii and on the water system standards of the Kauai Department of Water. The master plan provides for a maximum of 1,800 single family and multi-family residential units.

Table 5. POTABLE WATER REQUIREMENTS
(Based on maximum number of units)

Land Use	PHASE I		PHASE II		PHASE III		PHASE IV		Totals
	Units	gpd	Units	gpd	Units	gpd	Units	gpd	(gpd)
Residential: Single Family Multi Family	418 134	209,000 46,900	310 256	155,000 89,600	470 160	235,000 56,000	52 -	26,000	675,000 192,500
Retail/Ofc	20.2 acs	60,600	13.5 acs	40,500	5.1 acs	15,300	31.2 acs	93,600	210,000
Industrial	26.7 acs	106,800	27.4 acs	109,600	37.3 acs	149,200	36.5 acs	146,000	511,600
Public/Quasi Public	63.9 acs	192,300	-		-		-		192,300
Parks/Open Space	13.6 acs	30,000	17.1 acs	-	11.2 acs	25,000	6.4 acs	-	55,000
TOTAL Average Day Demand (gpd)	645,600		334,700		480,500		265,600		1,786,400
TOTAL Maximum Day Demand (gpd)	968,400		592,000		720,800		398,400		2,679,600

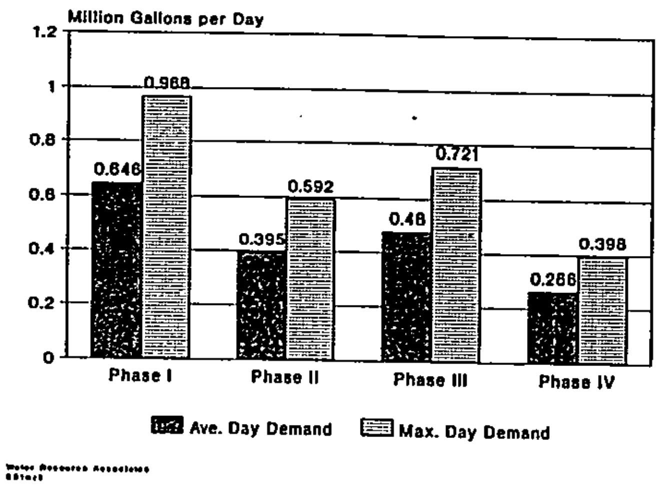
Notes: gpd = gallons per day
Maximum Day Demand = 1.5 x Average Day Demand
Single Family: 500 gpd/unit
Multi-Family: 350 gpd/unit
Retail/Ofc (Commercial): 3,000 gpd/ac
Industrial: 4000 gpd/ac
Public/Quasi-Public: 3000 gpd/ac (includes 35 acs @ 2500 gpd/ac for recycling center, 8 acs @ 2500 gpd/ac for school, and 4.1 acs @ 4000 gpd/ac for disinfestation facility)
Parks/Open Space: 2500 gpd/ac (12 acres in Phase I and 10 acres in Phase III require water, remainder does not require water)

PROPOSED WATER SUPPLY

Availability of Ground Water

The County's Lihue Water System, which currently serves the area surrounding the proposed development, does not have sufficient source capacity to meet the projected 1.78 mgd average day water requirements of the proposed

Figure 4. POTABLE WATER REQUIREMENTS



development. Consequently, new well sources must be sought and developed. The Hanamaulu Aquifer System, in which the proposed development is located, has an estimated groundwater recharge of 79 mgd and a sustainable yield of 40 mgd (State CWRM, 1990, p. B4). The 40 mgd sustainable yield greatly exceeds the estimated 1991 (pre-Hurricane Iniki) withdrawal of 5 mgd (3.34 mgd County plus others) from the aquifer system. Adding the 1.78 mgd needed for the proposed development, a total withdrawal of 6.78 mgd would represent only 17% of the 40 mgd sustainable yield of the aquifer system.

The most feasible source of potable water supply for the proposed development is the high-level aquifer in Koloa lavas. The aquifer is extensive and

wells need not be much deeper than 400 ft. Salt water intrusion would not be a problem. The alternative of developing the basal aquifer in Koloa lavas would require drilling deep wells (700 to 900 ft.) with greater capital and pumping costs. Wells located in Kalepa Ridge are most likely to be unsuccessful in producing suitable, potable water sources due to limited recharge and salt water intrusion.

Proposed Well Sites

The criteria used to determine the location of proposed exploratory wells are based upon the following:

- Sector recharge and sustainable yield
- Accommodation of existing and planned well sites
- Well elevations ranging from 300 to 400 feet
- Individual well capacities of 350± gpm

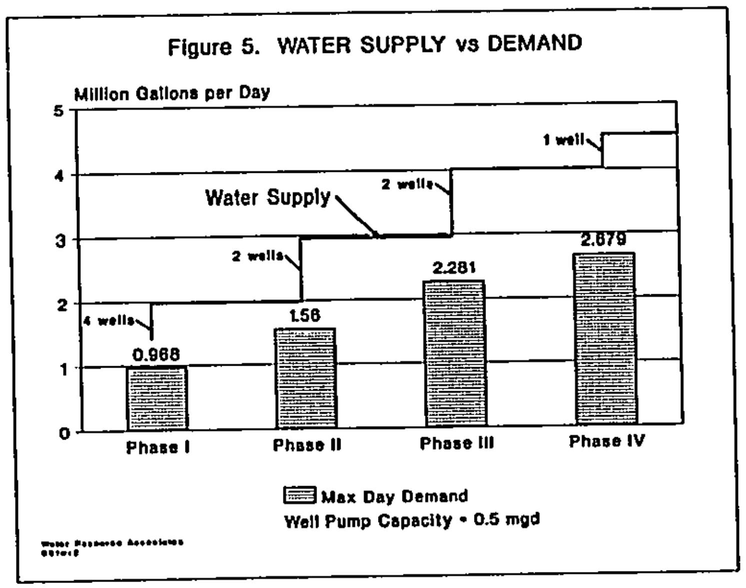
As shown on Map 3, two sites (A and B) for exploratory wells have been selected approximately 1.7 miles northwest of the proposed development. The sites selected have the advantages of extending past exploration and development efforts northward, being in a hydrologic sector with undeveloped recharge, and being located in an area upgradient of existing sugar cane lands. Site A has the advantage of being located along an existing road, while Site B has the advantage of being located slightly more upgradient and mauka of usable land.

Other than the selection of an initial exploratory well within the two 1.0 MG tank sites proposed by Kodani and Associates, engineering consultant for the project, specific well locations and well spacing within Sites A and B are beyond the scope of this report. However, for planning and budgeting purposes, it is assumed that the required wells will have an average depth of 400 feet and an average pump capacity of 350 gpm (0.5 mgd). Based on the Kauai Department of Water standards for source requirements and an average well capacity of 0.5 mgd, nine wells (includes one standby well) would be required for the full build-out of the proposed development (see Figure 5).

POTENTIAL IMPACT ON GROUNDWATER RESOURCES

Source Alternatives

An alternative to the development of ground water, is the development of surface water from Lihue Plantation Company's irrigation ditch system. However, surface water sources for municipal use are not a viable or economically acceptable



alternative for County water systems throughout the State because Federal and State safe drinking water regulations require expensive treatment for surface water.

Impact on Sustainable Yield

As mentioned earlier in this report, the estimated sustainable yield of 40 mgd available in the Hanamaulu Aquifer System far exceeds the estimated current withdrawal of 5 mgd (12.5% of sustainable yield) from the aquifer system. Adding the 1.78 mgd (average day demand) needed for the proposed development, the total withdrawal of 6.78 mgd would represent only 17% of the 40 mgd sustainable yield of the aquifer system. Consequently, the proposed development of 1.78 mgd at full build-out will have no measurable impact on the sustainable yield of the aquifer system.

Impact on Existing Potable Water Sources

The proposed development will require new potable well sources to meet a projected average demand of 1.78 mgd. The wells will be located a minimum distance of 0.6 mile from the nearest existing potable well (Kilohana Well G, Map 3) which belongs to the Lihue Water System. The new wells are expected to be included in this water system and will not affect any existing potable wells.

Impact on Groundwater Quality

The withdrawal of 1.78 mgd of high-level ground water at full build-out of the proposed development will have no measurable impact on groundwater quality (salinity) of the aquifer system because the amount represents only 2.2% of the 79 mgd of aquifer recharge. The proposed development lies hydrologically downgradient of existing urban areas and is underlain by the seaward part of high-level and basal aquifers which are not considered potential sources of drinking water because they are subject to salt water intrusion and potential contamination from existing urban developments.

The State Department of Health has established the UIC line along Kapule Highway which runs through the project area. The primary purpose of the UIC line is to protect potential sources of drinking water by not allowing wastewater injection wells or cesspools mauka of the line. However, no injection wells or cesspools are proposed and any runoff or wastewater disposal required for the project will be done in full compliance with the UIC and other applicable regulations.

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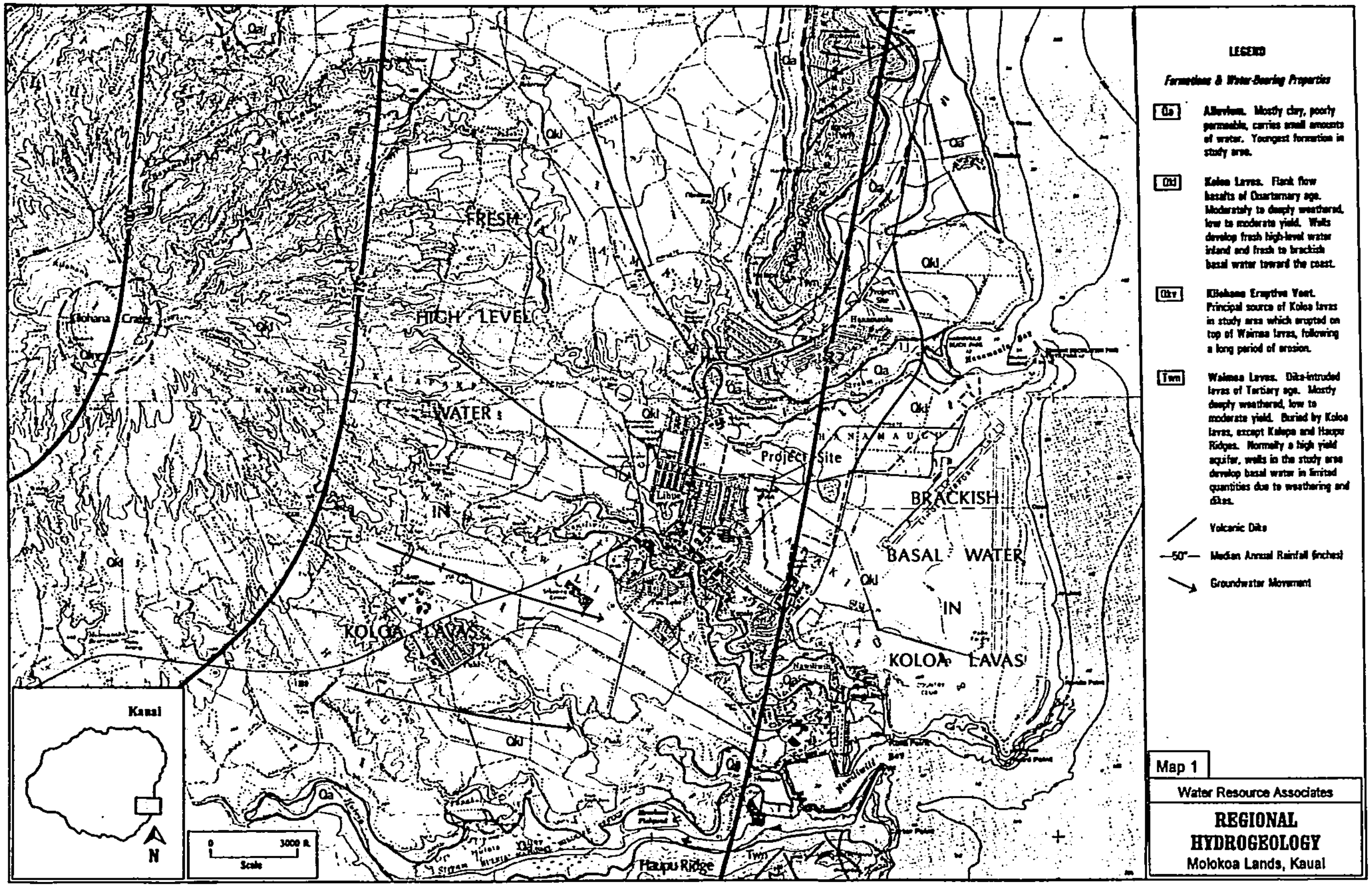
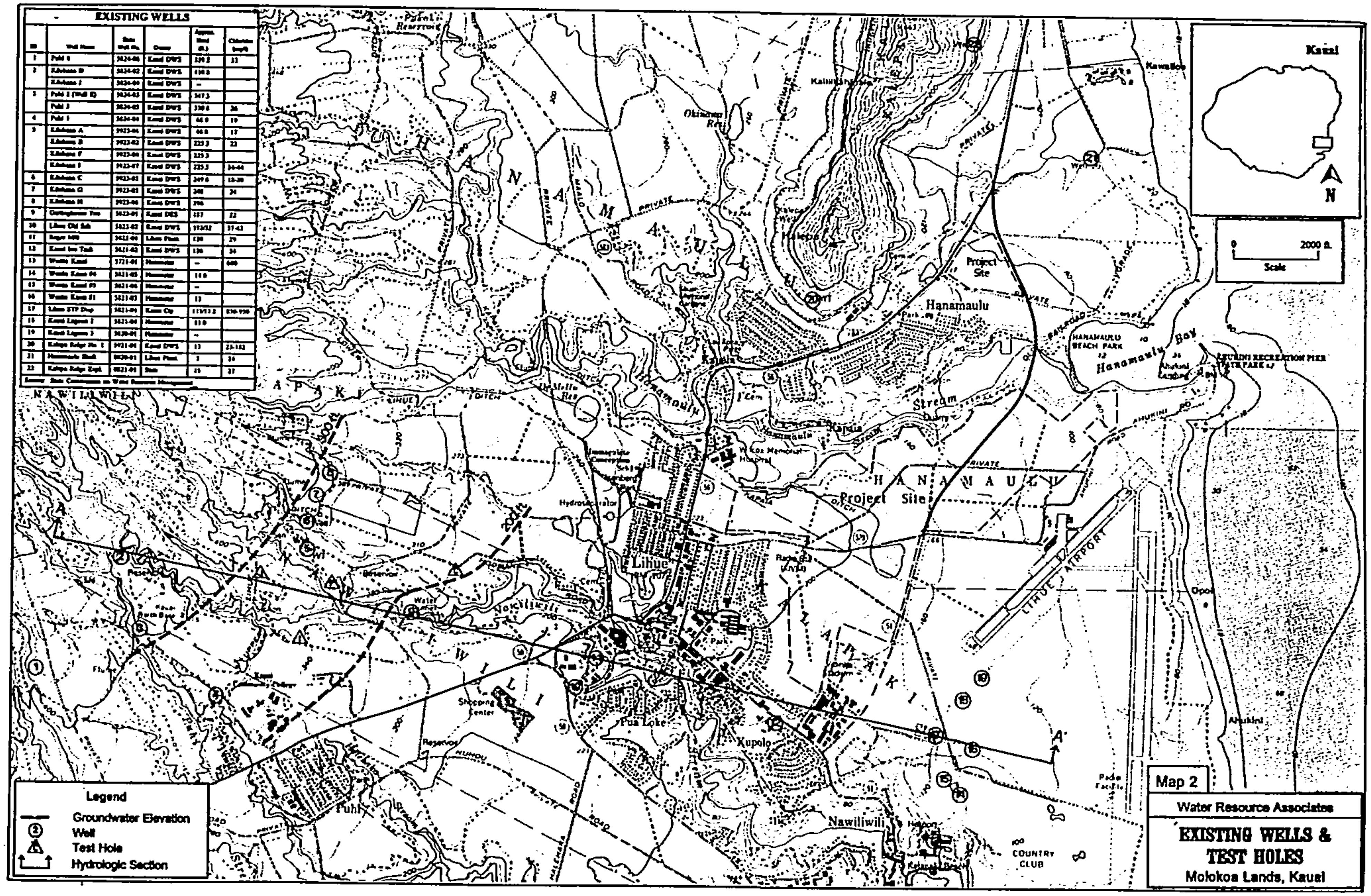
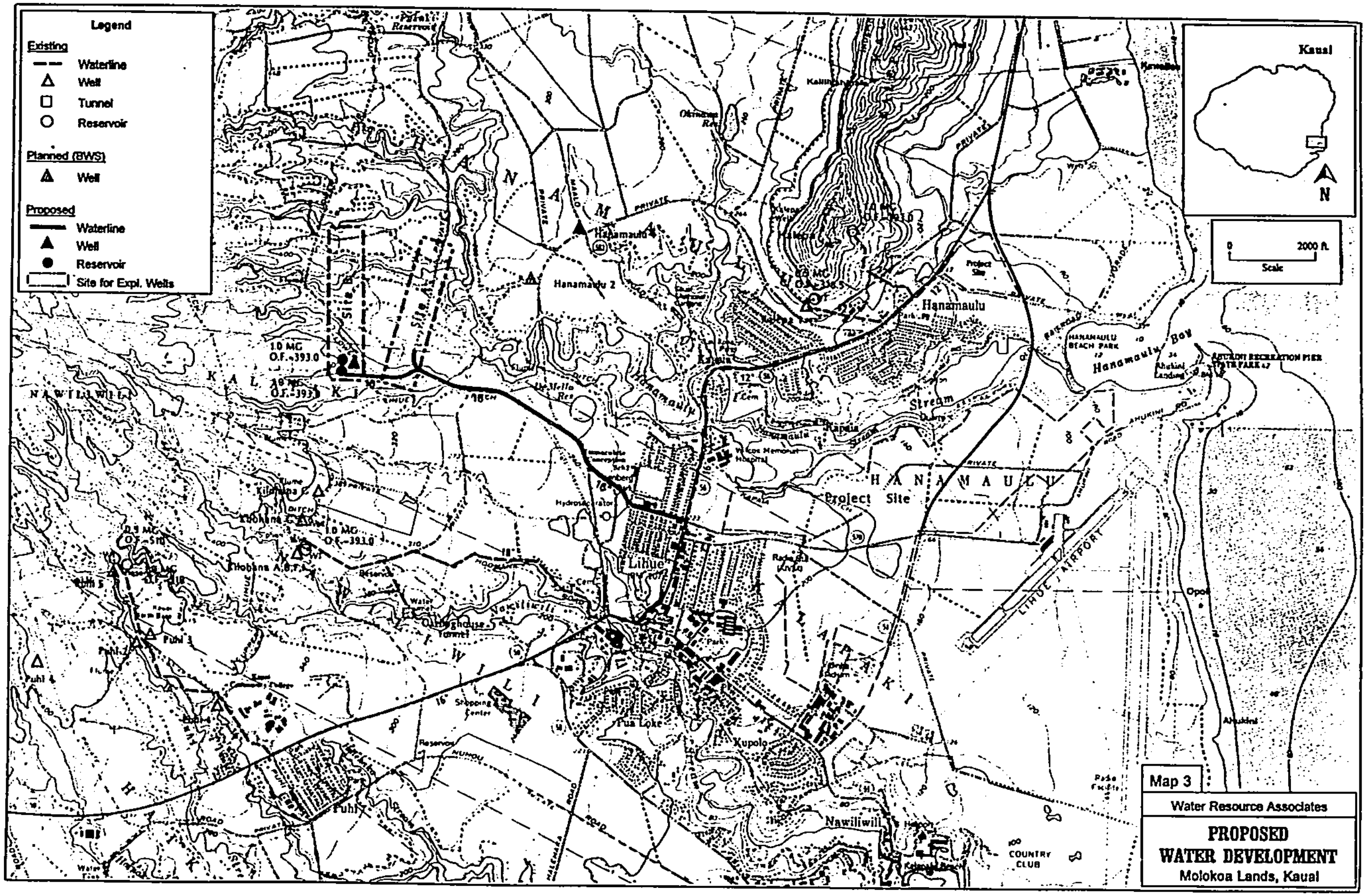
________, Department of Health, February 1989, Groundwater/Drinking Water Summary of Reported Positive Results.


LEGEND
Formations & Water-Bearing Properties
Qa
Alluvium. Mostly clay, poorly permeable, carries small amounts of water. Youngest formation in study area.
Qkl
Koloa Lavas. Flank flow basalts of Quaternary age. Moderately to deeply weathered, low to moderate yield. Wells develop fresh high-level water inland and fresh to brackish basal water toward the coast.
Qkv
Kilohana Eruptive Vent. Principal source of Koloa lavas in study area which erupted on top of Waimea lavas, following a long period of erosion.
Twn
Waimea Lavas. Dike-intruded lavas of Tertiary age. Mostly deeply weathered, low to moderate yield. Buried by Koloa lavas, except Kalepa and Haupu Ridges. Normally a high yield aquifer, wells in the study area develop basal water in limited quantities due to weathering and dikes.
Volcanic Dike
—50"— Median Annual Rainfall (inches)
Groundwater Movement
FRESH
HIGH LEVEL
WATER
IN
KOLOA LAVAS
BRACKISH
BASAL WATER
IN
KOLOA LAVAS
Project Site
Kilohana Crater
Haupu Ridge
Kauai
N
0 3000 ft.
Scale
Map 1
Water Resource Associates
REGIONAL
HYDROGEOLOGY
Molokoa Lands, Kauai



EXISTING WELLS
Kauai
N
0
2000 ft.
Scale
Legend
Groundwater Elevation
Well
Test Hole
Hydrologic Section
Map 2
Water Resource Associates
EXISTING WELLS & TEST HOLES
Molokoa Lands, Kauai
Hanamaulu
Hanamaulu Bay
HANAMAULU BEACH PARK
Project Site
HANAMAULU
Lihue
LIHUE AIRPORT
Kapaia
Stream
Kupolo
Nawiliwili
NAWILIWILI
Puhi
Pua Loke
Shopping Center
COUNTRY CLUB
Reservoir
PRIVATE
Ahukini
Opoi
Kawailoa



Legend
Existing
Waterline
Well
Tunnel
Reservoir
Planned (BWS)
Well
Proposed
Waterline
Well
Reservoir
Site for Expl. Wells
Kauai
N
0
2000 ft.
Scale
Hanamaulu 4
Hanamaulu 2
Hanamaulu
Hanamaulu Bay
HANAMAULU BEACH PARK
Ahukini Landing
Stream
Project Site
H A N A M A U L U
Lihue
LIHUE AIRPORT
Opoe
Ahukini
Pua Loke
Kupolo
Nawiliwili
Puhi
COUNTRY CLUB
Shopping Center
10 MG
O.F.=393.0
Site
Map 3
Water Resource Associates
PROPOSED
WATER DEVELOPMENT
Molokoa Lands, Kauai

APPENDIX

Water Quality Analysis
Well Record
Drilling Log for Old Lihue Grammar School Well

WATER QUALITY ANALYSES

Contaminant		Maximum Contaminant Level	Lihue Grammar School 5822 02	Garlinghouse Tunnel 5823 01	Kilohana A 5923 01	Kilohana B 5923 02	Kilohana C 5923 03	Kilohana G 5923 05	Lihue STP 5821 02
Primary Drinking Water Standards:									
Arsenic	(mg/l)	0.05	0.01						
Barium	(mg/l)	1.0							
Cadmium	(mg/l)	0.010							
Chromium	(mg/l)	0.05							
Fluoride	(mg/l)	1.4	0.1	0.1	0.5	0.3	0.1	0.1	0.2
Lead	(mg/l)	0.05							
Mercury	(mg/l)	0.002							
Nitrate & Nitrite	(mg/l)	10	0.1	0.88	0.02	0.72	1.1	0.89	1.4
Selenium	(mg/l)	0.01	0.05						
Silver	(mg/l)	0.05							
Coliforms (total)		1/100 mL							
Turbidity		1-5 NTU							
2, 4-D	(mg/l)	0.03							
Endrin	(mg/l)	0.0002							
Lindane	(mg/l)	0.002							
Toxaphene	(mg/l)	0.005							
Methoxychlor	(mg/l)	0.01							
2,4,5-TP Silvex	(mg/l)	0.01							
Benzene	(mg/l)	0.005							
Carbon tetrachloride	(mg/l)	0.005							
para-Dichlorobenzene	(mg/l)	0.075							
1,2 Dichloroethane	(mg/l)	0.005							
1,1-Dichloroethylene	(mg/l)	0.007							
1,1,1-Trichloroethane	(mg/l)	0.20							
Ethylene dibromide (EDB)	(mg/l)	0.00004							
1,2-Dibromo-3 Cl (DBCP)	(mg/l)	0.00004							
1,2,3, Trichloropro (TCP)	(mg/l)	0.0008							
1,2 Dichloropropane (DCP)	(mg/l)	0.005							
Atrazine	(mg/l)	0.003							

A1

Contaminant		Maximum Contaminant Level	Lihue Grammar School 5822 02	Garlinghouse Tunnel 5823 01	Kilohana A 5923 01	Kilohana B 5923 02	Kilohana C 5923 03	Kilohana G 5923 05	Lihue STP 5821 02
Trichloroethylene	(mg/l)	0.005							
Vinyl chloride	(mg/l)	0.002							
TTHM (chloroform, Bromoform, Bromodichloromethane, Dibromochloromethane)	(mg/l)	0.10							
Secondary Drinking Water Standards:									
Chloride	(mg/l)	250	41.0	22	16	24	18	17	29
Color		15 units							
Copper	(mg/l)	1	0.1						
Corrosivity		non corros.							
Foaming agents	(mg/l)	0.5							
Iron	(mg/l)	0.3				.02	.02		.03
Manganese	(mg/l)	0.05	0.1						
Odor		3 threshold							
pH		6.5-8.5	8.4	8.8	8.3	8.8	7.4	8.3	8.0
Sulfate	(mg/l)	250	23.2	11	2.8	6.6	8.2	10	78
Total Diss Solids	(mg/l)	500	172.0		174		120	107	
Zinc	(mg/l)	5	0.025						
Other Analyses:									
Silica	(mg/l)		21.2	32	23	33	25	27	34
Calcium	(mg/l)		11.1	6.7	9.0	7.2	6.3	5.8	15
Magnesium	(mg/l)		18.2	8.6	11	9.3	8.1	5.4	11
Sodium	(mg/l)		24.8	16	34	18	17	17	63
Potassium	(mg/l)		24.8	0.25	3.8	1.3	1.0	1.3	2.9
Hardness as $CaCO_3$	(mg/l)		108.2		68		49	37	83
Noncarbonate Hardness	(mg/l)							5	
Alkalinity as $CaCO_3$	(mg/l)		94.0	50	121	54	56	32	52
Spec Cond (us/cm @25°C)	(mg/l)			181	289	190	188	130	428
Temp °C					28.5	23.3			

081\chem3

A2

WELL RECORD

State Well No.	Well Name	Owner	Year Drilled	Ground Elev. (ft.)	Csg. Dia. (in.)	Csg. Depth (ft.)	Well Depth (ft.)	Approx. Head (ft.)	Pump Cap. (mgd)	Chloride (mg/l)	Status*
0020-01	Hanamaulu Shaft	Lihue Plantation						3		24	Uns
0021-01	Kalepa Ridge Expl.	State	1967	166	8	196	278	15		27	Uns
5721-01	Westin Kauai	Hemmeter	1988	23	12	65	325			600	Uns
5820-01	Kauai Lagoon 3	"	1987	138	12	180	315				Irr
5821-01	Lihue STP Disp	Kauai Cty	1974	121	12	170	440	115/11.2		850-950	Uns
5821-02	Kauai Inn Tank	"	1978	158	8	255	300	128		34	Obs
5821-03	Westin Kauai #1	Hemmeter	1987	160	12	220	277	13.0	.57		Irr
5821-04	Kauai Lagoon 2	"	1987	125	12	180	375	11.0			Irr
5821-05	Westin Kauai #4	"	1987	100	10	160	338	14.0	.29		Oth
5821-06	Westin Kauai #5	"	1987	100	10	160	380				
5822-01	Sugar Mill	Lihue Plantation	1965	150			700	120	.53	29	Ind
5822-02	Old Lihue Gr Sch	Kauai DWS	1961	224	8	320	745	192/32		37-43	Uns
5823-01	Garlinghouse Tun	"	1935	215				187	2.00	22	Mun
5824-01	Puhi 1 (KCC Well)	"	1975	328	14	400	772	68.9	0.28	19	Mun
5824-02	Kilohana D	"	1979	485	8	185	250	410.8	0.10		Uns
5824-03	Puhi 2 (Well E)	"	1980	408	8	200	200	347.3	.43		Mun
5824-04	Kilohana J	"	1982	484	12		475		0.07		Uns
5824-05	Puhi 3	"	1990	411	12	340	348	350.6		28	Mun
5824-06	Puhi 4	"	1992	473	12	331	504	359.2	.57	33	Uns
5921-01	Kalepa Ridge No. 1	"	1954	302	14	315	540	13		23-182	Uns
5923-01	Kilohana A	"	1974	371	14	421	920	48.8	.50	17	Mun
5923-02	Kilohana B	"	1977	371	12	187	187	225.3	1.0	22	Mun
5923-03	Kilohana C	"	1978	364	14	214	272	248.8	.38	18-20	Mun
5923-04	Kilohana F	"	1980	369	12	180	201	225.3	.58		Mun
5923-05	Kilohana G	"	1981	384	12	275	295	248	.29	24	Mun
5923-06	Kilohana H	"	1981	394	18	10	240	298			Uns
5923-07	Kilohana I	"	1982	363	12	200	200	225.5	1.01	34-44	Mun

Source of Data: Commission on Water Resource Management.
Personal Communication, Department of Water and Lihue Plantation, 1994.

* Ind - Industrial
Irr - Irrigation
Mun - Municipal
Obs - Observation
Oth - Other
Uns - Unused

081WellRec2

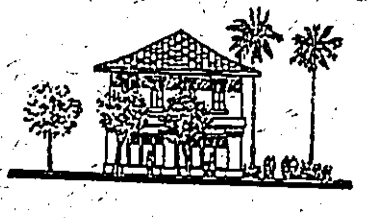
DRILLING LOG

Old Lihue Grammar School Well (5822-02)
Lihue, Kauai
Gr. El. = 223.8 ft., msl

Depth (ft.) From	Depth (ft.) To	Thickness (ft.)	Driller's Description	Remarks
0	9	9	Dirt	
9	13	4	Hard rock	
13	100	87	Clay	Depth to water (DTW) = 32.0 ft. (Head = 191.8 ft.)
100	120	20	Red Shale	
120	145	25	Very hard rock	
145	155	10	Hard rock	
155	157	2	Clay	
157	158	1	Med. hard rock	
158	159	1	Clay	
159	190		Hard rock	
190	251	61	Very hard blue rock	DTW = 31.3 ft. (Head = 192.5 ft.)
251	255	4	Brown hard gravel	
255	268	13	Brown shale & blue rock	DTW = 32.0 ft.
268	293		Very hard to hard blue rock	DTW = 31.0 ft.
293	324	31	Yellow Clay, sticky	DTW = 36.0 ft. @ 320 ft. depth
324	347	23	Brown cinder	DTW = 37.0 ft. @ 336 ft. depth
347	360	13	Hard blue rock	Hole caved-in badly at 352 ft. Fill hole with dirt to 323'. Redrill.
360	370	10	Blue rock, sandy at bottom	DTW = 39.0 ft.
370	371	1	Sand	Sand ran in
371	376	5	Med. hard rock	DTW = 35.0 ft.
376	396	20	Coral	DTW = 36.0 ft.
396	410	14	Coral and sand	
410	420	10	Sand and clay	
420	432	12	Med. hard brown sand	DTW = 36.0 ft.
432	479	47	Med. hard blue rock	DTW dropped to 191.4 ft. at 472' depth (-248', msl) (Head = 32.4')
479	530	50	Hard blue rock	DTW = 193 ft. @ 515' depth DTW = 196 ft. @ 519' depth Pump test No. 1 (specific capacity = 8.3 gpm/ft. at 200 gpm)
530	542	12	Med. hard gray rock	
542	543	1	Very hard rock	
543	547	4	Very hard black sand & coral	Coral probably caved-in from above.
547	563	16	Hard gray rock	DTW = 196 ft. @ 563'
563	570	7	Very hard black sand & cinders	
570	580	10	Very hard to med. hard gray rock	
580	584	4	Soft gray rock	
584	589	5	Very hard black rock	DTW = 191 ft.
589	593	4	Med. hard cinders	Pump test No. 2 (specific capacity = 8.7 gpm/ft. at 200 gpm)
593	595	2	Med hard rock	
595	635	40	Hard to med. hard black rock	DTW = 193 ft. at 602' depth
635	647	12	Yellow clay	
647	680	33	Gray cinders	
680	684	4	Hard gray rock w/green clay	
684	712	28	Gray mud rock w/hard gray cinder at bottom	DTW = 192 ft. at 705' depth
712	719	7	Very hard to hard gray rock	DTW = 191 ft. at 719' depth
719	720	1	Very hard yellow sand	
720	725	5	Sand and coral	
725	745	20	Coral (with lava rock @ 725'-735')	
T.D.				
				Pump test No. 3 (specific capacity = 10.0 gpm/ft. at 200 gpm)

D

Lihue-Hanamaulu Master Planned Community
Preliminary Engineering Report for Drainage Requirements



LIHUE - HANAMAULU MASTER PLANNED COMMUNITY

PRELIMINARY ENGINEERING REPORT FOR DRAINAGE REQUIREMENTS

JANUARY 6, 1995

KODANI AND ASSOCIATES, INC.
LIHUE, KAUAI, HAWAII 96766

PRELIMINARY ENGINEERING REPORT
FOR DRAINAGE REQUIREMENTS

TABLE OF CONTENTS

INTRODUCTION 1
PROJECT DESCRIPTION 4
METHODOLOGY 5
STORM RUNOFF 6
DRAINAGE SYSTEM 19
EROSION AND SEDIMENT CONTROL 27
ESTIMATED ORDER-OF-MAGNITUDE COSTS 32
OVERVIEW OF PROPOSED DRAINAGE SYSTEM 35
APPENDIX A-1

INTRODUCTION

This engineering report was prepared in conjunction with Amfac/JMB Hawaii, Inc.'s preparation and processing of an Environmental Impact Statement, State LUC Boundary Amendment, and County of Kauai General Plan Amendment for the 555 acre Lihue-Hanamaulu Master Planned Community in the Lihue District on the Island of Kauai.

Amfac/JMB Hawaii, Inc.'s Lihue-Hanamaulu Master Planned Community, displayed in Figure No. 1, is located between the northeastern edge of the developed portion of Lihue and the southern edge of the developed portion of Hanamaulu. A closer look at this Master Planned Community (see Figure No. 2) reveals that it is composed of four specific geographic areas which will be identified as Molokoa, Ahukini Mauka, Ahukini Makai and Hanamaulu. The development of each geographic area will be flexible and responsive to the future needs of the community.

The Lihue-Hanamaulu Master Planned Community includes a mixture of single and multi-family residential, commercial, industrial and public land uses, as well as parks, open spaces and an elementary school. The Master Planned Community would abut or be in close proximity to existing residential, commercial, industrial, and public land uses. The land used to build this proposed Master Planned Community is presently being used to grow sugar cane by Lihue Plantation Company, Limited and uses a network of ditches and sumps to control storm runoffs from its cane fields.

A critical requirement that should be addressed for any planned community is to mitigate any adverse drainage impacts to neighboring and downstream properties caused by the development of the planned community. This report will first examine existing storm runoff flows and drainage patterns, then will examine storm runoff flows and drainage patterns generated when the Lihue-Hanamaulu Master Planned Community is fully developed. A master plan of the drainage system for the Lihue-Hanamaulu Master Planned Community will be developed to include mitigative measures such as detention basins. This report will then evaluate the impacts of runoff from the Master Planned Community on downstream properties and waterways. Finally, this report will analyze the potential for soil erosion and sediment loss during the various development stages of the Master Planned Community. As part of the Environmental Impact Statement for this project, there are separate reports being prepared to evaluate the impact of this project on Hanamaulu Stream, Hanamaulu Bay, and off shore waters.

The analysis and findings contained herein are at a general concept level and reflect the preliminary nature of Amfac/JMB Hawaii, Inc.'s proposal at this early stage of the planning process for their Lihue-Hanamaulu Master Planned Community.

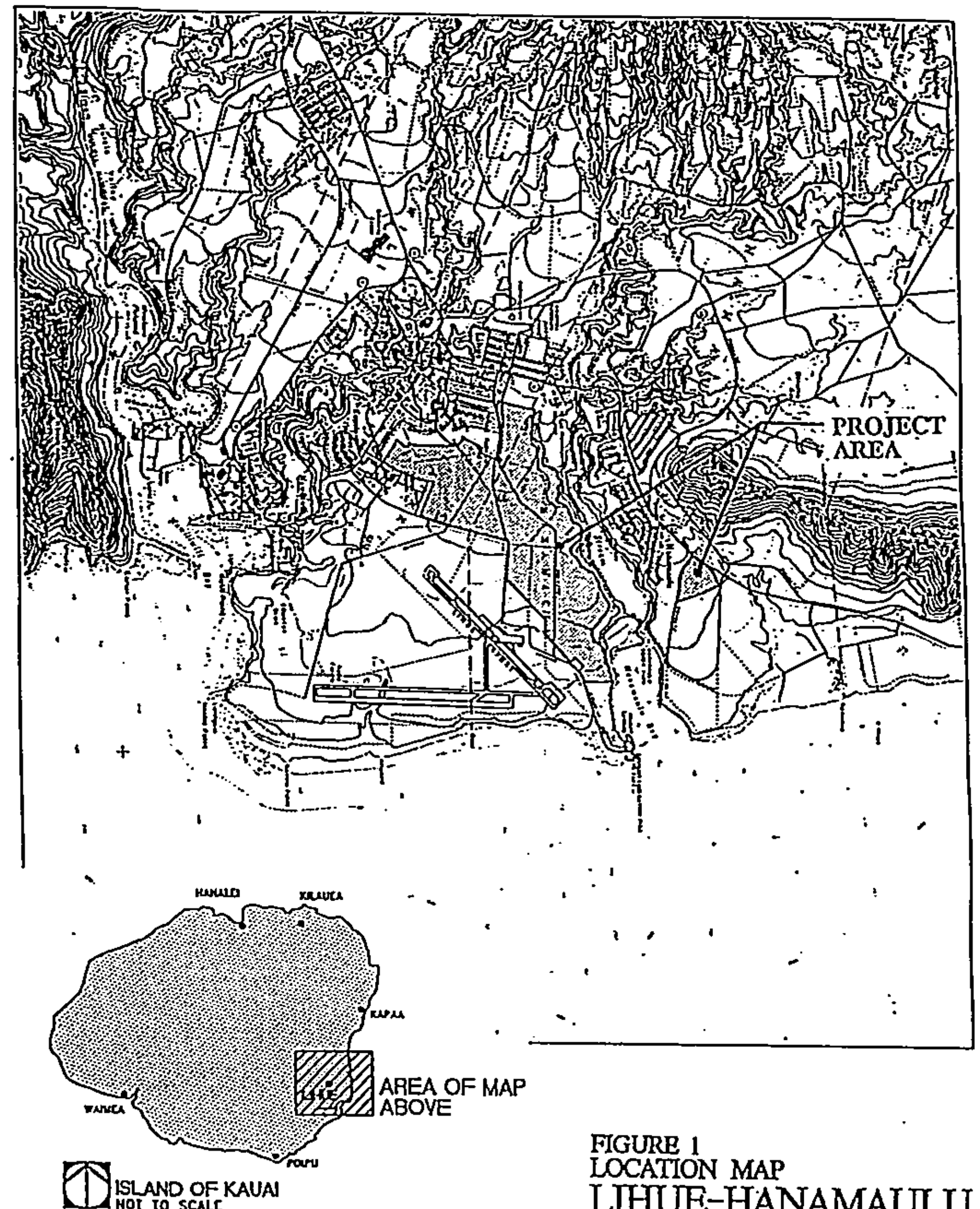
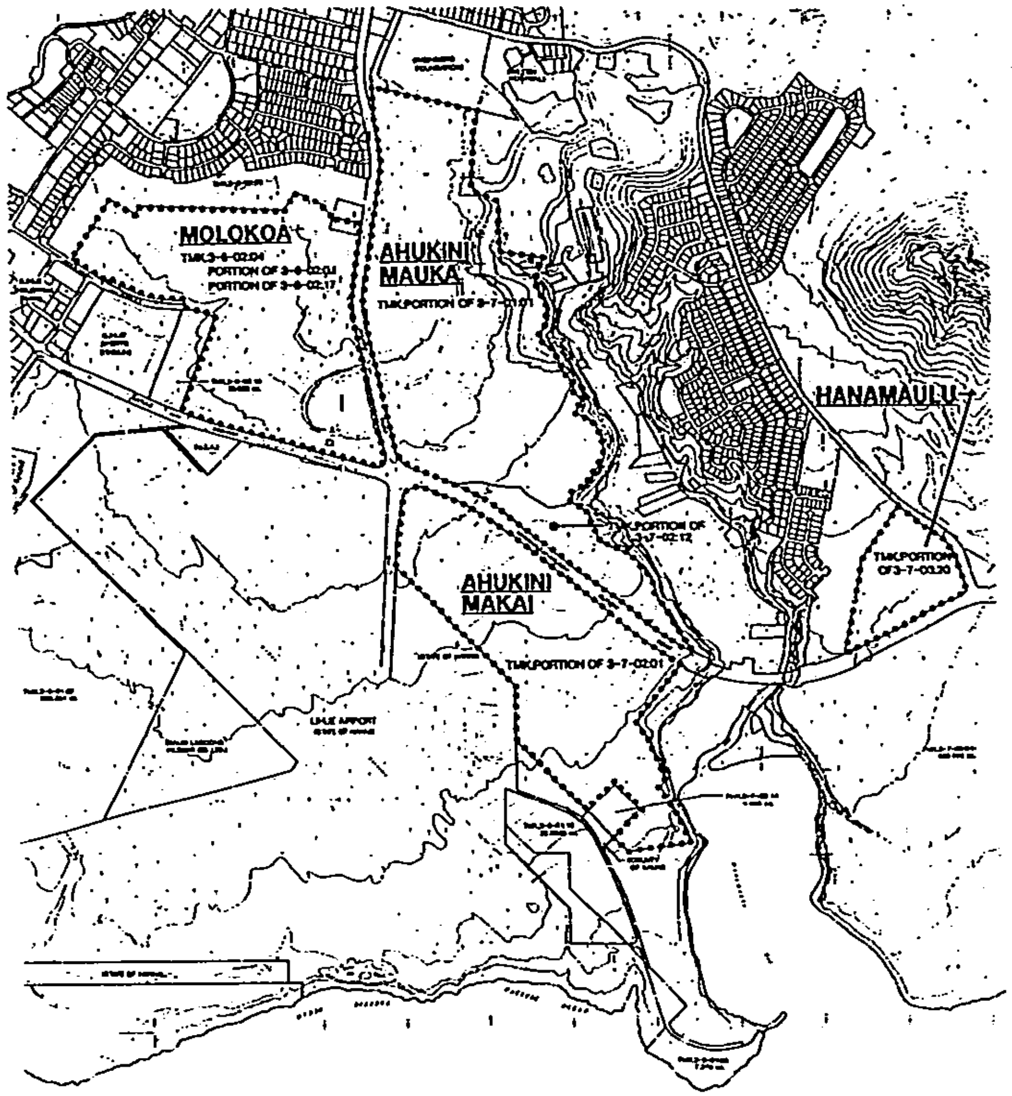


FIGURE 1
LOCATION MAP
LIHUE-HANAMAULU



LEGEND

PETITION AREA BOUNDARY

FIGURE 2
TAX MAP KEYS
LIHUE-HANAMAULU

PROJECT DESCRIPTION

The Lihue-Hanamaulu Master Plan provides for a range of residential and village mixed uses on 555 acres of land located at Lihue and Hanamaulu, Kauai. Four geographic areas of the Master Plan include Molokoa, Ahukini Mauka, Ahukini Makai and Hanamaulu. Development is projected to be over a 15 to 20 year period and is planned to be flexible in responding to future community needs. The Master Plan components include single and multi-family residential uses, public and quasi-public facilities, village mixed use, light industrial development, parks and open spaces. The village mixed use areas within Molokoa and Ahukini Mauka envision a variety of retail and office uses, including multi-family residential uses that would form the village core of the community.

The general land use allocation is summarized below:

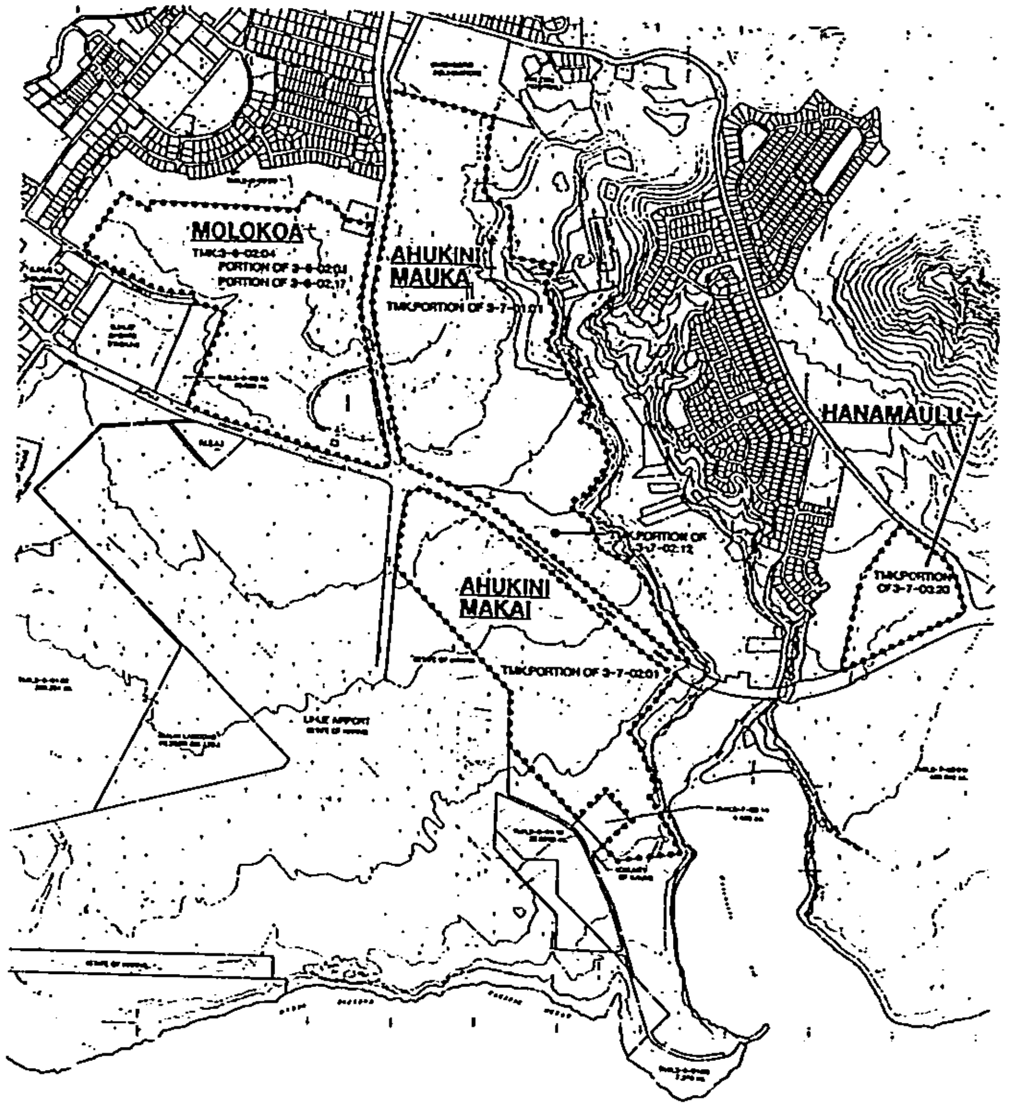
LAND USE	ACRES
Residential	
Single-Family (1,000 - 1,250 units)	180
Multi-Family (400 - 550 units)	35
Village Mixed Use	
Retail/Office	70
Service/Light Industrial	26
Industrial	102
Public/Quasi-Public Facilities	70
Parks/Open Spaces	48
Major Roadways	24

Residential development will provide approximately 1,400 to 1,800 units in a mix of product type, densities and range of prices including affordable, gap, and market prices. Densities for single family homes will range from 5.6 to 7 units per acre and multi-family homes will range from 11.7 to 16.2 units per acre. Public and quasi-public facilities include a Veterans Center, state judiciary complex, police headquarters, YMCA/teen center, an elementary school, a debris recycling station, and a fruit disinfestation facility.

The initial land use approvals to allow implementation of the proposed Master Plan include a State Land Use Boundary Amendment to reclassify State Agricultural and Conservation land to the State Urban District and a County General Plan Amendment to designate Agricultural and Public Facility land as Urban Mixed Use.

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING



LEGEND

PETITION AREA BOUNDARY

FIGURE 2
TAX MAP KEYS
LIHUE-HANAMAULU

3

PROJECT DESCRIPTION

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METHODOLOGY

As the Lihue-Hanamaulu Master Planned Community is developed, land that is currently farmed will be transformed into a school, parks, homes, public buildings, offices, roads, and open spaces. In terms of drainage, the Master Planned Community will result in an increase of impermeable areas and the subsequent generation of additional runoff. This report will analyze the quantities of runoff generated under existing and proposed conditions and determine the impact that these additional flows will have on downstream areas.

Hydrology calculations were performed by using the Soil Conservation Services, SCS, TR-55 method (Urban Hydrology for Small Watersheds). The base storm used for flood analysis purposes is the 100-year 24-hour storm. The rainfall intensity for the base storm is 16.5 inches in the Lihue-Hanamaulu area. The following Runoff Coefficients were used in the calculations of peak discharge flows:

Sugar Cane (Straight Row, Full Growth) = 61
Sugar Cane with Cane Haul Roads = 62.5
Open = 61
Single Family = 85
Multi-Family = 85
Commercial = 92
Roads = 92
Industrial = 92
Detention Basin = 98

STORM RUNOFF

1. Existing Drainage Conditions. The land area for the proposed Lihue-Hanamaulu Master Planned Community is presently being used to grow sugar cane. Storm runoff is collected in open irrigation ditches and conveyed to sedimentation trenches located at the downstream perimeter of the cane fields. The ditch and trench network prevents runoff from smaller rainstorms from flowing onto adjacent properties; however, it will not contain runoff from larger storm events. Runoff from larger storms will overflow trenches and flow overland to abutting properties via swales, ditches or gullies. The four geographic areas of the Lihue-Hanamaulu Master Planned Community have the following existing drainage patterns and peak flows during large storm events:

   a. Molokoa. During large storms, runoff generated in the Molokoa area flows under Kapule Highway through existing culverts to the Kauai Lagoons and Marriott properties. Once on the Kauai Lagoons and Marriott properties, runoff is channelled through grassed swales to underground culverts which route the runoff to Nawiliwili Stream.

      Using the SCS TR-55 computer program, the peak discharge generated by the Molokoa area based on existing conditions is calculated to be 811 cfs for the 100-year 24-hour storm.

   b. Ahukini Mauka. During large storms, runoff generated in the Ahukini Mauka area flows into Hanamaulu Stream through natural swales and gullies. Upon entering Hanamaulu Stream, runoff flows through a large flood plain that eventually discharges into Hanamaulu Bay. The total drainage area of Hanamaulu Stream is about 11 square miles (see Figure No. 3) and was calculated to have a peak discharge of about 28,000 cfs for the 100-year 24-hour storm (see Plate 6A of Kauai's Storm Drainage Standards).

      Using the SCS TR-55 computer program, the peak discharge generated by the Ahukini Mauka area based on existing conditions is calculated to be 852 cfs for the 100-year 24-hour storm. The peak flow generated by the Ahukini Mauka area represents about 3% of the total peak flow of Hanamaulu Stream.

c. Ahukini Makai. During large storms, runoff generated in the Ahukini Makai area flows across Ahukini Road through an adjacent sugar cane field to the ocean. Runoff is conveyed to the ocean by ditches, swales, and a concrete channel. One discharge point is Ahukini Bay, the other is at the end of a small gully, hereinafter referred to as the Southern Outlet. The concrete channel discharges into the Southern Outlet.

Using the SCS TR-55 computer program, the peak discharge generated by the Ahukini Makai area based on existing conditions is calculated to be 736 cfs for the 100-year 24-hour storm.

d. Hanamaulu. During large storms, runoff generated in the Hanamaulu area flows under Kapule Highway through siphons to cane fields located makai of the highway. After flowing through the makai cane field via ditches, trenches, sumps and swales, runoff is discharged directly into the ocean.

Using the SCS TR-55 computer program, the peak discharge generated by the Hanamaulu area based on existing conditions is calculated to be 207 cfs for the 100-year 24-hour storm.

Existing Drainage patterns and estimated runoffs for the four geographic areas of the Lihue-Hanamaulu Master Planned Community are summarized in Figure No. 4. The existing drainage patterns and estimated runoff quantities were calculated for the 100-year 24-hour storm and calculations are included for review in the Appendix.

2. Proposed Drainage Conditions. The development of Amfac/JMB Hawaii, Inc.'s Lihue-Hanamaulu Master Planned Community will result in increased runoff due to the increase in impermeable areas caused when homes, buildings, parking lots, walkways and roads are constructed. Runoff from large storm events will sheet flow across lots to roadside swales. Runoff will flow in these swales until it reaches gullies, culverts, siphons, swales or channels that direct runoff downstream.

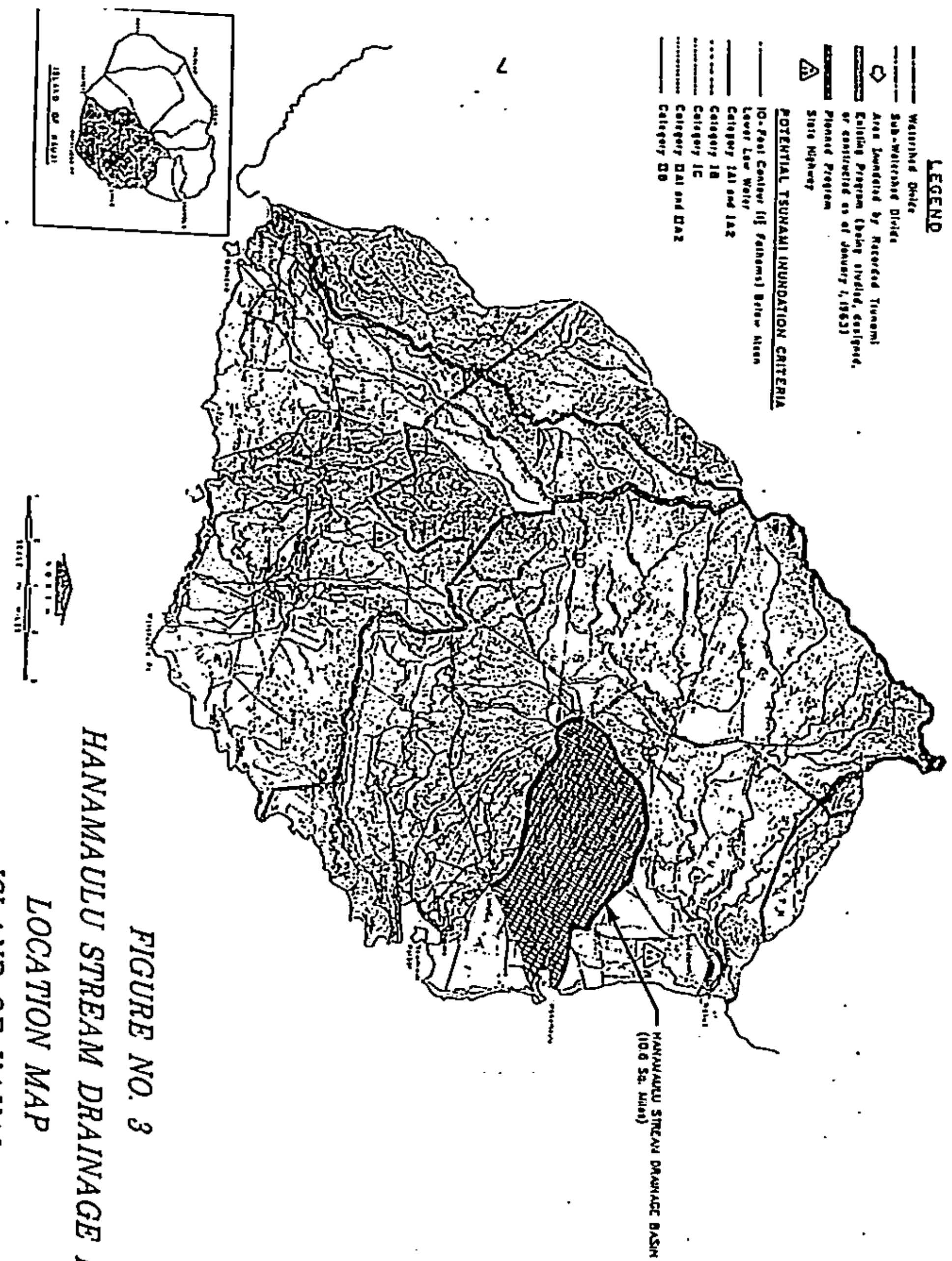

FIGURE NO. 3
HANAMAULU STREAM DRAINAGE BASIN
LOCATION MAP
ISLAND OF KAUAI

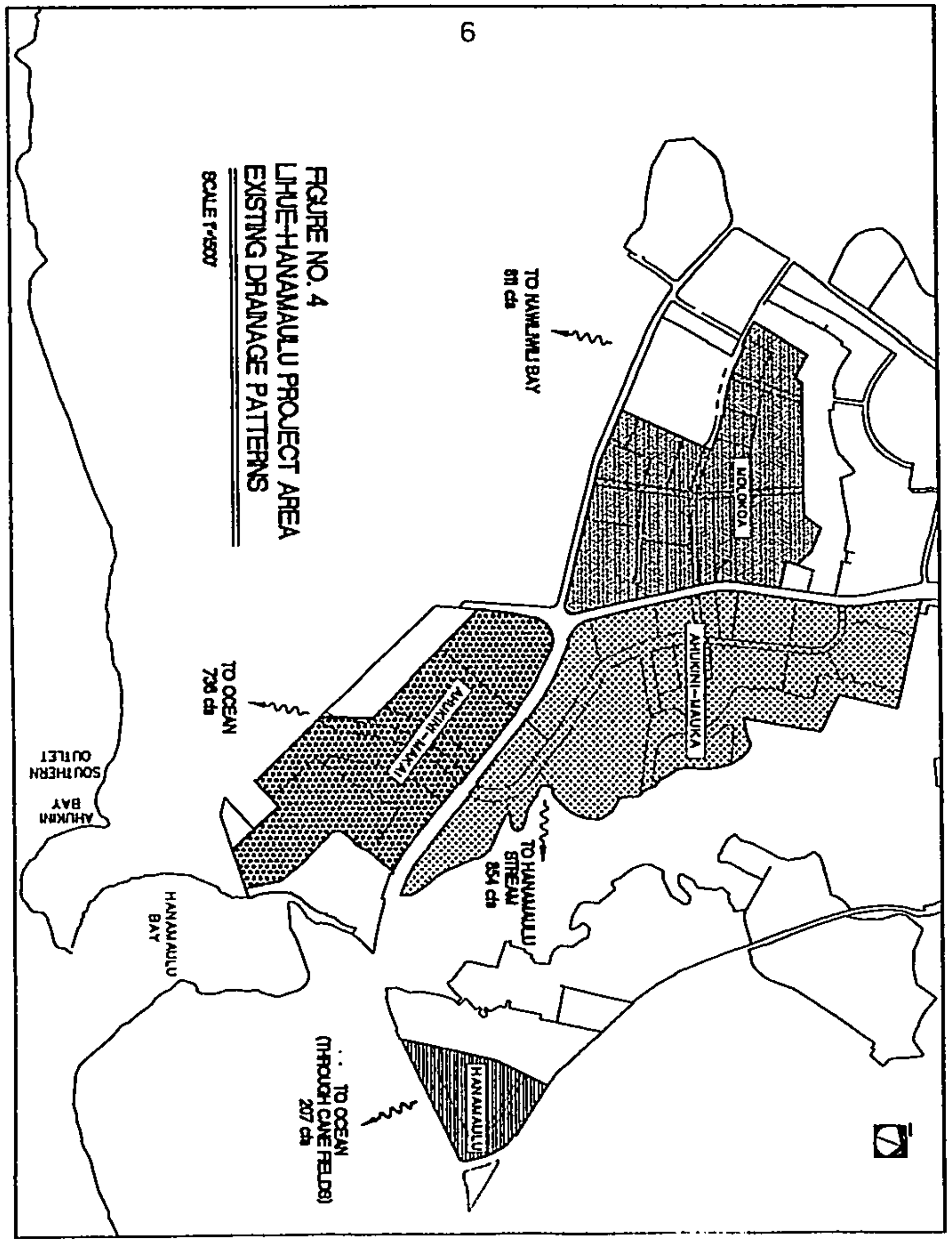

FIGURE NO. 4
LIHUE-HANAMAULU PROJECT AREA
EXISTING DRAINAGE PATTERNS

To ensure that downstream property and structures are not adversely affected by the increased runoff, combination park/detention basins will be constructed in both the Molokoa and Ahukini Mauka areas. Furthermore, a portion of the runoff from Molokoa will be diverted through Ahukini Mauka to Hanamaulu Stream. This diversion will be the only change to existing drainage patterns.

The combination park/detention basins will designed to County of Kauai requirements with the intent of dedicating these areas to the County of Kauai. The County of Kauai would be responsible for the operation and maintenance of these facilities. To ensure that continuous use of the park facilities is available, the following guidelines were used in the design of the park/detention basins; however, we note that detailed engineering design will be based on specific site information during the site planning process in coordination with the County:

a. Park areas that are designed as "active recreational areas" will be located above the base (100-year) flood elevation.

b. All other park areas will be located above the 2-year 24-hour flood elevation. This will ensure that the park does not become flooded during the "more frequent storm event".

c. The depth of flooding in areas, except the area directly adjacent to the outlet, shall be kept relatively shallow for liability and safety purposes. The area near the outlet, which may be deeper, will be fenced off.

To provide a better model of drainage patterns and to facilitate the calculation of peak flow, some of the geographic areas were divided into sub-areas which are referred to by name in the remainder of the report. See Figure No. 5 for the location and names of these sub-areas. The runoff calculations which are provided in the Appendix are based on the sub-areas.

Runoff from 28.95 acres of Molokoa Diverted will be combined with flows from Ahukini Mauka III and routed through a large 10 acre combination park/detention basin that has been proposed for an area in Ahukini Mauka next to Kapule Highway. The diversion of this flow through detention basin and the use of one 4 acre and one 4-5 acre combination park/detention basin at Molokoa allow for the development of both Molokoa and Ahukini Mauka without adversely impacting downstream areas.

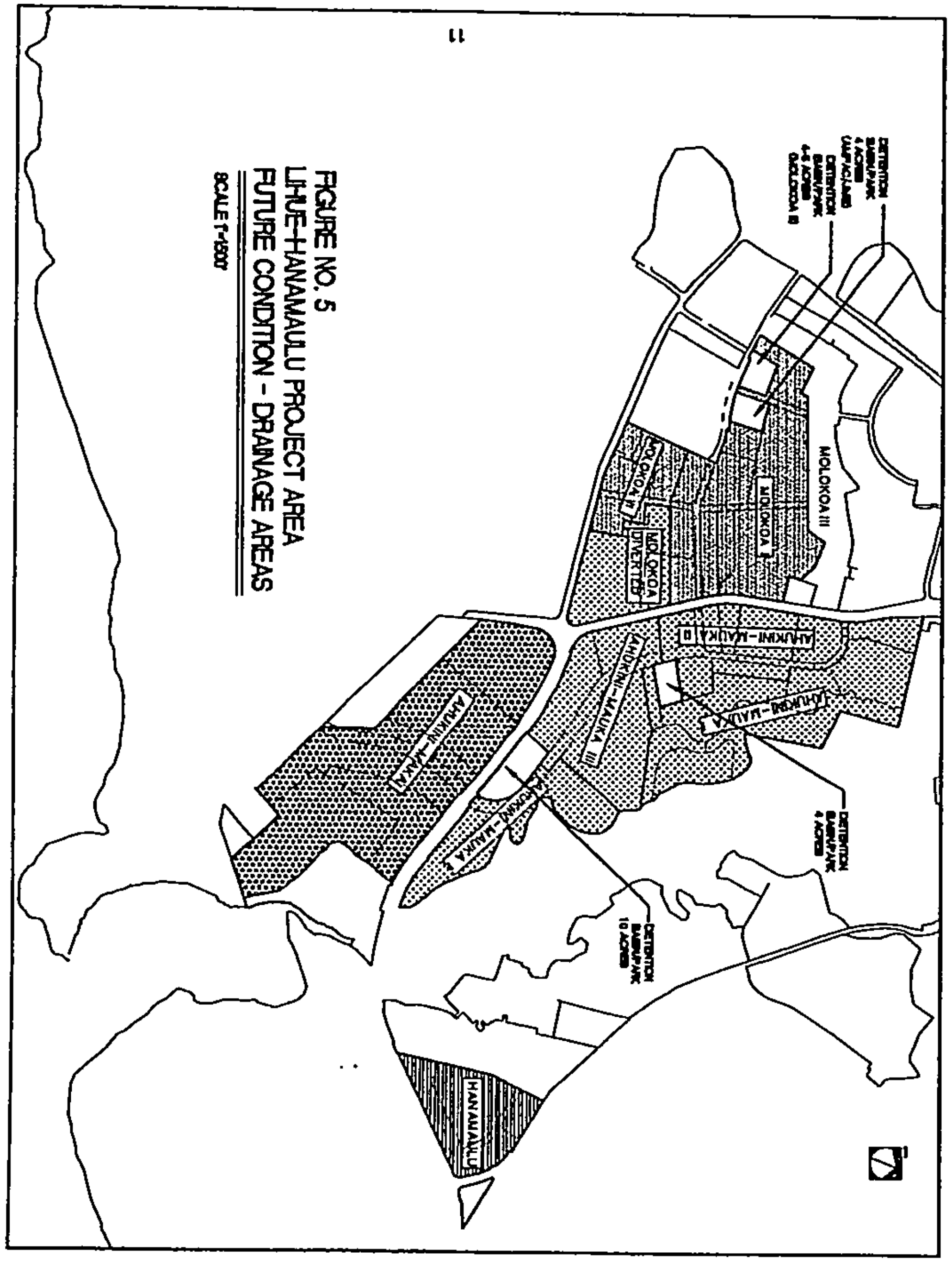

FIGURE NO. 5
LIHUE-HANAMAULU PROJECT AREA
FUTURE CONDITION - DRAINAGE AREAS

SCALE 1"=1500'

Proposed locations for the park/detention basins are shown in Figure No. 5. It should be noted that one 4 acre and one 4-5 acre park/detention basins are to be located in the Molokoa area of the Lihue Hanamaulu Master Planned Community. The southern most of the two park/detention basins will be designed and constructed to serve only the Molokoa III Subdivision. Construction plans are currently being finalized for the Molokoa III Subdivision which is located along the southern and western boundaries of the Molokoa area and is not part of Amfac/JMB Hawaii's Lihue -Hanamaulu Master Planned Community. The northern park/detention basin will control runoff from the Molokoa area of the Lihue Hanamaulu Master Planned Community.

The four geographic areas of the proposed Lihue-Hanamaulu Master Planned Community had the following drainage patterns and peak discharges during the base (100-year 24-hour) storm event:

a. Molokoa. The Molokoa area of the Master Planned Community is composed of single family, multi-family, commercial and public land uses. Runoff generated from 130 acres (Molokoa I and Molokoa II) of the developed Molokoa area will flow across Kapule Highway to the Kauai Lagoons and Marriott properties, while runoff from the remaining 28.95 acres (Molokoa Diverted) will be diverted to the Ahukini Mauka area. Prior to flowing onto the Kauai Lagoons and Marriott properties, runoff generated from 101 (Molokoa I) of the 130 acres will first be routed through a 4 acre park which also serves as a shallow detention basin. The park/detention basin will dampen the peak flows that are directed toward the developed downstream areas.

Using the SCS TR-55 computer program, the peak discharge for the Molokoa area of the Master Planned Community (excluding diverted flow) was calculated to be 810 cfs for the 100-year 24-hour storm.

b. Ahukini Mauka. The Ahukini Mauka area of the Master Planned Community is composed of single family, multi-family, commercial, park, school, service/light industrial, and public land uses. Runoff from this 221.7 acre area flows to Hanamaulu Stream. Runoff from about 23% or 50.5 acres (Ahukini Mauka II) of this area will be routed through a 5 acre park/detention basin which will be located adjacent to the proposed school.

Runoff from another 35% or 77.7 acres (Ahukini Mauka III) will be combined with runoff diverted from Molokoa and routed through a 10-acre park/detention basin.

Using the SCS TR-55 computer program, the peak discharge for the Ahukini Mauka area (including flow diverted from Molokoa) of the Master Planned Community is calculated to be 1067 cfs for the 100-year 24-hour storm.

c. Ahukini Makai. The Ahukini Makai area of the Master Planned Community has an area of 143.8 acres and is composed of industrial and public land uses.

Using the SCS TR-55 computer program, the peak discharge for the Ahukini Makai area of the Master Planned Community is calculated to be 909 cfs for the 100-year 24-hour storm.

d. Hanamaulu. The Hanamaulu area of the Master Planned Community has an area of 30 acres and is composed of single family and multi-family land uses.

Using the SCS TR-55 computer program, the peak discharge for the Hanamaulu area of the Master Planned Community is calculated to be 274 cfs for the 100-year 24-hour storm.

Overall, the peak discharge rose from 2608 cfs to 3060 cfs from the existing to developed condition. This translates to an overall increase in peak discharge of approximately 17.3%. Except for a portion of the Molokoa area, existing drainage patterns will not change. Figure No. 6 illustrates the proposed drainage patterns along with the estimated peak discharge quantities. Table No. 1 compares peak discharge rates between the existing and proposed conditions. Figure No. 7 is a schematic that summarizes the routing of the runoff which will occur once the Master Planned Community is developed. As the schematic shows, the use of combination park/detention significantly lowers the peak flows. The calculations of the peak flows can be found in the Appendix.

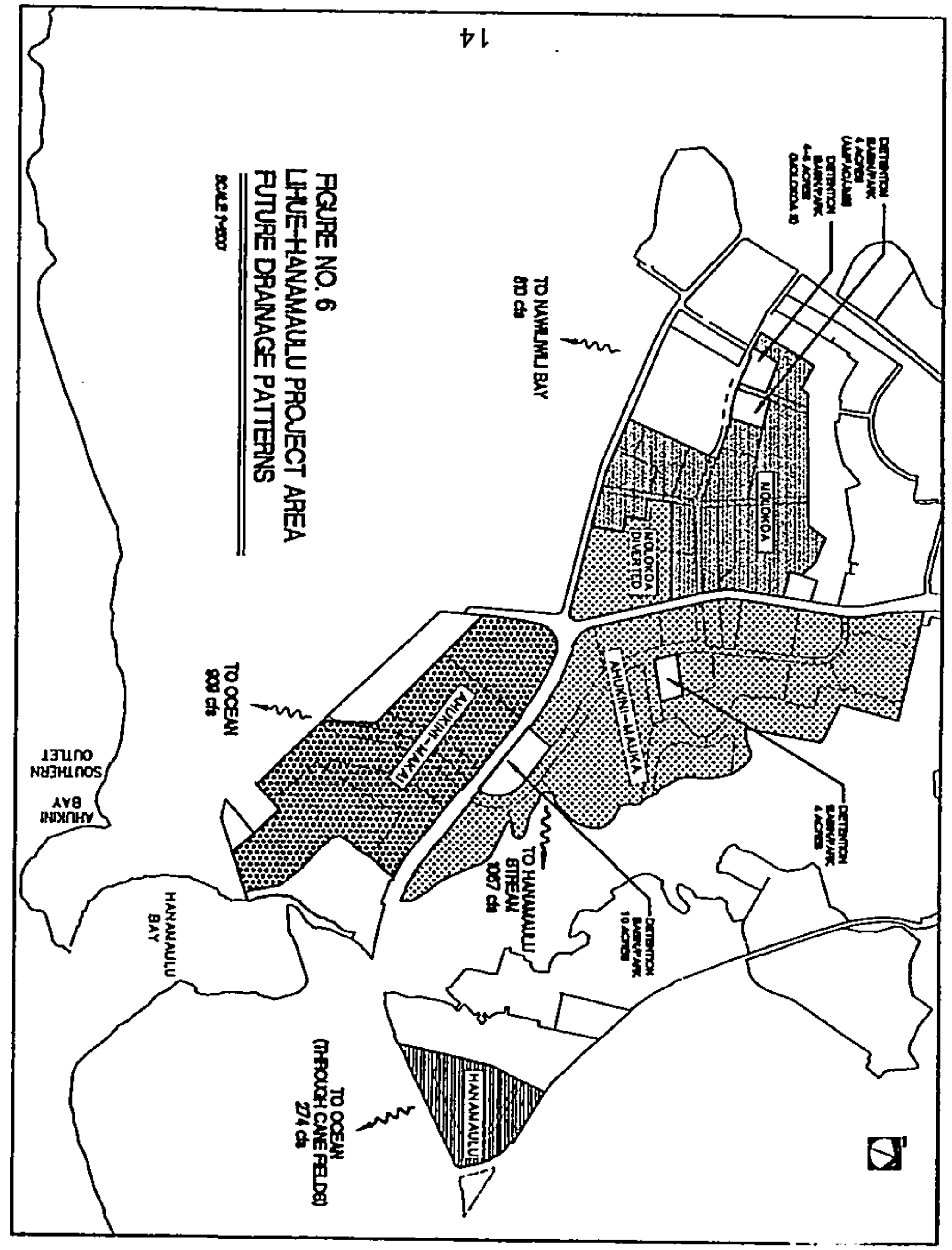

FIGURE NO. 6
LIHUE-HANAMAULU PROJECT AREA
FUTURE DRAINAGE PATTERNS

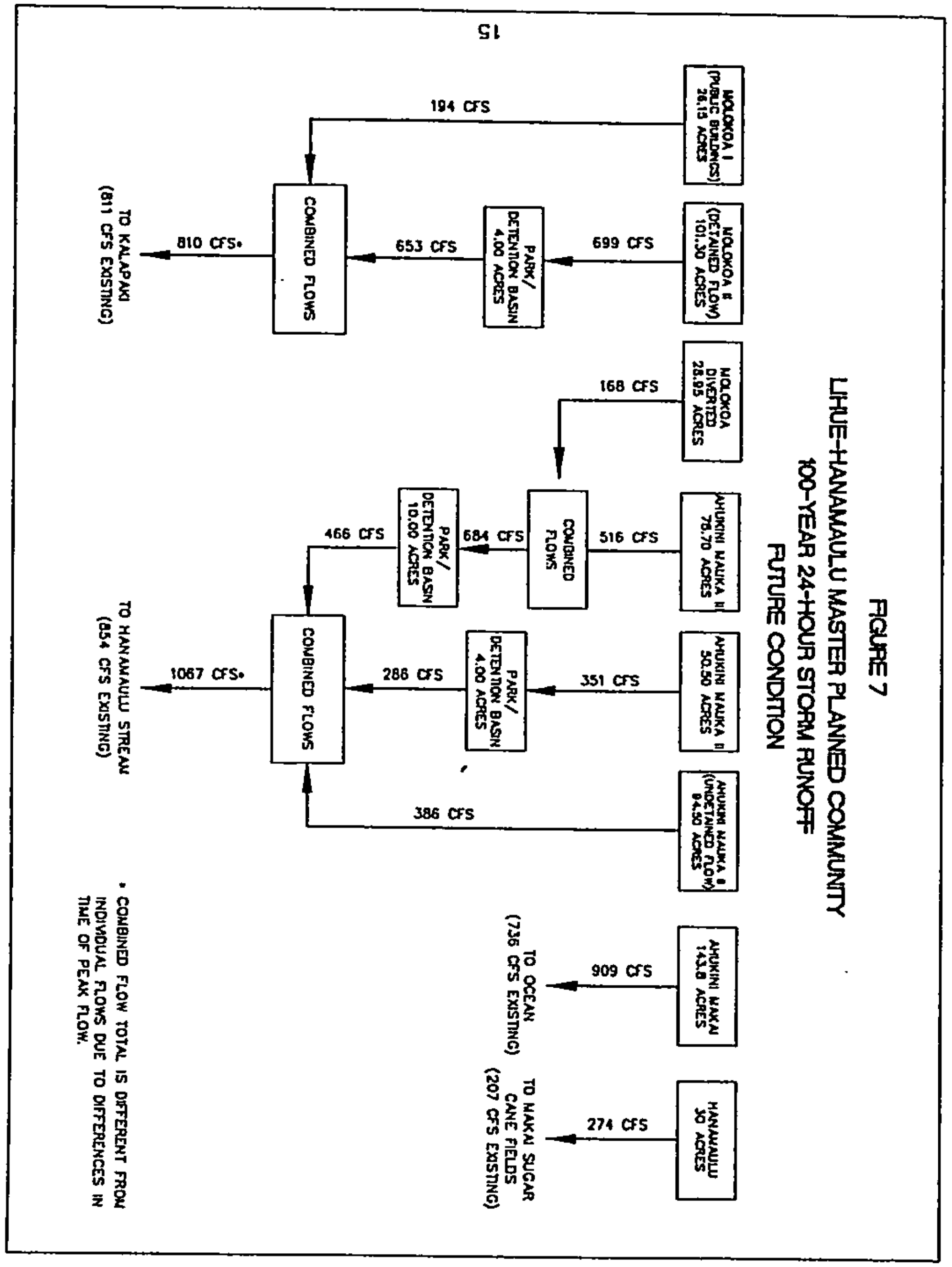

FIGURE 7
LIHUE-HANAMAULU MASTER PLANNED COMMUNITY
100-YEAR 24-HOUR STORM RUNOFF
FUTURE CONDITION

TABLE 1
PEAK DISCHARGE RATES

AREA	EXISTING CONDITIONS	PROPOSED CONDITIONS	PERCENT CHANGE
Molokoa	811 cfs	810 cfs	-0.1
Ahukini Mauka	854 cfs	1067 cfs	+24.9
Ahukini Makai	736 cfs	909 cfs	+23.5
Hanamaulu	207 cfs	274 cfs	+32
TOTAL	2608 cfs	3060 cfs	+17.3

3. Impact of Increased Runoff. The impact of additional runoff generated by Amfac/JMB Hawaii, Inc.'s Lihue-Hanamaulu Master Planned Community can and will be mitigated through the use of combination park/detention basins and flow diversion. Calculations based on the conceptual plan for mitigation show that no adverse impacts on downstream areas will occur. The impact of increased runoff caused by the development of the Master Planned Community for each of the four geographic areas are discussed below:

a. Molokoa. Since the Molokoa area diverts a portion of its flow to the Hanamaulu Stream and utilizes a detention basin, the peak flow can be kept at existing levels (810 cfs for future conditions versus 811 cfs under existing conditions). No adverse impacts to downstream areas are anticipated since there is no increase in the peak flow.

b. Ahukini Mauka. Storm runoff from the Ahukini Mauka area will be combined with the runoff from the diverted area of Molokoa and routed through detention basins before discharging to Hanamaulu Stream. Peak flows to Hanamaulu Stream will increase to 1067 cfs from the 854 cfs discharged under existing conditions.

Although this represents a 25% increase in the runoff to Hanamaulu Stream from Ahukini Mauka, there should be no adverse impact to downstream properties. The runoff from Ahukini Mauka under present conditions represents about 3% of the total peak flow for Hanamaulu Stream. The increase in runoff will be less than 1% of the total peak flow. Since the Hanamaulu Stream area below the discharges from Ahukini Mauka is a wide flood plain, the rise in the base flood elevation due to the increase in runoff will be less than 0.1 feet and therefore will have no adverse impact on downstream properties.

c. Ahukini Makai. The runoff from Ahukini Makai combines with runoff from the airport property before discharging to the ocean. So while peak flows generated by Ahukini Makai will increase by 23.5% from 736 cfs to 909 cfs, the increase in this combined flow to the ocean is only 12%, from 1893 cfs to 2126 cfs.

There is a decrease in runoff to Ahukini Bay of 41% from 382 cfs to 224 cfs due the construction of the drainage system in Ahukini Makai. This system will collect and route most of the runoff from Ahukini Makai to the large concrete channel that also serves parts of the airport. Runoff at the Southern Outlet, where the discharge from the concrete channel is located, increases by 26% from 1511 cfs to 1902 cfs.

The majority of the runoff from the developed Ahukini Makai area will be routed through the concrete channel before discharging to the ocean. The remainder of the runoff will need to flow through adjacent cane fields to reach the ocean. The adjacent land is owned by the Department of Transportation (DOT) Airports Division and is farmed by Lihue Plantation Company, Limited. There are no existing structures on this property that will be impacted by the additional runoff.

There is presently a proposal by DOT Airports Division to relocate the concrete channel. If the channel is to be relocated, Amfac/JMB will work with the Airports Division to size and construct a new channel that serves both of their needs. If this channel is not relocated and is determined to not have sufficient capacity, Amfac/JMB may construct a channel that runs parallel to the existing channel. In either case, design and construction of all required drainage facilities that will take the runoff from Ahukini Makai to the ocean will be closely coordinated with the DOT Airports Division and any commitment made to the State will be extended to any third party builder and/or sub-developer.

d. Hanamaulu. The runoff from the developed Hanamaulu area will flow through cane fields located makai of Kapule Highway and to the ocean. The land is owned and farmed by Lihue Plantation Company, Limited and does not contain any buildings or structures. Lihue Plantation will accept the additional runoff from this development and will take measures as necessary to mitigate any adverse effects the additional runoff may have on its cane fields. Therefore, the additional runoff generated by the development of the Hanamaulu area will not adversely affect the downstream area. The acceptance of these flows will be extended to any developer that develops these sites.

The effect that increases in runoff will have on the water quality and flora and fauna of Hanamaulu Stream, Hanamaulu Bay, Kalapaki Bay, and offshore areas was studied in two separate reports, one by Richard Brock titled A Quantitative Assessment of the Marine Community and Water Quality in Hanamaulu Bay, Kauai and the other by Ron Englund titled Hanamaulu Stream Biological Survey Kauai, Hawaii. The reports concluded that increases in runoff that could be expected with the development of the Lihue-Hanamaulu Master Planned Community will not significantly these water bodies. Both reports are included in the EIS completed for the Lihue-Hanamaulu Master Planned Community.

DRAINAGE SYSTEM.

Plans to effectively manage storm runoffs from common storm events should be a part of any planned community. Amfac/JMB Hawaii, Inc.'s Lihue-Hanamaulu Master Planned Community will control runoff from common storm events with a drainage system consisting of drain inlets, manholes, drain pipes and outlet structures built along the roadways of its development. The drainage system will be designed to County of Kauai and State Department of Health standards with the intent that the infrastructure improvements will be dedicated to the County of Kauai.

The calculation of storm runoff quantities for the Lihue-Hanamaulu Master Planned Community was based on the Storm Drainage Standards of the Department of Public Works, County of Kauai, dated February 1972. As specified in the Storm Drainage Standards, the rational method for computing flow rates was used with the following factors:

Rainfall Intensity (10-year) = 3.25
Rainfall Intensity (50-year) = 4.10
Time of Concentration = 10 min
Intensity Correction Factor = 2.7
Runoff Coefficient (Residential) = 0.50
Runoff Coefficient (Apartment) = 0.55
Runoff Coefficient (Commercial/Public) = 0.74
Runoff Coefficient (Industrial) = 0.82
Runoff Coefficient (Park) = 0.31
Runoff Coefficient (Road) = 0.82

Runoff quantities from drainage sub-areas within each of the four geographic area were calculated and are displayed in Table Nos. 2 through 6. Per the Storm Drainage Standards, the 10-year storm was used to design the drainage systems within the subdivisions and the 50-year storm was used to size culverts crossing roadways where a static head was used. To size the drain pipes, it was assumed that the system was inlet controlled with a ratio of headwater to pipe diameter of 1.5. A conceptual drainage system layout along the major roadways for each area of the Master Planned Community was then developed (see Figure No. 8). Drainage systems within individual lots are not included in the conceptual layout since the location of interior roadways will be determined at a later stage of the development. Discussion on each area's drainage system is described below (areas used in the description are shown in Figure No. 5):

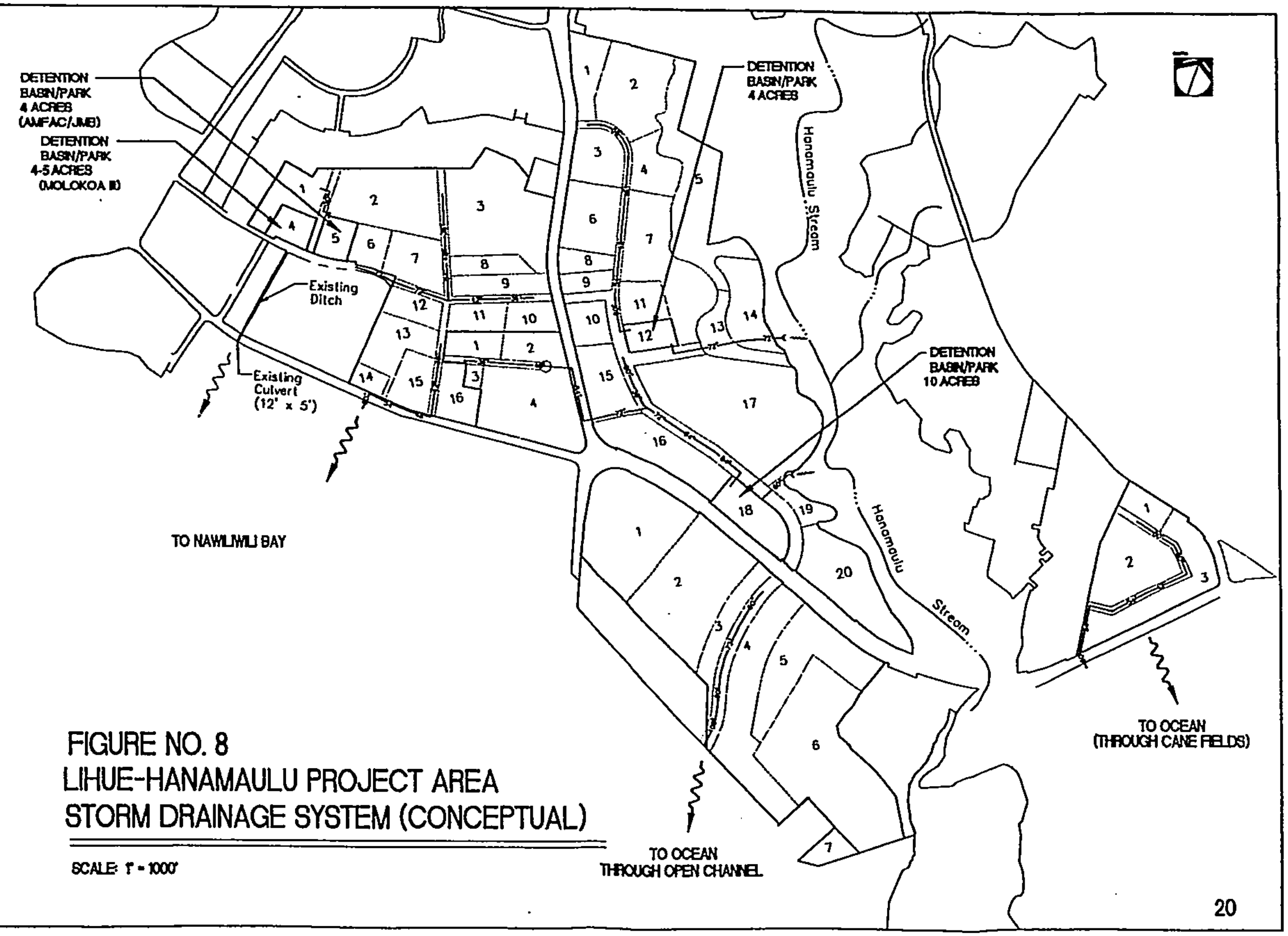

FIGURE NO. 8
LIHUE-HANAMAULU PROJECT AREA
STORM DRAINAGE SYSTEM (CONCEPTUAL)

SCALE: 1" = 1000'

TABLE NO. 2
STORM RUNOFF
MOLOKOA

DRAINAGE AREA NO.	AREA Acres	LAND USE		RUNOFF(cfs)	
		Description	Coefficient	10-year	50-year
1	9.0	Residential	0.50	39.51	49.78
2	22.3	Residential	0.50	97.90	125.36
3	21.5	Residential	0.50	94.39	118.93
4	5.0	PARK	0.31	13.60	17.14
5	5.0	PARK	0.31	13.60	17.14
6	4.0	YMCA	0.74	25.99	32.75
7	6.6	Commercial	0.74	42.88	54.03
8	3.8	Apartment	0.55	18.35	23.12
9	4.4	Commercial	0.74	28.59	36.02
10	5.0	Commercial	0.74	32.49	40.94
11	4.0	Commercial	0.74	25.99	32.75
12	5.1	Commercial	0.74	33.14	41.76
13	10.0	Police	0.74	64.97	81.86
14	2.3	Veterans	0.74	14.94	18.82
15	6.5	Judiciary	0.74	42.23	53.21
16	5.35	Commercial	0.74	34.76	43.80
17	0.4	Kauai Gateway	0.31	1.09	1.37
18	7.3	Road	0.82	52.56	66.22
TOTAL	127.55	----	----	676.58	855.00

TABLE NO. 3
STORM RUNOFF
MOLOKOA-DIVERTED

DRAINAGE AREA NO.	AREA (Acres)	LAND USE		RUNOFF (cfs)	
		Description	Coefficient	10-year	50-year
1	4	Commercial	0.74	25.99	32.75
2	5.1	Commercial	0.74	33.14	41.76
3	1.75	Commercial	0.74	11.37	14.33
4	16.2	Commercial	0.74	105.25	132.62
5	1.9	Road	0.82	13.68	17.24
TOTAL	28.95	----	----	189.43	238.70

TABLE NO. 4
STORM RUNOFF
AHUKINI-MAUKA

DRAINAGE AREA NO.	AREA Acres	LAND USE		RUNOFF (cfs) 10-year
		Description	Coefficient	
1	5.0	Commercial	0.74	34.49
2	13.2	Apartment	0.55	63.74
3	6.7	Residential	0.50	29.41
4	6.6	Residential	0.50	28.97
5	17.1	Open	0.31	46.54
6	7.0	Residential	0.50	30.73
7	20.9	Residential	0.50	91.75
8	3.0	Apartment	0.55	14.49
9	2.5	Commercial	0.74	16.24
10	5.0	Commercial	0.74	32.49
11	8.0	School	0.50	35.12
12	5.0	Park	0.31	13.62
13	6.4	Open	0.31	17.42
14	8.8	Residential	0.50	38.63
15	10	Apartment	0.55	48.29
16	47.2	Residential	0.50	207.21
17	16.8	Industrial	0.82	120.95
18	8	Park	0.31	27.76
19	1.2	Open	0.31	3.27
20	11.5	Industrial	0.82	82.80
22	0.8	Kauai Gateway	0.31	2.18
23	11.0	Road	0.82	79.19
TOTAL	221.7	----	----	1065.29

TABLE NO. 5
STORM RUNOFF
AHUKINI-MAKAI

DRAINAGE AREA NO.	AREA Acres	LAND USE		RUNOFF (cfs) 10-year
		Description	Coefficient	
1	17.2	Industrial	0.82	123.83
2	30.3	Industrial	0.82	218.15
3	8.1	Industrial	0.82	58.32
4	18.6	Industrial	0.82	133.91
5	27.4	Industrial	0.82	197.27
6	35.0	Recycling Plant	0.31	95.26
7	4.1	Disinfestation	0.82	29.52
8	0.4	Kauai Gateway	0.31	1.09
9	2.7	Road	0.82	19.44
TOTAL	143.8	----	----	876.79

TABLE NO. 6
STORM RUNOFF
HANAMAULU

DRAINAGE AREA NO.	AREA Acres	LAND USE		RUNOFF (cfs)	
		Description	Coefficient	10-year	50-year
1	4.0	Apartment	0.55	19.32	24.34
2	12.1	Residential	0.50	53.11	66.92
3	12.9	Residential	0.50	56.63	71.36
4	1.0	Road	0.82	7.20	9.07
TOTAL	30.0	----	----	136.26	171.69

1. Molokoa. Runoff from Molokoa I would be routed through a 4 acre park which also serves as a detention basin. The detained flow would be combined with flows from the 4-5 acre detention basin (serving the proposed Molokoa Phase III Subdivision), and flows from the existing stadium area. The combined flows would flow through an existing box culvert (12' wide x 5' high) that crosses under Kapule Highway and onto the Kauai Lagoons property.

   Flows from the Molokoa II area east of the stadium will be routed to a proposed 60" culvert that crosses Kapule Highway in front of the Veterans Building. The new 60" culvert will replace an existing 36" culvert at that location. The runoff will flow across Kauai Lagoons property through an existing drainage ditch and will be combined with flows from Molokoa I and other areas before entering two 88" culverts that take the runoff under Marriott properties to Kalapaki Stream.

2. Molokoa (Diverted). Runoff would be collected from a 28.95 acre area, routed across Ahukini Road through a new 72" culvert, and combined with flows from the lower areas of Ahukini Mauka III before being routed through a 10-acre combination park/detention basin and discharged into an existing ditch leading to Hanamaulu Stream.

3. Ahukini Mauka. There would be two separate storm drainage systems serving Ahukini Mauka. Runoff from about 50.5 acres in the Ahukini Mauka II area would be collected and routed through an 4 acre park/detention basin. The outflow from the park/detention basin would be combined with runoff from downstream lots and discharged into a natural swale which feeds Hanamaulu Stream.

   Runoff from 78 acres in the Ahukini Mauka III area would be combined with the diverted flow from Molokoa and routed through a 10-acre park/detention basin. The outflow from the park/detention basin would flow through a 60" drain pipe down to the floor of Hanamaulu Valley where it would discharge to a ditch leading to the stream.

   Outlet structures would be located at the base of the valley walls set back from Hanamaulu Stream and would discharge into existing swales or ditches which lead to the stream. There would be no alteration of the existing stream channel. Energy dissipators and rip rap would be provided at the outlet as required to ensure that erosion of downstream areas does not occur.

   The remaining lots make up Ahukini Mauka I and are located along the edge of Hanamaulu Valley. Runoff from these lots would flow through smaller drainage systems directly to swales or gullies leading to Hanamaulu Stream. The design of these drainage systems was not included in this report since the locations of interior roadways for these lots will be decided on at a date later in the planning process.

4. Ahukini Makai. Runoff would be collected from the Ahukini Makai area and conveyed through a concrete channel leading from the project area through the Lihue Airport property to a natural gully which flows directly to the ocean. The various options relating to the concrete channel was previously discussed under the section on the impact of the increased runoff.

   Runoff from the portion of Ahukini Makai that is located along Hanamaulu Valley and Bay will continue to flow toward the bay. This area includes the recycling center and disinfestation facility . Drainage systems for this area will be designed at a later date when more detailed information on the interior roadways is available.

5. Hanamaulu. Runoff would be collected along the roadways of the Hanamaulu area and routed across Kapule Highway through existing siphons 60" pipe. The runoff will flow through the existing sugar cane fields to the ocean.

EROSION AND SEDIMENT CONTROL.

The land that will be developed into the Lihue-Hanamaulu Master Planned Community is currently being used to grow sugar cane and may be subject to a significant amount of erosion and sediment loss due to runoff, especially during the early stages of growth. To minimize the transportation of sediment to Hanamaulu Stream and to the ocean, sediment ditches and basins have been constructed by Lihue Plantation Company, Limited along the perimeter of the cane fields. As development of the Master Planned Community progresses, the amount of land area that will be landscaped or covered with impermeable surfaces will increase, thus decreasing amount of sediment loss.

The Universal Soil Loss Equation (USLE) as outlined in the U.S. Soil Conservation Services (SCS) Erosion and Sediment Control Guide for Hawaii is used to estimate erosion from the Lihue-Hanamaulu Master Planned Community under existing and developed conditions. The soil loss equation is defined as followed:

A = Soil Loss (tons/acre/year) = (R)(K)(L)(S)(C)(P) where:

R = Rainfall Factor
K = Soil Erodibility Factor
L = Slope Length Factor
S = Slope Gradient Factor
C = Cover and Management Factor
P = Erosion Control Practice Factor

1. Existing Conditions. The land that will be developed into the Lihue-Hanamaulu Master Planned Community is currently being used to grow sugar cane and may be subject to significant erosion and sediment losses due to runoff during the harvesting and planting stages. To minimize the transportation of sediment to downstream areas, sediment ditches and basins at the perimeter of the cane fields have been utilized.

To determine the soil loss for the existing condition of the project area, six unknowns must be established. The rainfall factor (R) and the soil erodibility factor (K) is set at 400 and 0.17 (Lihue Silty Clay), respectively. Based on a slope length of 200 feet and an average slope of 2.8%, the (L)(S) factor calculates to be 0.33. A cover and management factor (C) of 0.10 is used for irrigated sugar cane. This factor provides an average of the factors that apply for sugar cane fields during the various stages of growth or canopy cover. An erosion control practice factor (P) of 0.25 reflects the irrigation ditches and sediment ditches used in the cane fields. Using this data, the soil loss (A) calculates to be:

A = (400)(.17)(.33)(.10)(.25) = 0.56 tons/acre/year

For the 555 acre Master Planned Community site, the soil loss will be about 309 tons per year.

2. Developed Conditions. The Lihue-Hanamaulu Master Planned Community includes residential housing, commercial, and industrial uses. As stated earlier, soil loss for the developed condition is expected to decrease because of the increase in impermeable areas and use of landscaping caused by development.

Combination park/detention basins are proposed for Molokoa and Ahukini Mauka. While these facilities will provide for some sedimentation of solids, they were designed to County of Kauai guidelines for the primary purpose of dampening peak discharge flows. The alternative of providing permanent siltation basins was considered but found to be unfeasible and perhaps unnecessary. Because the County's requires that the depth of the detention facilities be kept shallow, about twice as much land area as presently proposed would be required for detention basins that provided sufficient detention time for sedimentation purposes.

As performed earlier, the six unknowns for the developed condition of the project must be defined before soil loss can be determined. The rainfall factor (400) and the soil erodibility factor (0.17) were previously determined and will not change for the developed condition. Based on a slope length of 300 feet and an average slope of 2.8% the (L)(S) factor calculates to be 0.37. To define an established grass cover, the cover and management factor (C) is set at 0.01. An erosion control practice factor (P) of 0.9 reflects the use of parks/detention basins to detain a portion of the runoff. Using this data, the soil loss (A) for the developed condition calculates to be:

A = (400)(.17)(.37)(.01)(.90) = 0.23 tons/acre/year

To determine the quantity of soil loss under the developed condition, it was estimated that about 50% of the developed area will consist of impermeable areas such as roads, buildings, or parking areas. This is a conservative estimate since the maximum allowable lot coverage ranges from 50% for residential areas to 100% for industrial areas. Using this conservative estimate, the annual soil loss would be about 63 tons per year or about 20% of the soil loss under existing conditions. Table No. 7 summarizes the soil losses experienced during existing and developed conditions.

TABLE NO. 7
SOIL LOSS CALCULATIONS

CONDITION	SOIL LOSS FACTOR Tons/Acre/Year	AREA (Acres)	TOTAL SOIL LOSS (Tons)
Sugar Cane	0.56	552	309
Developed	0.23	276	63

3. Soil Loss During Construction. The potential for erosion and sediment loss is greatest during the development of the Lihue-Hanamaulu Master Planned Community, especially during the grading process. However, soil loss will be minimal since the development of the project will be phased over a 15 to 20 year period and measures to mitigate erosion and sediment loss such as temporary grassing and sediments basins will be utilized during development. Sediment basins will be located within or just downstream of the area being developed. Sediment basins will be designed per Department of Health standards with a volume of at least 3,600 square feet per acre of disturbed land.

To evaluate the amount of soil loss, the Master Planned Community was assumed to have a development schedule that spans a period of 15 years or about 36 acres per year. Further, the Department of Public Works requires that graded areas be grassed if the area is to remain bare for a period greater than 30 days. This construction requirement means that there will be no area within the Master Planned Community that will be bare for a period longer than 30 days or a twelfth (1/12) of a year. Thus, the area exposed to soil loss is extrapolated as follows:

Area Under Construction = 36 ac./yr.
Max. Time of Bare Soil Exposure = .0833 or 1/12 yr.
Area Exposed to Soil Loss = (36 ac./yr.)(.0833 yr.)
= 3 ac. (yearly basis)

Before soil loss during construction can be established, six unknowns must be defined. The rainfall factor (400), the soil erodibility factor (0.17) and (L)(S) factor (0.37) were previously determined and will not change for soil loss during construction. To define bare ground, the cover and management factor (C) is set at 1.0. An erosion control practice factor of 0.25 reflects the utilization of sedimentation basins during construction. Using this data, the soil loss (A) during construction calculates to be:

$$A = (400)(.17)(.37)(1.0)(.25) = 6.29 \text{ tons/acre/year}$$

The soil losses for Lihue-Hanamaulu Master Planned Community during the first year of its 15 year projected development period are:

6.29 x 3 acres = 18.9 tons (graded area)
0.56 x 549 acres = 307.4 tons (sugar cane fields)

The first year's total soil loss is 326 tons, which represents a 5.5% increase from existing conditions. This increase in soil loss is a conservative estimate because the calculation does not include any grassed area (i.e. it assumes that the total area exposed to soil loss occurs in the last twelfth of the first year).

During the second year, assuming that the previously graded 36 acres is fully grassed, the soil losses are:

6.29 x 3 acres = 18.9 tons (graded area)
0.56 x 513 acres = 287.3 tons (sugar cane fields)
0.23 x 36 acres = 8.3 tons (grassed)

The second year's total soil loss is 314.5 tons, which is about 1.8% more than under existing conditions. The calculations are based on the same assumption used in the first year and do not include lands graded during the second year.

In the third year, assuming the 36 acres graded in the second year are now grassed and assuming that the 36 acres graded in the first year are now developed with a 50% grass and 50% impermeable surface, the soil losses are:

6.29 x 3 acres = 18.9 tons (graded area)
0.56 x 477 acres = 267.1 tons (sugar cane fields)
0.23 x 36 acres x = 8.3 tons (grassed)
0.23 x 36 acres x 0.5 = 4.1 tons (developed)

The conservatively calculated soil loss total for third year is 298.4 tons or a 3.4% decrease over existing conditions. This declining soil loss trend would continue throughout the remainder of the development period. Based on the assumptions stated above, estimates of soil loss experienced during the 15 years of development are displayed in Table No. 8.

TABLE NO. 8
SOIL LOSS DURING CONSTRUCTION

YEAR	AREA UNDER CONSTRUCTION	SUGAR CANE FIELDS	GRASSED/ DEVELOPED LOT AREAS	TOTAL SOIL LOSS
0	None	310 tons	None	310 tons
1	19 tons	307 tons	None	326 tons
2	19 tons	287 tons	8 tons	314 tons
3	19 tons	267 tons	13 tons	299 tons
5	19 tons	227 tons	21 tons	267 tons
10	19 tons	126 tons	42 tons	186 tons
15	19 tons	26 tons	62 tons	107 tons

4. <u>Mitigation of Soil Loss During Construction</u>. Soil losses can be minimized during construction by implementing the following measures:

   a. Minimize time that soil is left bare. The Department of Public Works requires that temporary vegetative cover be provided if a site is left bare for more than 30 days.

   b. Construct temporary berms, sediment ditches, filter fences, and sediment basins to divert runoff and trap silt during development. Sediment basins will be constructed in conjunction with each phase of grading at the rate of 3,600 cubic feet per disturbed acre. Temporary sediment basins will be located at the downstream end of each graded area or in the lot adjacent to the graded area.

   c. Use water trucks and sprinkler systems to keep the area moist during construction and also during nights and weekends

Amfac/JMB Hawaii will coordinate its construction plans with the County of Kauai and the State Department of Health to obtain the necessary permits for grading and stormwater discharges (NPDES). At the time of permit application, site specific plans and best management practices for erosion and sediment control will be prepared and submitted for review to the applicable agencies.

ESTIMATED ORDER-OF-MAGNITUDE COST

The order-of-magnitude cost of the drainage improvements for Amfac/JMB Hawaii, Inc.'s Lihue-Hanamaulu Master Planned Community is estimated at $4,640,700 in 1994 dollars. The estimate assumes that the drainage system would be constructed to Department of Public Works, County of Kauai standards and includes the drainage systems along the major interior roadways. The estimate does not include the drainage systems for the minor roadways since planning for those roadways will be performed at a later stage of the development. See Table No. 9 for a breakdown of the costs.

TABLE NO. 9

DRAINAGE SYSTEM

CONSTRUCTION COST ESTIMATE

PROJECT AREA	DESCRIPTION	UNITS	UNIT PRICE	TOTAL COST
MOLOKOA	30" C.M.P.	250 LF	$70/LF	$17,500
	36" C.M.P.	1800 LF	$80/LF	$144,000
	42" C.M.P.	950 LF	$90/LF	$85,500
	48" C.M.P.	1100 LF	$100/LF	$110,000
	54" C.M.P.	1450 LF	$110/LF	$159,500
	60" C.M.P.	200 LF	$125/LF	$25,000
	72" C.M.P.	1750 LF	$150/LF	$262,500
	C.B.	50	$5000	$250,000
DETENTION BASIN		1	LUMP SUM	$65,000
			TOTAL	$1,119,000
AHUKINI MAUKA	30" C.M.P.	250 LF	$70/LF	$17,500
	36" C.M.P.	1050 LF	$80/LF	$84,000
	42" C.M.P.	350 LF	$90/LF	$31,500
	48" C.M.P.	500 LF	$100/LF	$50,000
	54" C.M.P.	350 LF	$110/LF	$38,500
	60" C.M.P.	1350 LF	$125/LF	$168,750
	72" C.M.P.	1300 LF	$150/LF	$195,000
	84" C.M.P.	1250 LF	$190/LF	$237,500
	C.B.	43	$5000	$215,000
OUTLET STRUCTURES		2	LUMP SUMP	$250,000
DETENTION BASINS		2	LUMP SUMP	$355,000
			TOTAL	$1,642,750

TABLE NO. 9 (CONT-)

DRAINAGE SYSTEM

CONSTRUCTION COST ESTIMATE

PROJECT AREA	DESCRIPTION	UNITS	UNIT PRICE	TOTAL COST
AHUKINI MAKAI	60" C.M.P.	300 LF	$125/LF	$37,500
	72" C.M.P.	600 LF	$150/LF	$90,000
	90" C.M.P.	400 LF	$205/LF	$82,000
	108" C.M.P.	400 LF	$275/LF	$110,000
Concrete Channel		2000 LF	$200/LF	$400,000
	C.B.	12	$5000	$60,000
			TOTAL	$779,500
HANAMAULU	30" C.M.P.	900 LF	$70/LF	$63,000
	42" C.M.P.	400 LF	$90/LF	$36,000
	54" C.M.P.	950 LF	$110/LF	$104,500
	60" C.M.P.	300 LF	$125/LF	$37,500
	C.B.	17	$5000	$85,000
			TOTAL	$326,000
			SUB-TOTAL	$3,867,250
	ENGINEERING AND CONTINGENCY (20%)			$773,450
			TOTAL	$4,640,700

OVERVIEW OF DRAINAGE REQUIREMENTS

This engineering report found that by using mitigating measures such as detention basins, there will be no adverse drainage impacts on downstream properties and waterways caused by the development of Amfac/JMB Hawaii, Inc.'s Lihue-Hanamaulu Master Planned Community. To support the Lihue-Hanamaulu Master Planned Community, new drainage systems within all four geographic areas, as well as, off-site/downstream drainage facilities will have to be constructed. The drainage system includes a network of drain inlets, manholes, outlet structures, detention ponds; swales and drain pipes ranging between 30" - 108" in size. Off-site drainage improvements include new concrete channels, new culverts, new swales and upgrades to existing culverts.

Another requirement that the Master Planned Community must satisfy is to minimize soil/sediment loss during the project's development. Temporary berms, sediment ditches, filter fences, and sediment basins will be incorporated into the project's development plan.

The drainage related requirements derived in this engineering report are based on the expanded drainage needs due to Amfac/JMB Hawaii, Inc.'s Lihue-Hanamaulu Master Planned Community only, and does not include additional drainage system improvements due to other developments or subdivisions. Amfac/JMB Hawaii, Inc. is committed to working closely with all applicable agencies during the entire development of its Master Planned Community.

KODANI AND ASSOCIATES, INC.
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APPENDIX

KODANI AND ASSOCIATES, INC.
3145 AKAHI STREET
LIHUE, KAUAI, HAWAII 96766

PEAK DISCHARGE FOR EXISTING CONDITION

(100 YEAR - 24 HOUR STORM)

TR-55 TABULAR HYDROGRAPH METHOD
Type I Distribution
(24 hr. Duration Storm)

Executed: 12-30-1994 09:30:18
Watershed file: --> C:\PONDPACK\MOLO-P1 .WSD
Hydrograph file: --> C:\PONDPACK\MOLO-P1 .HYD

LIHUE-HANAMAULU MASTER PLANNED COMMUNITY
MOLOKOA
PRESENT CONDITION 100-year 24-hour storm
December 30,1994

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Molokoa 1 & 2	99.10	62.5	0.40	0.00	16.50	10.90	.07 .10
Molokoa 3 & 4	56.40	62.5	0.20	0.00	16.50	10.90	.07 .10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 155.50 acres or 0.2430 sq.mi
Peak discharge = 811 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Molokoa 1 & 2	0.40	0.00	**	**	No	Computed Ia/p < .1
Molokoa 3 & 4	0.20	0.00	**	**	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD
Type I Distribution
(24 hr. Duration Storm)

Executed: 12-19-1994 09:38:26
Watershed file: --> C:\PONDPACK\A-MAUKAP.WSD
Hydrograph file: --> C:\PONDPACK\A-MAUKAP.HYD

LIHUE-HANAMAULU MASTER PLANNED COMMUNITY
AHUKINI MAUKA
PRESENT CONDITION
September 13, 1994

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Upper Mauka I	24.10	62.5	0.20	0.75	16.50	10.90	.07 .10
Middle Mauka I	31.80	62.5	0.40	0.75	16.50	10.90	.07 .10
Lower Mauka I	32.60	62.5	0.20	0.50	16.50	10.90	.07 .10
Bottom Lot 17	12.40	62.5	0.10	0.50	16.50	10.90	.07 .10
Lots 18-20	24.20	62.5	0.10	0.50	16.50	10.90	.07 .10
Upper Mauka II	75.00	62.5	0.30	0.30	16.50	10.90	.07 .10
Lower Mauka II	21.60	62.5	0.40	0.10	16.50	10.90	.07 .10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 221.70 acres or 0.3464 sq.mi
Peak discharge = 854 cfs

WARNING: Drainage areas of two or more subareas differ by a factor of 5 or greater.

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Upper Mauka I	0.20	0.75	**	**	No	Computed Ia/p < .1
Middle Mauka I	0.40	0.72	0.40	0.75	No	Computed Ia/p < .1
Lower Mauka I	0.20	0.62	0.20	0.50	No	Computed Ia/p < .1
Bottom Lot 17	0.10	0.62	0.10	0.50	No	Computed Ia/p < .1
Lots 18-20	0.10	0.58	0.10	0.50	No	Computed Ia/p < .1
Upper Mauka II	0.30	0.28	0.30	0.30	No	Computed Ia/p < .1
Lower Mauka II	0.40	0.10	**	**	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD
Type I Distribution
(24 hr. Duration Storm)

Executed: 12-19-1994 09:36:49
Watershed file: --> C:\PONDPACK\AMAKAI-P.WSD
Hydrograph file: --> C:\PONDPACK\AMAKAI-P.HYD

LIHUE-HANAMAULU MASTER PLANNED COMMUNITY
AHUKINI MAKAI
PRESENT CONDITION
September 13, 1994

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
DA 1	19.00	62.5	0.30	0.30	16.50	10.90	.07 .10
DA 2	26.00	62.5	0.40	0.00	16.50	10.90	.07 .10
DA 3	37.40	62.5	0.40	0.00	16.50	10.90	.07 .10
DA 4	61.40	62.5	0.40	0.00	16.50	10.90	.07 .10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 143.80 acres or 0.2247 sq.mi
Peak discharge = 736 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
DA 1	0.28	0.30	0.30	0.30	No	Computed Ia/p < .1
DA 2	0.40	0.00	**	**	No	Computed Ia/p < .1
DA 3	0.40	0.00	**	**	No	Computed Ia/p < .1
DA 4	0.35	0.00	0.40	0.00	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

Quick TR-55 Version: 5.46 S/N:

TR-55 TABULAR HYDROGRAPH METHOD
Type I Distribution
(24 hr. Duration Storm)

Executed: 12-19-1994 09:38:55
Watershed file: --> C:\PONDPACK\HANAMAUP.WSD
Hydrograph file: --> C:\PONDPACK\HANAMAUP.HYD

LIHUE-HANAMAULU MASTER PLANNED COMMUNITY
HANAMAULU
PRESENT CONDITION
September 13, 1994

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Hanamaulu	30.00	62.5	0.20	0.00	16.50	10.90	.07 .10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 30.00 acres or 0.04688 sq.mi
Peak discharge = 207 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Hanamaulu	0.20	0.00	**	**	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

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PEAK DISCHARGE FOR FUTURE CONDITION

(100 YEAR - 24 HOUR STORM)

Executed 12-30-1994 09:34:45

File Summary for Composite Hydrograph

Time (hrs)	MOLO-12D (cfs)	MOLO-PUB (cfs)	MOLO-30 (Total)
9.00	0.0	17.0	17.0
9.10	116.0	19.0	135.0
9.20	12.0	20.0	32.0
9.30	128.0	22.0	150.0
9.40	28.0	25.0	53.0
9.50	148.0	27.0	175.0
9.60	48.0	30.0	78.0
9.70	185.0	43.0	228.0
9.80	101.0	56.0	157.0
9.90	238.0	69.0	307.0
10.00	225.0	117.0	342.0
10.10	351.2	183.0	534.2
10.20	492.2	194.0	686.2
10.30	616.1	185.0	801.1
10.40	652.6	157.0	809.6
10.50	620.1	118.0	738.1
10.60	523.2	91.0	614.2
10.70	420.7	73.0	493.7
10.80	336.3	60.0	396.3
10.90	276.0	54.0	330.0
11.00	180.8	48.0	228.8
11.10	194.2	44.0	238.2
11.20	149.8	40.0	189.8
11.30	169.2	39.0	208.2
11.40	131.8	38.0	169.8
11.50	155.2	37.0	192.2
11.60	121.8	36.0	157.8
11.70	147.2	35.0	182.2
11.80	115.8	34.0	149.8
11.90	140.2	34.0	174.2
12.00	108.8	34.0	142.8

COMBINED FLOW FROM MOLOKOA I
AND MOLOKOA II

Pond File: C:MOLO-12D.PND
Inflow Hydrograph: C:MOLO-121.HYD
Outflow Hydrograph: C:MOLO-12D.HYD

EXECUTED: 12-30-1994
09:32:07

INFLOW HYDROGRAPH / ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
22.700	37.0	75.0	-51.2	51.2	51.2	100.25
22.800	37.0	74.0	-22.8	22.8	22.8	100.11
22.900	36.0	73.0	-50.2	50.2	50.2	100.24
23.000	36.0	72.0	-21.8	21.8	21.8	100.10
23.100	36.0	72.0	-50.2	50.2	50.2	100.24
23.200	35.0	71.0	-20.8	20.8	20.8	100.10
23.300	35.0	70.0	-49.2	49.2	49.2	100.24
23.400	34.0	69.0	-19.8	19.8	19.8	100.10
23.500	34.0	68.0	-48.2	48.2	48.2	100.23
23.600	34.0	68.0	-19.8	19.8	19.8	100.10
23.700	33.0	67.0	-47.2	47.2	47.2	100.23
23.800	33.0	66.0	-18.8	18.8	18.8	100.09
23.900	32.0	65.0	-46.2	46.2	46.2	100.22

Peak Inflow = 699.0 cfs
Peak Outflow = 652.6 cfs
Peak Elevation = 103.54 ft

POND-2 Version: 4.10
S/N: 89020387

Molokoa Detention Basin/Park
4-Acre Park Above Stadium
December 30, 1994

EXECUTED 12-30-1994 09:32:07
Disk Files: C:MOLO-12D.PND ; C:MOLO-121.HYD

INITIAL CONDITIONS
Elevation = 100.00 ft
Outflow = 0.0 cfs

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
100.00	0.0	0.00
100.50	104.0	0.00
101.00	143.0	0.00
102.00	260.0	0.00
102.10	286.0	0.20
102.50	390.0	1.00
103.00	520.0	2.00
103.50	650.0	3.00
104.00	680.0	4.00

COMPUTATIONS

2S/t (cfs)	2S/t + 0 (cfs)
0.0	0.0
0.0	104.0
0.0	143.0
0.0	260.0
48.4	334.4
242.0	632.0
484.0	1004.0
726.0	1376.0
968.0	1648.0

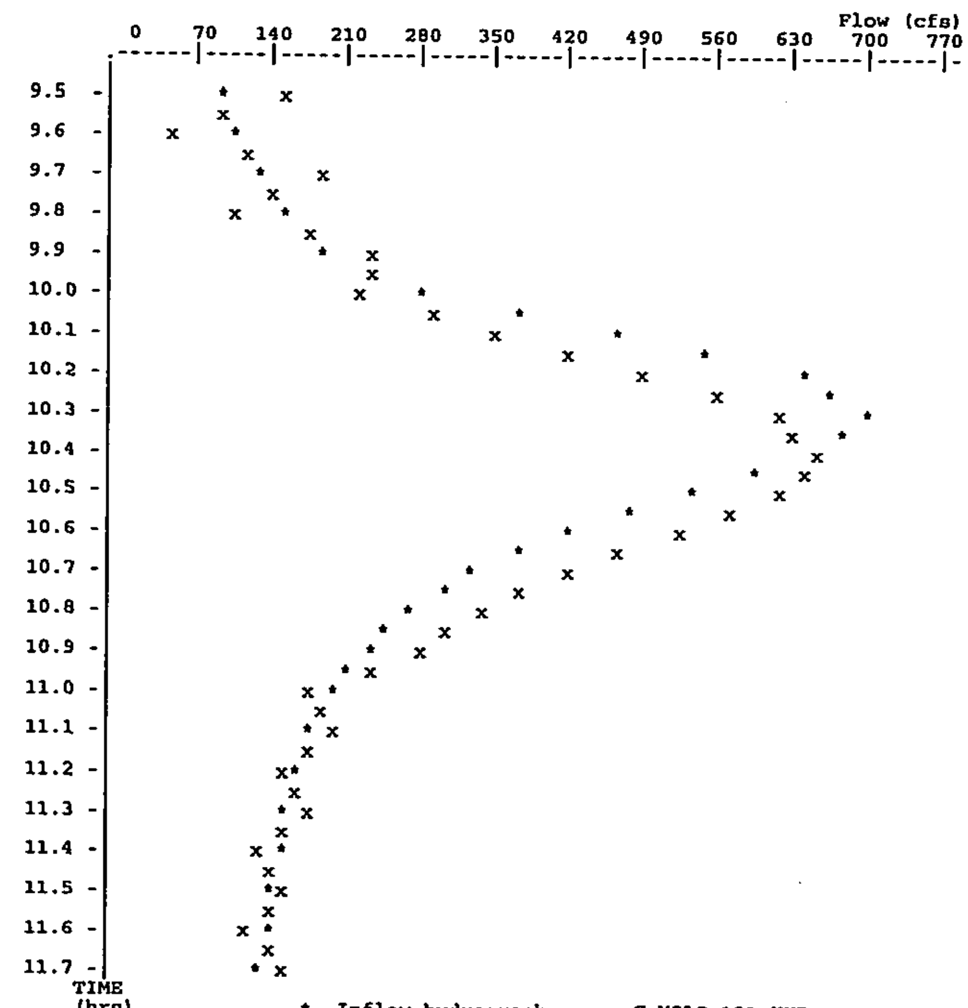
Time increment (t) = 0.100 hrs.

POND-2 Version: 4.10 S/N: 89020387

Pond File: C:MOLO-12D.PND
Inflow Hydrograph: C:MOLO-121.HYD
Outflow Hydrograph: C:MOLO-12D.HYD

EXECUTED: 12-30-1994
09:32:07

Peak Inflow = 699.0 cfs
Peak Outflow = 652.6 cfs
Peak Elevation = 103.54 ft



* Inflow hydrograph ---> C:MOLO-121.HYD
x Outflow hydrograph ---> C:MOLO-12D.HYD

TR-55 TABULAR HYDROGRAPH METHOD
Type I Distribution
(24 hr. Duration Storm)

Executed: 12-30-1994 09:30:49
Watershed file: --> C:\PONDPACK\MOLO-121.WSD
Hydrograph file: --> C:\PONDPACK\MOLO-121.HYD

LIHUE-HANAMAULU MASTER PLANNED COMMUNITY
MOLOKOA I
MAUKA AREA BEFORE 4-ACRE PARK/DETENTION BASIN
December 13, 1994

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input	Ia/p used
Single Family	10.00	85.0	0.20	0.00	16.50	14.50	.02	.10
Single Family	11.30	85.0	0.30	0.00	16.50	14.50	.02	.10
Single Family	15.00	85.0	0.30	0.10	16.50	14.50	.02	.10
Single Family	10.00	85.0	0.20	0.20	16.50	14.50	.02	.10
Single Family	11.50	85.0	0.20	0.20	16.50	14.50	.02	.10
Park/Detention	5.00	79.0	0.20	0.00	16.50	13.60	.03	.10
VMX	14.70	92.0	0.20	0.10	16.50	15.50	.01	.10
Multi Family	3.80	85.0	0.20	0.20	16.50	14.50	.02	.10
VMX	13.40	92.0	0.20	0.20	16.50	15.50	.01	.10
Road	6.60	92.0	0.20	0.00	16.50	15.50	.01	.10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 101.30 acres or 0.1583 sq.mi
Peak discharge = 699 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Single Family	0.23	0.00	0.20	0.00	No	Computed Ia/p < .1
Single Family	0.27	0.00	0.30	0.00	No	Computed Ia/p < .1
Single Family	0.27	0.10	0.30	0.10	No	Computed Ia/p < .1
Single Family	0.23	0.21	0.20	0.20	No	Computed Ia/p < .1
Single Family	0.23	0.16	0.20	0.20	No	Computed Ia/p < .1
Park/Detention	0.19	0.00	0.20	0.00	No	Computed Ia/p < .1
VMX	0.21	0.10	0.20	0.10	No	Computed Ia/p < .1
Multi Family	0.21	0.19	0.20	0.20	No	Computed Ia/p < .1
VMX	0.21	0.16	0.20	0.20	No	Computed Ia/p < .1
Road	0.20	0.00	**	**	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD
Type I Distribution
(24 hr. Duration Storm)

Executed: 12-14-1994 09:15:24
Watershed file: --> C:\PONDPACK\MOLO-PUB.WSD
Hydrograph file: --> C:\PONDPACK\MOLO-PUB.HYD

LIHUE-HANAMAULU MASTER PLANNED COMMUNITY
MOLOKOA II
PUBLIC BUILDINGS
September 13, 1994

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input	Ia/p used
Police	10.00	92.0	0.10	0.20	16.50	15.50	.01	.10
Road	2.00	92.0	0.20	0.10	16.50	15.50	.01	.10
Commercial	5.35	92.0	0.10	0.10	16.50	15.50	.01	.10
Judiciary	6.50	92.0	0.10	0.00	16.50	15.50	.01	.10
Veterans	2.30	92.0	0.10	0.00	16.50	15.50	.01	.10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 26.15 acres or 0.04086 sq.mi
Peak discharge = 194 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Police	0.10	0.20	**	**	No	Computed Ia/p < .1
Road	0.20	0.10	**	**	No	Computed Ia/p < .1
Commercial	0.10	0.10	**	**	No	Computed Ia/p < .1
Judiciary	0.10	0.00	**	**	No	Computed Ia/p < .1
Veterans	0.10	0.00	**	**	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

Executed 12-14-1994 10:00:09

File Summary for Composite Hydrograph

Time (hrs)	AHU-12E (cfs)	AHU-12AE (cfs)	AHU-NOD6 (cfs)	AHU-12N (Total)
9.00	0.0	0.0	30.0	30.0
9.10	0.0	0.0	33.0	33.0
9.20	0.0	0.0	37.0	37.0
9.30	0.0	0.0	40.0	40.0
9.40	0.0	0.0	45.0	45.0
9.50	120.0	0.0	49.0	169.0
9.60	13.0	0.0	54.0	67.0
9.70	133.0	0.0	62.0	195.0
9.80	28.0	0.0	70.0	98.0
9.90	152.0	58.0	78.0	288.0
10.00	47.0	7.0	99.0	153.0
10.10	190.0	65.0	137.0	392.0
10.20	105.0	16.0	178.0	299.0
10.30	201.0	75.0	196.0	472.0
10.40	206.1	26.0	215.0	447.1
10.50	229.0	95.0	253.0	577.0
10.60	283.4	57.0	303.0	643.4
10.70	376.9	126.0	350.0	852.9
10.80	439.3	127.2	379.0	945.5
10.90	465.7	160.7	382.0	1008.4
11.00	464.8	216.3	386.0	1067.1
11.10	445.3	265.6	356.0	1066.9
11.20	414.6	286.3	327.0	1027.9
11.30	379.3	279.8	294.0	953.1
11.40	343.2	256.0	260.0	859.2
11.50	308.9	224.5	229.0	762.4
11.60	278.3	192.2	197.0	667.5
11.70	255.6	163.4	178.0	597.0
11.80	243.4	139.7	158.0	541.1
11.90	231.8	90.8	146.0	468.6
12.00	220.9	75.2	133.0	429.1

COMBINED FLOW FROM AHUKINI MAUKA I
AHUKINI MAUKA II, AND AHUKINI MAUKA III

Ahukini Mauka
10 Acre Park/Detention Basin
December 13, 1994

EXECUTED 12-14-1994 09:50:00
Disk Files: C:AHU-12D .PND ; C:AHU-12 .HYD

INITIAL CONDITIONS
Elevation = 100.00 ft
Outflow = 0.0 cfs

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
100.00	0.0	0.00
101.00	143.0	0.00
101.50	198.0	0.00
102.00	260.0	4.00
102.50	390.0	8.00
103.00	520.0	12.00
103.50	650.0	16.00

COMPUTATIONS

2S/t (cfs)	2S/t + 0 (cfs)
0.0	0.0
0.0	143.0
0.0	198.0
968.0	1228.0
1936.0	2326.0
2904.0	3424.0
3872.0	4522.0

Time increment (t) = 0.100 hrs.

Pond File: C:AHU-12D .PND
Inflow Hydrograph: C:AHU-12 .HYD
Outflow Hydrograph: C:AHU-12D .HYD

EXECUTED: 12-14-1994
09:50:00

INFLOW HYDROGRAPH

TIME (hrs)	INFLOW (cfs)
22.700	37.0
22.800	37.0
22.900	36.0
23.000	36.0
23.100	35.0
23.200	35.0
23.300	34.0
23.400	34.0
23.500	33.0
23.600	33.0
23.700	32.0
23.800	32.0
23.900	31.0

ROUTING COMPUTATIONS

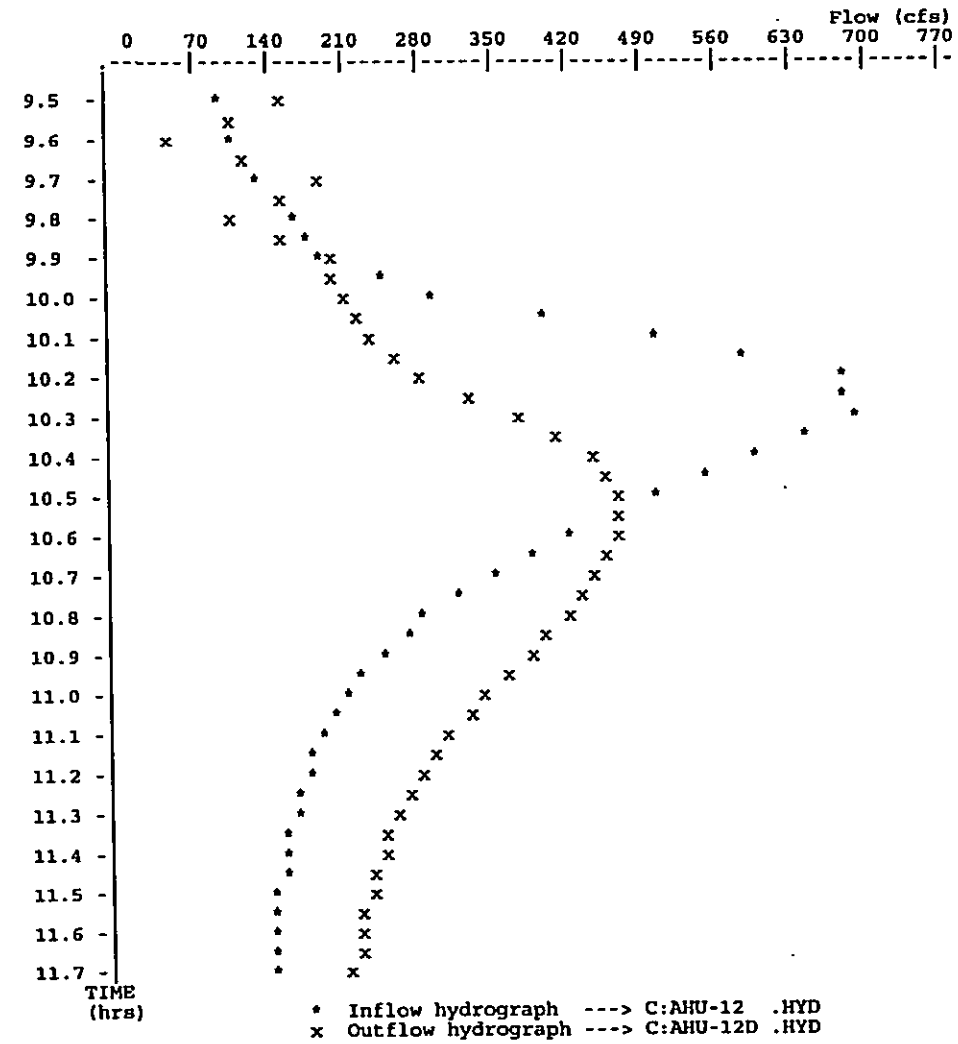
I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
75.0	-20.6	20.6	20.6	100.14
74.0	-53.4	53.4	53.4	100.37
73.0	-19.6	19.6	19.6	100.14
72.0	-52.4	52.4	52.4	100.37
71.0	-18.6	18.6	18.6	100.13
70.0	-51.4	51.4	51.4	100.36
69.0	-17.6	17.6	17.6	100.12
68.0	-50.4	50.4	50.4	100.35
67.0	-16.6	16.6	16.6	100.12
66.0	-49.4	49.4	49.4	100.35
65.0	-15.6	15.6	15.6	100.11
64.0	-48.4	48.4	48.4	100.34
63.0	-14.6	14.6	14.6	100.10

Peak Inflow = 684.0 cfs
Peak Outflow = 465.8 cfs
Peak Elevation = 102.79 ft

Pond File: C:AHU-12D .PND
Inflow Hydrograph: C:AHU-12 .HYD
Outflow Hydrograph: C:AHU-12D .HYD

EXECUTED: 12-14-1994
09:50:00

Peak Inflow = 684.0 cfs
Peak Outflow = 465.8 cfs
Peak Elevation = 102.79 ft



TR-55 TABULAR HYDROGRAPH METHOD
Type I Distribution
(24 hr. Duration Storm)

Executed: 12-14-1994 09:40:45
Watershed file: --> C:\PONDPACK\AHU-12 .WSD
Hydrograph file: --> C:\PONDPACK\AHU-12 .HYD

LIHUE-HANAMAULU MASTER PLANNED COMMUNITY
AHUKINI MAUKA III
AREA BEFORE 10 ACRE DETENTION (INCL. MOLOKOA DIV)
December 13, 1994

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input	Ia/p used
VMX	16.80	92.0	0.30	0.00	16.50	15.50	.01	.10
Single Family	36.30	85.0	0.30	0.00	16.50	14.50	.02	.10
Multi Family	10.00	85.0	0.20	0.20	16.50	14.50	.02	.10
VMX	10.00	92.0	0.20	0.30	16.50	15.50	.01	.10
VMX	6.10	92.0	0.20	0.30	16.50	15.50	.01	.10
VMX	6.65	92.0	0.20	0.40	16.50	15.50	.01	.10
Park	8.00	98.0	0.20	0.00	16.50	16.20	0	.10
Road	6.60	92.0	0.20	0.00	16.50	15.50	.01	.10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 100.45 acres or 0.1570 sq.mi
Peak discharge = 684 cfs

WARNING: Drainage areas of two or more subareas differ by a factor of 5 or greater.

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
VMX	0.28	0.00	0.30	0.00	No	Computed Ia/p < .1
Single Family	0.32	0.01	0.30	0.00	No	Computed Ia/p < .1
Multi Family	0.23	0.18	0.20	0.20	No	Computed Ia/p < .1
VMX	0.23	0.27	0.20	0.30	No	Computed Ia/p < .1
VMX	0.21	0.34	0.20	0.30	No	Computed Ia/p < .1
VMX	0.17	0.43	0.20	0.40	No	Computed Ia/p < .1
Park	0.22	0.00	0.20	0.00	No	Computed Ia/p < .1
Road	0.22	0.00	0.20	0.00	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.

Ahukini Mauka
4-Acre Park Near School
December 13, 1994

EXECUTED 12-14-1994 09:55:32
Disk Files: C:AHU-12AD.PND ; C:AHU-12A .HYD

INITIAL CONDITIONS
Elevation = 100.00 ft
Outflow = 0.0 cfs

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
100.00	0.0	0.00
100.50	45.0	0.00
101.00	63.0	0.00
102.00	126.0	0.00
102.10	139.0	0.20
102.50	184.0	1.00
103.00	240.0	2.00
103.50	294.0	3.00
104.00	304.0	4.00

COMPUTATIONS

2S/t (cfs)	2S/t + 0 (cfs)
0.0	0.0
0.0	45.0
0.0	63.0
0.0	126.0
48.4	187.4
242.0	426.0
484.0	724.0
726.0	1020.0
968.0	1272.0

Time increment (t) = 0.100 hrs.

Pond File: C:AHU-12AD.PND
Inflow Hydrograph: C:AHU-12A .HYD
Outflow Hydrograph: C:AHU-12AD.HYD

EXECUTED: 12-14-1994
09:55:32

INFLOW HYDROGRAPH / ROUTING COMPUTATIONS

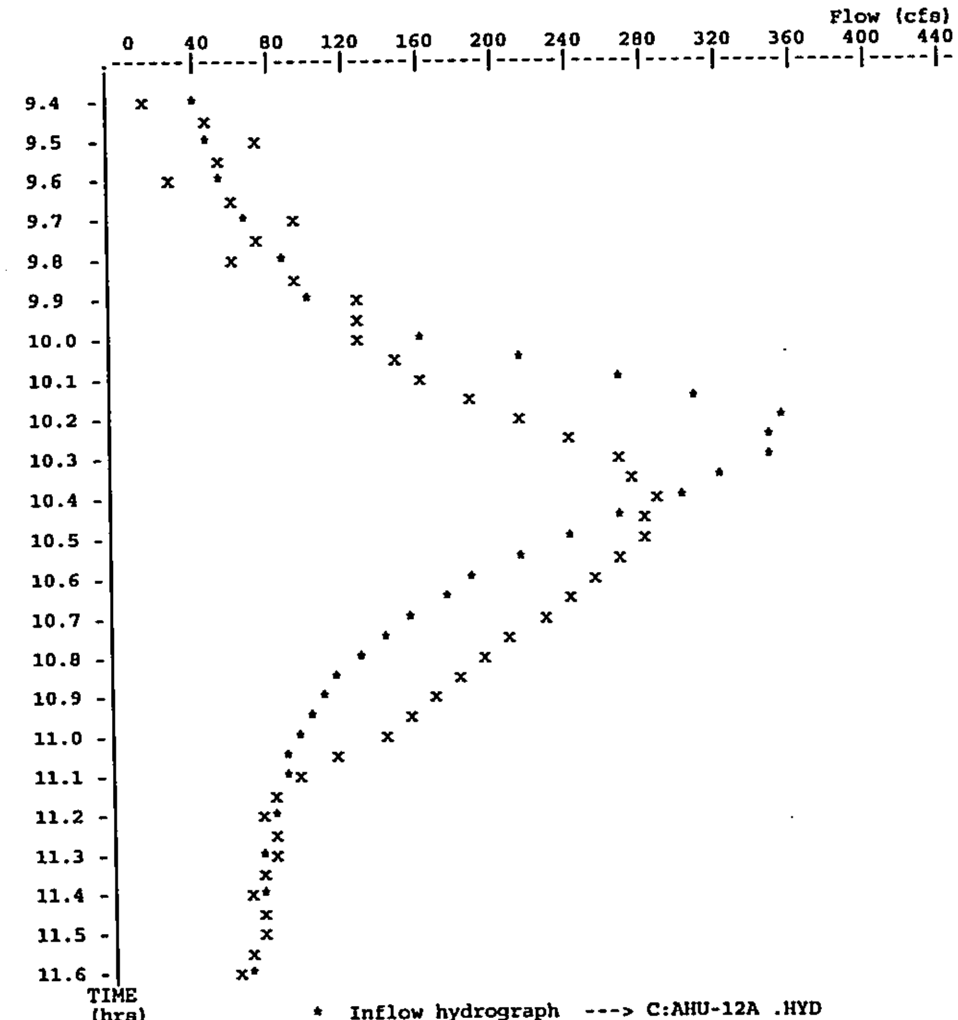
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
22.700	19.0	38.0	-23.8	23.8	23.8	100.26
22.800	19.0	38.0	-14.2	14.2	14.2	100.16
22.900	19.0	38.0	-23.8	23.8	23.8	100.26
23.000	19.0	38.0	-14.2	14.2	14.2	100.16
23.100	19.0	38.0	-23.8	23.8	23.8	100.26
23.200	18.0	37.0	-13.2	13.2	13.2	100.15
23.300	18.0	36.0	-22.8	22.8	22.8	100.25
23.400	18.0	36.0	-13.2	13.2	13.2	100.15
23.500	18.0	36.0	-22.8	22.8	22.8	100.25
23.600	18.0	36.0	-13.2	13.2	13.2	100.15
23.700	18.0	36.0	-22.8	22.8	22.8	100.25
23.800	17.0	35.0	-12.2	12.2	12.2	100.14
23.900	17.0	34.0	-21.8	21.8	21.8	100.24

Peak Inflow = 351.0 cfs
Peak Outflow = 286.4 cfs
Peak Elevation = 103.43 ft

Pond File: C:AHU-12AD.PND
Inflow Hydrograph: C:AHU-12A .HYD
Outflow Hydrograph: C:AHU-12AD.HYD

EXECUTED: 12-14-1994
09:55:32

Peak Inflow = 351.0 cfs
Peak Outflow = 286.4 cfs
Peak Elevation = 103.43 ft



* Inflow hydrograph ---> C:AHU-12A .HYD
x Outflow hydrograph ---> C:AHU-12AD.HYD

Quick TR-55 Version: 5.46 S/N: Page 1

TR-55 TABULAR HYDROGRAPH METHOD
Type I Distribution
(24 hr. Duration Storm)

Executed: 12-14-1994 09:41:39
Watershed file: --> C:\PONDPACK\AHU-12A .WSD
Hydrograph file: --> C:\PONDPACK\AHU-12A .HYD

LIHUE-HANAMAULU MASTER PLANNED COMMUNITY
AHUKINI MAUKA II
AREA BEFORE 4-ACRE DETENTION NEXT TO SCHOOL
DECEMBER 13, 1994

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
Single Family	6.70	85.0	0.20	0.20	16.50	14.50	.02	.10
Single Family	10.70	85.0	0.20	0.10	16.50	14.50	.02	.10
Multi-Family	3.00	85.0	0.20	0.10	16.50	14.50	.02	.10
VMX	2.50	92.0	0.20	0.10	16.50	15.50	.01	.10
VMX	5.00	92.0	0.20	0.00	16.50	15.50	.01	.10
School	8.00	85.0	0.20	0.00	16.50	14.50	.02	.10
Park	3.00	61.0	0.20	0.00	16.50	10.70	.08	.10
Road	4.60	92.0	0.30	0.10	16.50	15.50	.01	.10
VMX	5.00	92.0	0.20	0.30	16.50	15.50	.01	.10
Detention	2.00	98.0	0.20	0.00	16.50	16.20	0	.10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 50.50 acres or 0.07891 sq.mi
Peak discharge = 351 cfs

WARNING: Drainage areas of two or more subareas differ by a factor of 5 or greater.

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Single Family	0.20	0.20	**	**	No	Computed Ia/p < .1
Single Family	0.20	0.11	0.20	0.10	No	Computed Ia/p < .1
Multi-Family	0.17	0.10	0.20	0.10	No	Computed Ia/p < .1
VMX	0.17	0.10	0.20	0.10	No	Computed Ia/p < .1
VMX	0.17	0.00	0.20	0.00	No	Computed Ia/p < .1
School	0.21	0.00	0.20	0.00	No	Computed Ia/p < .1
Park	0.18	0.00	0.20	0.00	No	Computed Ia/p < .1
Road	0.30	0.10	**	**	No	Computed Ia/p < .1
VMX	0.22	0.30	0.20	0.30	No	Computed Ia/p < .1
Detention	0.18	0.00	0.20	0.00	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

Quick TR-55 Version: 5.46 S/N: Page 1

TR-55 TABULAR HYDROGRAPH METHOD
Type I Distribution
(24 hr. Duration Storm)

Executed: 12-14-1994 09:40:08
Watershed file: --> C:\PONDPACK\AHU-NOD6.WSD
Hydrograph file: --> C:\PONDPACK\AHU-NOD6.HYD

LIHUE-HANAMAULU MASTER PLANNED COMMUNITY
AHUKINI MAUKA I
NO DETENTION 100 year 24 hour
September 13, 1994

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
Multi-Family	13.20	85.0	0.20	1.00	16.50	14.50	.02	.10
Single Family	6.60	85.0	0.10	1.00	16.50	14.50	.02	.10
Single Family	4.30	85.0	0.20	0.75	16.50	14.50	.02	.10
Single Family	12.90	85.0	0.20	0.75	16.50	14.50	.02	.10
Single Family	10.90	85.0	0.20	0.40	16.50	14.50	.02	.10
Industrial	11.50	92.0	0.30	0.00	16.50	15.50	.01	.10
Open	9.20	61.0	0.10	0.75	16.50	10.70	.08	.10
Open	17.10	61.0	0.30	0.75	16.50	10.70	.08	.10
Single Family	8.80	85.0	0.10	0.75	16.50	14.50	.02	.10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 94.50 acres or 0.14766 sq.mi
Peak discharge = 386 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Multi-Family	0.23	0.93	0.20	1.00	No	Computed Ia/p < .1
Single Family	0.16	0.93	0.10	1.00	No	Computed Ia/p < .1
Single Family	0.20	0.83	0.20	0.75	No	Computed Ia/p < .1
Single Family	0.24	0.70	0.20	0.75	No	Computed Ia/p < .1
Single Family	0.17	0.40	0.20	0.40	No	Computed Ia/p < .1
Industrial	0.34	0.00	0.30	0.00	No	Computed Ia/p < .1
Open	0.14	0.70	0.10	0.75	No	Computed Ia/p < .1
Open	0.37	0.72	0.30	0.75	No	Computed Ia/p < .1
Single Family	0.16	0.70	0.10	0.75	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type I Distribution
(24 hr. Duration Storm)

Executed: 12-19-1994 09:41:27
Watershed file: --> C:\PONDPACK\AMAKAI-F.WSD
Hydrograph file: --> C:\PONDPACK\AMAKAI-F.HYD

LIHUE-HANMAULU MASTER PLANNED COMMUNITY
AHUKINI MAKAI
FUTURE CONDITION
September 13, 1994

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
DA 1	20.20	92.0	0.40	0.20	16.50	15.50	.01	.10
DA 2	20.00	92.0	0.30	0.20	16.50	15.50	.01	.10
DA 3	17.10	92.0	0.20	0.00	16.50	15.50	.01	.10
DA 4	23.40	92.0	0.30	0.10	16.50	15.50	.01	.10
DA 5	43.10	75.0	0.40	0.00	16.50	13.00	.04	.10
DA 6	20.00	92.0	0.20	0.00	16.50	15.50	.01	.10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 143.80 acres or 0.2247 sq.mi
Peak discharge = 909 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	* Tt (hr)	Rounded Values Tc (hr)	* Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
DA 1	0.36	0.19	0.40	0.20	No	Computed Ia/p < .1
DA 2	0.33	0.21	0.30	0.20	No	Computed Ia/p < .1
DA 3	0.24	0.00	0.20	0.00	No	Computed Ia/p < .1
DA 4	0.28	0.10	0.30	0.10	No	Computed Ia/p < .1
DA 5	0.35	0.00	0.40	0.00	No	Computed Ia/p < .1
DA 6	0.24	0.00	0.20	0.00	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type I Distribution
(24 hr. Duration Storm)

Executed: 12-19-1994 09:40:55
Watershed file: --> C:\PONDPACK\HANAMAU .WSD
Hydrograph file: --> C:\PONDPACK\HANAMAU .HYD

LIHUE-HANAMAULU MASTER PLANNED COMMUNITY
HANAMAULU
FUTURE CONDITION
September 13, 1994

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
sf	25.00	85.0	0.20	0.00	16.50	14.50	.02	.10
mf	4.00	85.0	0.20	0.00	16.50	14.50	.02	.10
road	1.00	92.0	0.10	0.00	16.50	15.50	.01	.10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 30.00 acres or 0.04688 sq.mi
Peak discharge = 274 cfs

WARNING: Drainage areas of two or more subareas
differ by a factor of 5 or greater.

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	* Tt (hr)	Rounded Values Tc (hr)	* Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
sf	0.20	0.00	**	**	No	Computed Ia/p < .1
mf	0.20	0.00	**	**	No	Computed Ia/p < .1
road	0.10	0.00	**	**	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

KODANI AND ASSOCIATES, INC.
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SOIL LOSS TABLES AND CHARTS

PLATE 6A, STORM DRAINAGE STANDARDS

TABLE 14. SOIL PROPERTIES RELATED TO EROSION AND SEDIMENTATION FOR THE ISLANDS OF KAUAI, OAHU, MAUI, MOLOKAI, AND LANAI (Continued)

Soil Symbol	Soil Series	Erodibility Factor(K)	Hydrologic Classification	Erosion Resistant Group	Tolerance Value(T) t/A/yr.	Tolerance Value(T) t/ha./yr.
IaA, IaB, IbB, IbC, IcB, IcC	Iao	0.17	C	II	5	2.0
ISD	Io	0.17	B	IV	2	0.8
IoB, IoC, IoD2, IoE2	Ioleau	0.10	C	I	5	2.0
JaC, JcC, JfB, JkB	Jaucas	0.10	A-1	IV	5	2.0
JL	Jaucas-Blown out land	0.17	A-D			
KaB, KaC, KaeB, KaeC, KaeD, KanE, KavB, KavC	Kaena	0.28	D	II	5	2.0
KhB, KhC, KhD	Kahana	0.17	B	II	5	2.0
KASD, KAYD	Kahanui	0.10	B	I	3	1.2
KBID	Kailua	0.05	A	I	5	2.0
KCID	Kaimu	0.05	A-1	I	1	0.4
KDIE, KDYE	Kaipoioi	0.17	B	III	5	2.0
KcB, KcC, KcC3, KcD3, KcE3	Kalae	0.10	B	I	5	2.0
KdD, KdE, KdF, KEFH	Kalapa	0.10	B	I	5	2.0
KFID	Kalaupapa	0.17	D	IV	1	0.4
Ke	Kalihi	0.28	D	II	5	2.0
Kf, Kfa, Kfb	Kaloko	0.17	D	II	5	2.0
KGKC, KGLC	Kamaole	0.17	B	III	1	0.4
KgB, KgC, KHDF, KHDC, KHDE, KHNF	Kaneohe	0.17	B	I	5	2.0
KhB, KhB2, KhC, KhC2	Kaneepuu	0.17	B	II	5	2.0
KlB, KlC, KlD, KlE, KlG	Kapaa	0.10	A	II	5	2.0
KKTC	Kapuhikani	0.28	D	II	2	0.8
KLUD, KLVD	Kaupo	0.17	A	IV	2	0.8
KIA, KIB, KIC, KlaA, KlaB, KlbC, KlcB	Kawaihapai	0.17	B	II	5	2.0
KmA, KmaB, KmbA	Keaau	0.28	D	II	5	2.0
KnB, KnC, KnaB, KnaC, KnaD, KnbD, KncC, KnbC, KnzC	Keahua	0.17	B	II	5	2.0
KM	Kealia	0.17	D	IV	5	2.0
KNID	Keawakapu	0.28	B	III	1	0.4
KoA, KoB, KobA, KOYE	Kekaha	0.28	B	IV	5	2.0
KpB, KpC, KpD, KpE, KpF	Kemoo	0.17	B	II	5	2.0
KPZ	Kemoo-Badland	0.43	B-C			
KrB, KrC, KrD	Koele	0.17	B	II	5	2.0
KRL	Koele-Badland	0.43	B-C			
KRS	Koele-rocky	0.28	B-D			
KSKE, KSKF	Kokee	0.10	B	I	3	1.2
KsB, KsC, KsD	Koko	0.17	B	IV	3	1.2
KtC, KTKE	Kokokahi	0.28	D	II	5	2.0
KuB, KuC, KuD	Kolekole	0.17	C	III	5	2.0
KvB, KvC, KvD	Koloa	0.17	C	I	2	0.8
Kw, KWL	Kolokolo	0.28	B	III	5	2.0
KVSB, KVSE	Koolau	0.28	C	II	5	2.0
KxC, KxD, KxaD, KxbE	Kula	0.17	B	IV	3	1.2
KyA, KyB, KyC	Kunia	0.17	B	II	5	2.0
KZC	Kunuweia	0.10	C	I	5	2.0
LaA, LaB, LaB3, LaC, LaC3, LaD, LaD3, LaE3	Lahaina	0.17	B	II	5	2.0
LUE, LUF, LUC	Laumaia	0.17	B	III	5	2.0
rLW	Lava flows, Aa	0.0	A-1			
LcB, LcC, LcD	Lawai	0.10	B	I	5	2.0
LeB, LeC	Leilehua	0.10	B	I	5	2.0
LhB, LhC, LhD, LhE2, LIB, LIC	Lihue	0.17	B	II	5	2.0
LoB, LoC, LoD, LoE, LoF	Lolekaa	0.17	B	I	5	2.0
LuA, LuB, LvA, LvB, LPE	Lualualei	0.28	D	II	5	2.0
MaC, MaD, MaD3, MaE, MaE3	Mahana	0.43	B	IV	5	2.0
McC2, McD2, McE2	Mahana	0.37	B	IV	5	2.0
MBL	Mahana-Badland	0.49	B-C			

Table 16. Slope-effect (LS) values[1]

Percent slope	Slope length (feet) 25	50	75	100	150	200	300	400	500	600	800	1,000
0.5	0.065	0.080	0.091	0.099	0.112	0.122	0.138	0.150	0.160	0.169	0.185	0.197
1	.085	.105	.119	.129	.146	.159	.180	.196	.210	.222	.242	.258
2	.133	.163	.185	.201	.227	.248	.280	.305	.326	.344	.376	.402
3	.190	.233	.264	.287	.325	.354	.400	.437	.466	.492	.536	.573
4	.230	.303	.357	.400	.471	.528	.621	.697	.762	.820	.920	1.01
5	.268	.379	.464	.536	.656	.758	.923	1.07	1.20	1.31	1.52	1.69
6	.336	.476	.583	.673	.824	.952	1.17	1.35	1.50	1.65	1.90	2.13
8	.496	.701	.859	.992	1.21	1.40	1.72	1.98	2.22	2.43	2.81	3.14
10	.655	.968	1.19	1.37	1.68	1.94	2.37	2.74	3.06	3.36	3.87	4.33
12	.903	1.28	1.56	1.80	2.21	2.55	3.13	3.61	4.04	4.42	5.11	5.71
14	1.15	1.62	1.99	2.30	2.81	3.25	3.98	4.59	5.13	5.62	6.49	7.26
16	1.42	2.01	2.46	2.84	3.48	4.01	4.92	5.68	6.35	6.95	8.03	8.98
18	1.72	2.43	2.97	3.43	4.21	4.86	5.95	6.87	7.68	8.41	9.71	10.9
20	2.04	2.88	3.53	4.08	5.00	5.77	7.07	8.16	9.12	10.0	11.5	12.9
25	2.95	4.17	5.10	5.89	7.22	8.33	10.2	11.8	13.2	14.4	16.7	18.6
30	3.98	5.62	6.89	7.95	9.74	11.2	13.8	15.9	17.8	19.5	22.5	25.2
40	6.33	8.95	11.0	12.7	15.5	17.9	21.9	25.3	28.3	31.0	—	—
50	8.91	12.6	15.4	17.8	21.8	25.2	30.9	—	—	—	—	—
60	11.6	16.4	20.0	23.1	28.4	—	—	—	—	—	—	—

1. Based on the formula:

$$LS = \left(\frac{\lambda}{72.6}\right)^m \left(\frac{430x^2 + 30x + 0.43}{6.57415}\right)$$

where m = 0.5 if s = 5% or greater, 0.4 if s = 4%, and 0.3 if s = 3% or less; and x = sin θ.

Values shown for slopes of less than 3%, greater than 18%, or longer than 400 feet, represent extrapolations of the formula beyond the range of research data.

Table 17. C values for sugarcane[1]

24-month, irrigated	0.10
24-month, dryland	0.13
27-month, dryland	0.15
30-month, dryland	0.16
36-month, dryland	0.16

1. Where cane residue covers the soil evenly at a rate of 2,000 pounds per acre or more, reduce "C" value by 50 percent.

Reference: USDA-Soil Conservation Service, Technical Note, Agronomy No. 7, "Estimating Crop Residue on Sugarcane Land," December 1976.

Table 18. C values for diversified agricultural crops

Type of Crop	Clean-tilled Operation	Green-manure crop or weed cover utilized
Vine Crops	0.30	0.20
Leafy vegetables	0.36	0.25
Corn	0.40	0.30
Head vegetables	0.40	0.30
Root crops	0.45	0.25

Table 21. Values for woodland

Stand condition	Percent tree[1] Canopy	Forest litter percent[2] of area	Undergrowth[3]	C Factor
Well stocked	100–75	100–90	Managed[4]	.001
			Mismanaged[4]	.003–.011
Medium stocked	70–40	85–75	Managed	.002–.004
			Mismanaged	.01–.04
Poorly stocked	35–20	70–40	Managed	.003–.009
			Mismanaged	.02–.09[5]

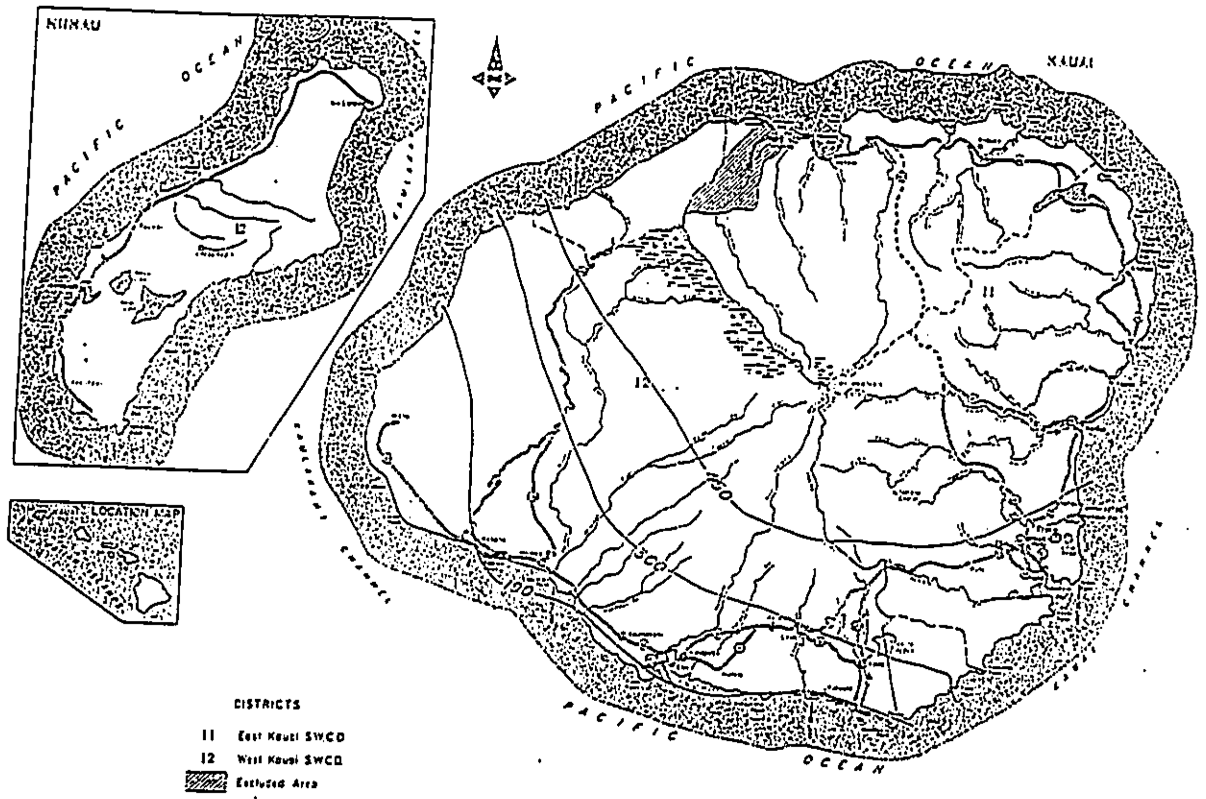
1. When tree canopy is less than 20 percent, the area will be considered as grassland for estimating soil loss.
2. Forest litter is assumed to be at least 2 inches deep over the percent ground surface area covered.
3. Undergrowth (usually found under canopy openings) is defined as shrubs, weeds, grasses, vines, etc., on the surface area not protected by forest litter.
4. Managed: grazing and fires are controlled.
Mismanaged: stands that are overgrazed or subjected to repeated burning.
5. For mismanaged woodland with litter cover of less than 75 percent, C values should be derived by taking 0.7 of the appropriate values. The factor of 0.7 reflects the higher organic-matter content in woodland soils.

Table 22. C values for ground cover

Kind of Ground Cover	Value
Grass Sod	.01
Seedlings (*fully established* stand):	
Permanent grasses (rhizomatous or stoloniferous)	.01
Field bromegrass	.03
Ryegrass (perennial)	.05
Small grain	.05
Millet or sudangrass	.05
Ryegrass (annual)	.10
Mulches:	
Bagasse (2 tons/acre)	.02
Hay (2 tons/acre)	.02
Small grain straw (2 tons/acre)	.02
Woodchips (6 tons/acre)	.06
Wood cellulose fiber (1¾ tons/acre)	.10
Bare soil	1.00

Table 23. P value for erosion control practice

Percent slope	Up & down slope farming	Contour planting	Contour irrigation furrows	Cross slope farming
2.0–7.0	1.00	0.50	0.25	0.75
7.1–12	1.00	.60	.30	.80
12.1–18	1.00	.80	1.00	.90
18.1–24	1.00	.90	1.00	.95
Above 24	1.00	1.00	1.00	1.00



AVERAGE ANNUAL VALUES OF RAINFALL FACTOR, R
SOIL AND WATER CONSERVATION DISTRICTS
KAUAI COUNTY
ISLANDS OF KAUAI AND NIHAU, HAWAII

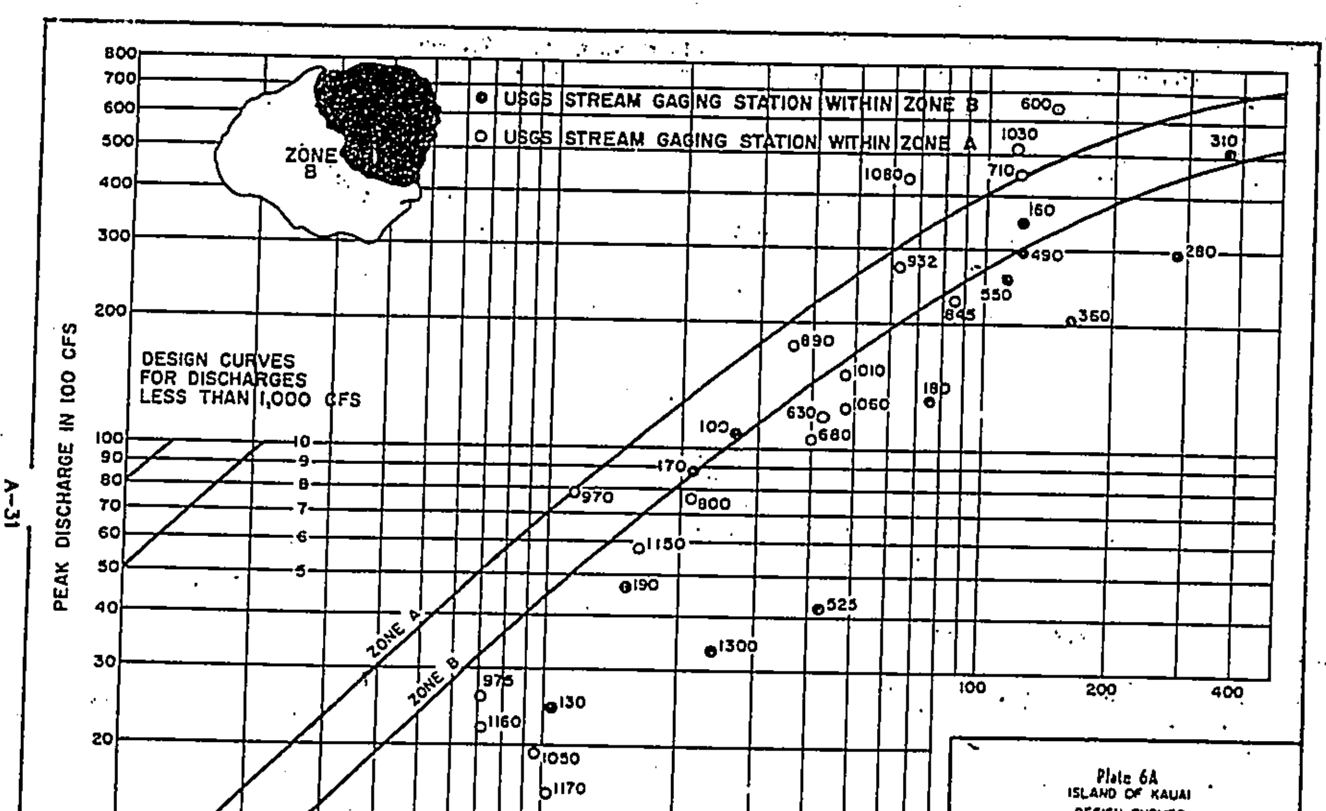
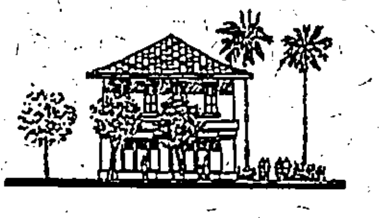


Plate 6A
ISLAND OF KAUAI
DESIGN CURVES
FOR
100-YEAR PEAK DISCHARGES
VS
DRAINAGE AREA

E

Traffic Impact Report
for the Proposed Lihue-Hanamaulu Master Plan Development



TRAFFIC IMPACT REPORT

FOR THE PROPOSED

LIHUE-HANAMAULU MASTER PLAN DEVELOPMENT

ISLAND OF KAUAI

PREPARED FOR

AMFAC/JMB HAWAII, INC.

Prepared By

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
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January 1995

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

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EXECUTIVE SUMMARY

I. INTRODUCTION

The Lihue-Hanamaulu Master Plan provides for a range of residential and village mixed uses on 555 acres of land located at Lihue and Hanamaulu, Kauai. Four geographic areas of the Master Plan include Molokoa, Ahukini Mauka, Ahukini Makai and Hanamaulu. Development is projected to be over a 15 to 20 year period and is planned to be flexible in responding to future community needs. The Master Plan components include single and multi-family residential uses, public and quasi-public facilities, village mixed-use, light industrial development and parks and open space. The village mixed use areas within Molokoa and Ahukini Mauka envision a variety of retail and office uses that would form the village core of the community.

The purpose of the study is to analyze potential development-generated traffic impacts on the roadway system within the study area. Proposed roadway improvements, which are required to allow the street and highway system to accommodate the future traffic volumes after the completion of the development, are identified in this study. The following traffic scenarios are analyzed in the study:

- Existing Conditions
- Year 2006 Base Conditions (Without Project)
- Year 2006 With Project Conditions
- Year 2016 Base Conditions (Without Project)
- Year 2016 With Project Conditions

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WAILUKU, MAUI, HAWAII • HILO, HAWAII

Seven existing intersections and three future intersections have been selected to be analyzed under the above traffic scenarios. The analyzed intersections are as follows:

Existing Intersections:

- Kuhio Highway and Kaumualii Highway/Rice Street (signalized)
- Hoolako Street and Rice Street (stop-controlled)
- Kapule Highway and Rice Street (stop-controlled)
- Kuhio Highway and Ahukini Road (signalized)
- Kapule Highway and Ahukini Road (signalized)
- Kapule Highway and Kuhio Highway (signalized)
- Kapule Highway and Post Office Driveway/future Kaana Street extension (stop-controlled)

Future Intersections:

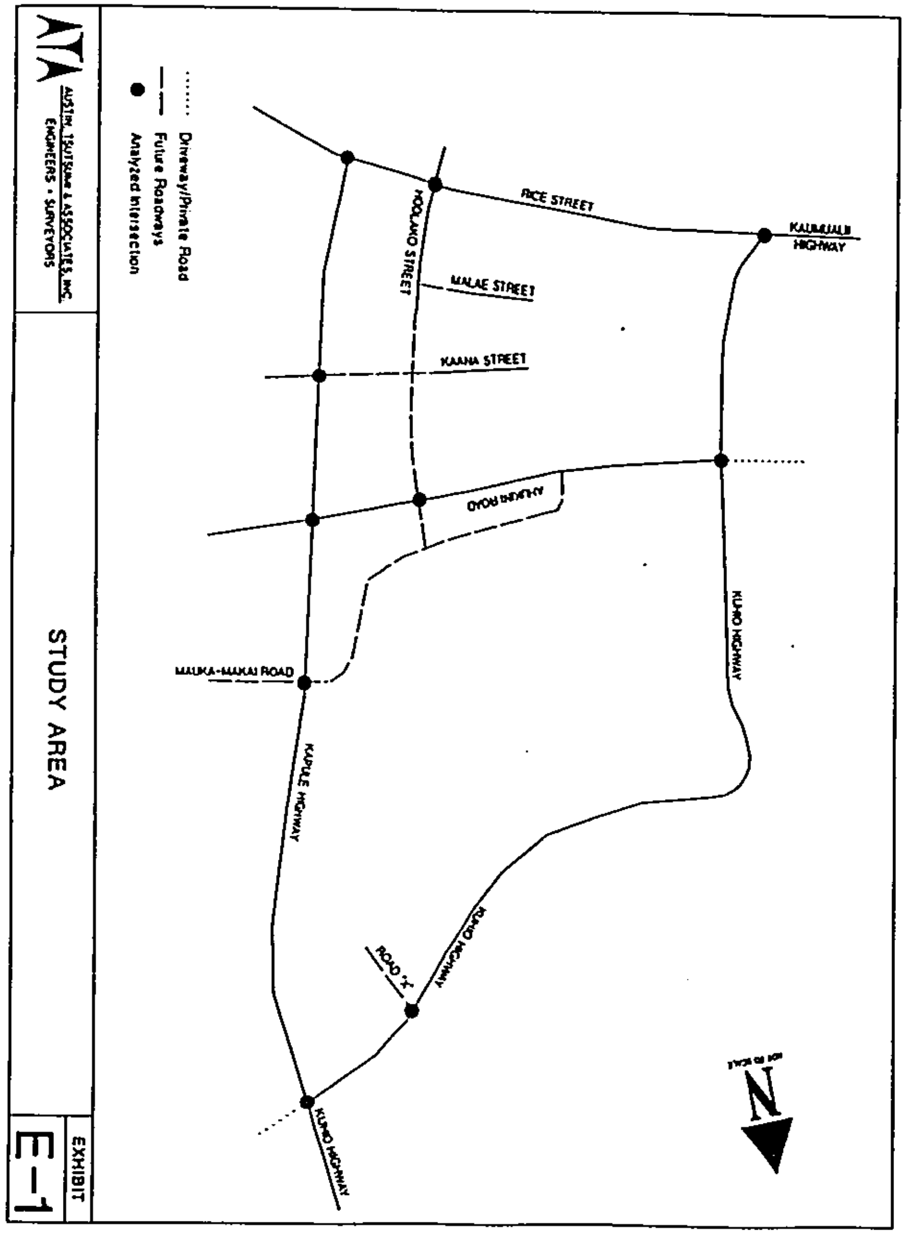
- Hoolako Street Extension and Ahukini Road
- Kapule Highway and Mauka-Makai Road
- Road "X" (from Hanamaulu II development) and Kuhio Highway

Exhibit E-1 illustrates the study area and the locations of the analyzed intersections.

II. EXISTING CONDITIONS

Existing traffic volumes within the study area are relatively moderate with few traffic problems. Under existing conditions, the following intersections are currently operating at LOS E or F during either the AM or PM peak hour or both.

- Kuhio Highway and Kaumualii Highway/Rice Street
- Hoolako Street and Rice Street



- Kapule Highway and Rice Street
- Kapule Highway and Ahukini Road

The delay experienced by the four intersections are caused by localized physical constraints and can be mitigated with intersection improvements.

III. YEAR 2006 TRAFFIC IMPACT ANALYSIS

In order to properly evaluate the potential impact of the proposed Lihue-Hanamaulu Master Plan Development on local traffic conditions, it is necessary to develop forecasts of future traffic conditions in the study area under cases both with and without the proposed project traffic. The following traffic scenarios are analyzed:

- Year 2006 base (without project)
- Year 2006 with project
- Year 2006 base with improvements
- Year 2006 with project, base improvements and project mitigation.

A. Year 2006 Base (without Project) Traffic Impact Analysis

Traffic in the Lihue-Hanamaulu area is expected to increase and overall growth in the study area, without the Lihue Hanamaulu Master Plan Development, will result in long vehicular delay at most major intersections.

B. Year 2006 With Project Traffic Impact Analysis

As mentioned above, under the Year 2006 Base without project, the overall growth in the Lihue area will increase the traffic demand on the existing roadway system within the study area, resulting in long vehicular delay at most intersections. With the addition of the Lihue-Hanamaulu Master Plan Development traffic, vehicular delay will increase.

C. Year 2006 Base With Improvements

The following roadway improvements are recommended to accommodate the Year 2006 traffic demand without the proposed Lihue-Hanamaulu Development. The improvements are from the "Lihue Corridor Improvement Package" as recommended in the 1990 "Kauai Highway Planning study" by Kaku Associates, Inc.:

- The widening of Kuhio Highway to four lanes from south of Wailua Bridge to Kapule Highway.
- The widening of Kapule Highway to four lanes from Kuhio Highway to Ahukini Road. This will include widening of the existing bridge over Hanamaulu Stream or the construction of a parallel bridge.

As a result of this study, the following additional roadway improvements are recommended to accommodate background traffic growth (without project) to the Year 2006 in the Lihue area:

- The widening of Kapule Highway to four lanes from Ahukini Road to Rice Street.
- Realignment of Kapule Highway and the east-leg of Rice Street to become the major through street while the west-leg of Rice Street will terminate as a T-intersection at Kapule Highway.
- Widen Rice Street to four lanes through Lihue Town (between Kuhio/Kaumualii Highway and to a point east of Kapule Highway)
- At the intersection of Kuhio Highway and Ahukini Road, provide the southbound approach with an exclusive left-turn lane and the northbound approach with an exclusive right-turn lane.
- Signalization of the following intersections:
  - Kapule Highway and Rice Street
  - Hoolako Street and Rice Street

  - Kapule Highway and Post Office Driveway
  - Kuhio Highway and Road "X"

Analysis indicates that, under the Year 2006 base with recommended improvements, all analyzed intersections will be operating at acceptable level of service (i.e. LOS D or better) during both AM and PM peak hours.

D. Year 2006 With Project, Recommended Base Improvements and Project Mitigation

The impact of the project generated traffic on the Year 2006 traffic conditions were analyzed assuming the implementation of the base improvements described above. With the implementation of the recommended base improvements, only the intersection of Kuhio Highway and Ahukini Road will be operating at LOS F (PM peak hour only).

To accommodate the Year 2006 project generated traffic, the following mitigation measures are recommended:

- An additional westbound left-turn lane on Ahukini Road, at the intersection of Kuhio Highway and Ahukini Road is recommended. With this recommended project mitigation, the intersection will operate at LOS B during the FM peak hour of traffic.
- Although the intersection of Hoolako Street and Rice Street is estimated to be operating at UNDER capacity with the widening of Rice Street to four lanes, an additional eastbound left-turn lane and an exclusive westbound right-turn lane on Rice Street are recommended to accommodate the high eastbound left-turn and westbound right-turn traffic, respectively.

With the implementation of the recommended base improvements and project mitigation, all analyzed intersections will be operating at acceptable levels of service (i.e. LOS D or better).

IV. YEAR 2016 TRAFFIC IMPACT ANALYSIS

In order to properly evaluate the potential impact of the proposed Lihue-Hanamaulu Master Plan Development on local traffic conditions in the Year 2016, it is necessary to develop forecasts of future traffic conditions in the study area under cases both with and without the proposed development traffic. The following traffic scenarios are analyzed:

- Year 2016 base (without project)
- Year 2016 with project
- Year 2016 base with improvements
- Year 2016 with project, base improvements and project mitigation.

A. Year 2016 Base (without Project) Traffic Impact Analysis

Traffic in the Lihue-Hanamaulu area is expected to increase and overall growth in the study area, without the Lihue Hanamaulu Master Plan Development, will result in long vehicular delay at most major intersections.

B. Year 2016 With Project Traffic Impact Analysis

As mentioned above, under the Year 2016 Base without project, the overall growth in the Lihue area will increase the traffic demand on the existing roadway system within the study area, resulting in long vehicular delay at most intersections. With the addition of the Lihue-Hanamaulu Master Plan Development traffic, vehicular delay will increase.

C. Year 2016 Base With Improvements

The following roadway improvements are recommended to be implemented to accommodate the Year 2016 traffic demand <u>without</u> the proposed Lihue-Hanamaulu Master Plan Development as recommended in the 1990 "Kauai Highway Planning Study".

- The widening of Kuhio Highway to four lanes from south of Wailua Bridge to Kapule Highway.
- The widening of Kapule Highway to four lanes from Kuhio Highway to Ahukini Road. This will include the widening of the existing bridge over Hanamaulu Stream or the construction of a parallel bridge to the existing bridge.
- The construction of a mauka Lihue bypass highway from the vicinity north of the intersection of Kapule Highway and Kuhio Highway and extending southwest, connecting at Kaumualii Highway west of Puhi.
- The realignment and widening of Ahukini Road to four lanes from Kapule Highway to Kuhio Highway. Although no alignment has been determined, possible realignment of Ahukini Road with Ehiku Street via the cane-haul road may be the most feasible option.
- The extension of the four-lane Ahukini Road mauka from Kuhio Highway to the future bypass highway.

As a result of this study, the following are additional roadway and intersection improvements recommended to accommodate background traffic growth (without project) to the Year 2016:

- The widening of Kapule Highway to four lanes from Ahukini Road to Rice Street.
- Realignment of Kapule Highway and the east-leg of Rice Street to become the major through street while the west-leg of Rice Street will terminate as a T-intersection at Kapule Highway/Rice Street.
- Widening of Rice Street to four lanes through Lihue Town (between Kuhio/Kaumualii Highway and to a point east of Kapule Highway)
- Signalization of the following intersections:
  - Kapule Highway and Rice Street

- Hoolako Street and Rice Street
- Kapule Highway and Post Office Driveway
- Kuhio Highway and Road "X".

Under the Year 2016 base (without project) with recommended improvements, all analyzed intersections will be operating at acceptable level of service (i.e. LOS D or better) during both AM and PM peak hours.

D. **Year 2016 With Project, Recommended Base Improvements and Project Mitigation**

The Year 2016 with project generated traffic scenario was analyzed assuming the implementation of the Year 2016 base improvements described above. With the implementation of the recommended Year 2016 base improvements, only the intersection of Kuhio Highway and Ahukini Road will be operating at LOS F during the PM peak hour. The remaining nine intersections will be operating at acceptable level of service (i.e. LOS D or better).

The following mitigation measures are recommended to accommodate the Year 2016 project generated traffic:

- At the intersection of Kuhio Highway and Ahukini Road, provided each of the approaches with dual, exclusive left-turn lanes. In addition, provide the northbound approach with a dual exclusive right-turn lane from Kuhio Highway to Ahukini Road. With the implementation of the recommended mitigation, the intersection of Kuhio Highway and Ahukini Road will be operating at LOS D during the PM peak hour.
- Although the intersection of Hoolako Street and Rice Street is estimated to be operating at Under and Near capacity (AM and PM peak hour, respectively), under the Year 2016 with project and base improvements, an additional exclusive eastbound left-turn lane and

exclusive westbound right-turn lane on Rice Street are recommended to accommodate the high eastbound left-turn and westbound right-turn traffic, respectively.

With the implementation of the recommended base improvements and project mitigation, all ten analyzed intersections will be operating at acceptable levels of service (i.e. LOS D or better).

V. CONCLUSIONS AND RECOMMENDATIONS

This study was undertaken to analyze the potential traffic impacts of the proposed Lihue-Hanamaulu Master Plan Development. The following summarizes the conclusions and recommendations of the study.

A. Conclusions

- Existing traffic entering Lihue Town is moderate and is presently accommodated without significant vehicular delays.
- Under existing conditions, four of the seven analyzed intersections are operating at LOS E or F during either the AM or PM peak hours, or both.
- By the Year 2006, the Proposed Lihue-Hanamaulu Development will generate a total of 2,120 vehicular trips during the AM peak hour of traffic and a total of 3,225 vehicular trips during the PM peak hour of traffic.
- By the Year 2016, the Proposed Lihue-Hanamaulu Development will generate a total of 3,755 vehicular trips during the AM peak hour of traffic and a total of 5,890 vehicular trips during the PM peak hour of traffic.
- Approximately 40% of the traffic generated by the development's residential uses will remain in the combined Lihue/Nawiliwili Harbor area. The remaining 60% of traffic generated by residential use will

be outbound (from Lihue) and will be travelling against the peak inbound (into Lihue) traffic.

- Approximately 30% of the traffic generated by retail and office uses will be from within the Lihue area.
- Under Year 2006 Base (without project) conditions, seven of the eight analyzed intersections will be operating at LOS E, F or OVER capacity during either the AM or PM peak hour or both. The forecasted traffic demand on the existing major roadways (without base improvements) in Lihue will exceed the traffic handling capacity.
- Under Year 2006 With Project conditions (without base improvements or project mitigation), seven of the ten analyzed intersections will be operating at LOS E, F or OVER capacity during either the AM or PM peak hour, or both.
- Under Year 2016 Base (without project) conditions, seven of the eight analyzed intersections will be operating at LOS E, F or OVER capacity during either the AM or PM peak hour or both. The forecasted traffic demand on the existing major roadways (without base improvements) in Lihue will exceed the traffic handling capacity.
- Under Year 2016 With Project conditions (without base improvements or project mitigation), all ten analyzed intersections will be operating at LOS E, F or OVER capacity during either the AM or PM peak hour, or both.

B. **Recommendations**

- Based on the October 1990 "Kauai County Highway Planning Study" prepared by Kaku Associates, Inc., the following base roadway improvements are recommended to accommodate Year 2006 base (without project) traffic demand within the study area.

1. The widening of Kuhio Highway to four lanes from south of Wailua Bridge to Kapule Highway.
2. The widening of Kapule Highway to four lanes from Kuhio Highway to Ahukini Road.

As a result of this study, the following are additional base improvements recommended to alleviate Year 2006 Base (without project) traffic:

1. The widening of Kapule Highway to four lanes from Ahukini Road to Rice Street.
2. Realignment of Kapule Highway and the east-leg of Rice Street to become the major through street while the west-leg of Rice Street will terminate as a T-intersection at Kapule Highway/Rice Street.
3. Widening of Rice Street to four lanes through Lihue Town.
4. At the intersection of Kuhio Highway and Ahukini Road, provide the southbound approach with an exclusive left-turn lane and the northbound approach with an exclusive right-turn lane.
5. Signalization of the following intersections:
   - Kapule Highway and Rice Street
   - Hoolako Street and Rice Street
   - Kapule Highway and Post Office Driveway
   - Kuhio Highway and Road "X".

In addition, the following project mitigation are required to accommodate the Year 2006 with project traffic.

1. At the intersection of Kuhio Highway and Ahukini Road, provide the westbound approach on Ahukini Road with an additional left-turn lane. The westbound approach will include two exclusive left-turn lanes and one right-turn lane.

2. At the intersection of Hoolako Street and Rice Street, provide the westbound approach on Rice Street with an exclusive right-turn lane. The westbound approach will include one exclusive left-turn lane, two through lanes, and one exclusive right-turn lane. Also, provide the eastbound approach on Rice Street with an additional exclusive left-turn lane. The eastbound approach will include two exclusive left-turn lanes, one through lane and one shared through and right-turn lane.

With the base improvements and project mitigation described above, all ten analyzed intersections will be operating at acceptable level of service (i.e. LOS D or better) under the Year 2006 with project traffic conditions.

- The following describes the recommended intersection configurations at intersections with project access roadways and existing roadways under the Year 2006 with project traffic conditions:

  Ahukini Road And Hoolako Street - Signalize the intersection and provide both the northbound and southbound approaches on Hoolako Street with one exclusive left-turn lane, one through lane and one exclusive right-turn lane. Provide both the eastbound and westbound approaches on Ahukini Road with one exclusive left-turn lane and one exclusive right-turn lane from Ahukini Road to Hoolako Street.

  Kapule Highway And Kaana Street - Signalize the intersection and provide the eastbound approach on Kaana Street with one shared left-turn and through lane and one exclusive right-turn lane. Provide

the northbound approach on Kapule Highway with an exclusive left-turn and the southbound approach with an exclusive right-turn lane from Kapule Highway to Kaana Street.

Kapule Highway And Mauka-Makai Road - Signalize the intersection and provide the westbound approach on the Mauka-Makai Road with one exclusive left-turn lane and one exclusive right-turn lane. Also, provide the northbound approach on Kapule Highway with an exclusive right-turn lane and the southbound approach with an exclusive left-turn lane.

Kuhio Highway And Road "X" - Signalize the intersection and provide the northbound approach on Road "X" with an exclusive left-turn lane and an exclusive right-turn lane. Also, provide the westbound approach on Kuhio Highway with an exclusive left-turn lane and an exclusive right-turn lane in the eastbound approach.

- Based on the October 1990 "Kauai County Highway Planning Study" prepared by Kaku Associates, Inc., the following base roadway improvements are recommended to accommodate Year 2016 base (without project) traffic demand through Lihue Town.

1. The widening of Kuhio Highway to four lanes from south of Wailua Bridge to Kapule Highway.
2. The widening of Kapule Highway to four lanes from Kuhio Highway to Ahukini Road.
3. The construction of a mauka bypass highway from the vicinity north of the intersection of Kapule Highway at Kuhio Highway and extending southwest, connecting at Kaumualii Highway west of Puhi.
4. The realignment and widening of Ahukini Road to four lanes from Kapule Highway to the Kuhio Highway. Although no

alignment has been determined, possible realignment of Ahukini Road with Ehiku Street via the cane-haul road may be the most feasible option.

5. The extension of the four-lane Ahukini Road mauka from Kuhio Highway to the future bypass highway.

As a result of this study, the following are additional base improvements recommended to alleviate Year 2016 Base (without project) traffic conditions:

1. The widening of Kapule Highway to four lanes from Ahukini Road to Rice Street.
2. Realignment of Kapule Highway and the east-leg of Rice Street to become the major through street while the west-leg of Rice Street will terminate as a T-intersection at Kapule Highway/Rice Street.
3. Widening of Rice Street to four lanes through Lihue Town.
4. Signalization of the following intersections:
   - Kapule Highway and Rice Street
   - Hoolako Street and Rice Street
   - Kapule Highway and Post Office Driveway
   - Kuhio Highway and Road "X".

In addition, the following project mitigation are required to accommodate the Year 2016 With Project traffic.

1. At the intersection of Kuhio Highway and Ahukini Road, provide double, exclusive left-turn lanes at all approaches to the intersection. In addition, provide the northbound

approach with double, exclusive right-turn lane from Kuhio Highway to Ahukini Road.

2. At the intersection of Hoolako Street and Rice Street, provide the westbound approach on Rice Street with an exclusive right-turn lane. The westbound approach will include one exclusive left-turn lane, two through lanes, and one exclusive right-turn lane. Also, provide the eastbound approach on Rice Street with an additional exclusive left-turn lane. The eastbound approach will include two exclusive left-turn lanes, one through lane and one shared through and right-turn lane.

With the base improvements and project mitigation described above, all ten analyzed intersections will be operating at acceptable level of service (i.e. LOS D or better) under the Year 2016 with project traffic conditions.

- The following describes the recommended intersection configurations at intersections with project access roadways and existing roadways under the Year 2016 traffic conditions:

  Ahukini Road And Hoolako Street - Signalize the intersection and provide the northbound approach on Hoolako Street with two exclusive left-turn lanes, one through lane and an exclusive right-turn lane. Provide the southbound approach on Hoolako Street with an exclusive left-turn lane, one through lane and an exclusive right-turn lane. Provide the eastbound approach on Ahukini Road with two exclusive left-turn lanes and one exclusive right-turn lane to Hoolako Street. Also, provide the westbound approach on Ahukini Road with an exclusive left-turn lane and an exclusive right-turn lane to Hoolako Street.

  Kapule Highway And Kaana Street - Signalize the intersection and provide the eastbound approach on Kaana Street with one shared left-turn and through lane and an exclusive right-turn lane. Provide the northbound approach on Kapule Highway with an exclusive left-turn and the southbound approach with an exclusive right-turn lane from Kapule Highway to Kaana Street.

Kapule Highway And Mauka-Makai Road - Signalize the intersection and provide the westbound approach on the Mauka-Makai Road with one exclusive left-turn lane, one shared left-turn and through lane and one exclusive right-turn lane. Provide the eastbound approach on the Mauka-Makai Road with one shared left-turn and through lane and an exclusive right-turn lane. Also, provide the both the northbound and southbound approaches of Kapule Highway with an exclusive left-turn lane and an exclusive right-turn lane.

Kuhio Highway And Road "X" - Signalize the intersection and provide the northbound approach on Road "X" with an exclusive left-turn lane and an exclusive right-turn lane. Also, provide the westbound approach on Kuhio Highway with an exclusive left-turn lane and an exclusive right-turn lane in the eastbound approach.

TABLE OF CONTENTS

		Page
I.	INTRODUCTION	1-8
	A. Project Description	1-3
	B. Purpose and Scope	3-8
II.	EXISTING CONDITIONS	9-15
	A. Existing Roadway System	9-10
	B. Existing Traffic Operations	10
	1. Existing Traffic Volumes	10-14
	2. Level of Service Methodology	14
	3. Existing Level of Service	14-15
III.	FUTURE TRAFFIC PROJECTIONS	16-34
	A. Project Traffic Volumes	16
	1. Project Traffic Generation	16-20
	2. Project Traffic Distribution	20-23
	3. Project Traffic Assignment	23
	B. Year 2006 Traffic Projections	23
	1. Year 2006 Base (Without Project) Traffic Volumes	23-27
	2. Year 2006 With Project Traffic Volumes	27
	C. Year 2016 Traffic Projections	27-31
	1. Year 2016 Base (Without Project) Traffic Volumes	32
	2. Year 2016 With Project Traffic Volumes	32-34
IV.	TRAFFIC IMPACT ANALYSIS	35-52
	A. Year 2006 Traffic Impact Analysis	35-36
	1. Year 2006 Base (Without Project) Traffic Impact Analysis	36
	2. Year 2006 With Project Traffic Impact Analysis	36-38
	3. Year 2006 Base Roadway Improvements	38-42

TABLE OF CONTENTS
(Cont'd.)

		Page
IV.	TRAFFIC IMPACT ANALYSIS (Continued)	
4.	Year 2006 With Project, Recommended Base Improvements and Project Mitigation	42
B.	Year 2016 Traffic Impact Analysis	43
1.	Year 2016 Base (Without Project) Traffic Impact Analysis	43-44
2.	Year 2016 With Project Traffic Impact Analysis	44
3.	Year 2016 Base Roadway Improvements	45-47
4.	Year 2016 With Project, Recommended Base Improvements and Project Mitigation	47-52
V.	CONCLUSIONS AND RECOMMENDATIONS	53-59
A.	Conclusions	53-54
B.	Recommendations	54-59
	REFERENCES	

TABLES

1	DEVELOPMENT SCHEDULE	4
2	PROJECT TRIP GENERATION RATES	17
3	YEAR 2006 TOTAL PROJECT TRIP GENERATION SUMMARY	18
4	YEAR 2016 TOTAL PROJECT TRIP GENERATION SUMMARY	19
5	YEAR 2006 REDUCED PROJECT TRIP GENERATION SUMMARY	21

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TABLE OF CONTENTS
(Cont'd.)

TABLES (Continued)

		Page
6	YEAR 2016 REDUCED PROJECT TRIP GENERATION SUMMARY	22
7	SUMMARY OF RELATED DEVELOPMENTS TRIP GENERATION	28
8	SUMMARY OF YEAR 2006 LEVEL OF SERVICE	37
9	SUMMARY OF YEAR 2006 WITH MITIGATION LEVEL OF SERVICE	41
10	SUMMARY OF YEAR 2016 LEVEL OF SERVICE	44
11	SUMMARY OF YEAR 2016 WITH MITIGATION LEVEL OF SERVICE	50

EXHIBITS

1	PROJECT LOCATION MAP	2
2	SITE MAP	6
3	STUDY AREA	8
4	EXISTING INTERSECTION CONFIGURATIONS	11
5	EXISTING 1994 CONDITIONS	13
6	GENERAL DISTRIBUTION PATTERN	24
7	YEAR 2006 PROJECT ONLY TRAFFIC VOLUMES	25
8	YEAR 2016 PROJECT ONLY TRAFFIC VOLUMES	26
9	LOCATION OF RELATED DEVELOPMENTS	29

TABLE OF CONTENTS
(Cont'd.)

		Page
EXHIBITS (Continued)		
10	YEAR 2006 BASE (WITHOUT PROJECT) TRAFFIC CONDITIONS	30
11	YEAR 2006 WITH PROJECT TRAFFIC CONDITIONS	31
12	YEAR 2016 BASE (WITHOUT PROJECT) TRAFFIC CONDITIONS	33
13	YEAR 2016 WITH PROJECT TRAFFIC CONDITIONS	34
14	YEAR 2006 BASE IMPROVEMENTS AND PROJECT MITIGATION - INTERSECTION CONFIGURATIONS	40
15	YEAR 2016 BASE IMPROVEMENTS AND PROJECT MITIGATION - INTERSECTION CONFIGURATIONS	48
16	YEAR 2016 BASE WITH IMPROVEMENTS TRAFFIC CONDITIONS	49
17	YEAR 2016 WITH BASE IMPROVEMENTS AND PROJECT MITIGATION TRAFFIC CONDITIONS	52

APPENDICES

A	TRAFFIC COUNTS
B	LEVEL OF SERVICE DEFINITIONS
C	LEVEL OF SERVICE CALCULATIONS (BOUND SEPARATELY)

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CONTINUING THE ENGINEERING PRACTICE FOUNDED BY H. A. R. AUSTIN IN 1934

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TRAFFIC IMPACT REPORT

FOR THE PROPOSED

LIHUE-HANAMAULU MASTER PLAN DEVELOPMENT

ISLAND OF KAUAI

I. INTRODUCTION

This report documents the findings of the traffic study conducted by Austin, Tsutsumi & Associates, Inc. (ATA) to evaluate the potential traffic impacts and circulation needs of the proposed Lihue-Hanamaulu Master Plan Development.

A. Project Description

The Lihue-Hanamaulu Master Plan provides for a range of residential and village mixed uses on 555 acres of land located at Lihue and Hanamaulu, Kauai. Four geographic areas of the Master Plan include Molokoa, Ahukini Mauka, Ahukini Makai and Hanamaulu. Development is projected to be over a 15 to 20 year period and is planned to be flexible in responding to future community needs. The Master Plan components include single and multi-family residential uses, public and quasi-public facilities, village mixed-use, light industrial development and parks and open space. The village mixed use areas within Molokoa and Ahukini Mauka envision a variety of retail and office uses, that would form the village core of the community. Exhibit 1 shows the project location.

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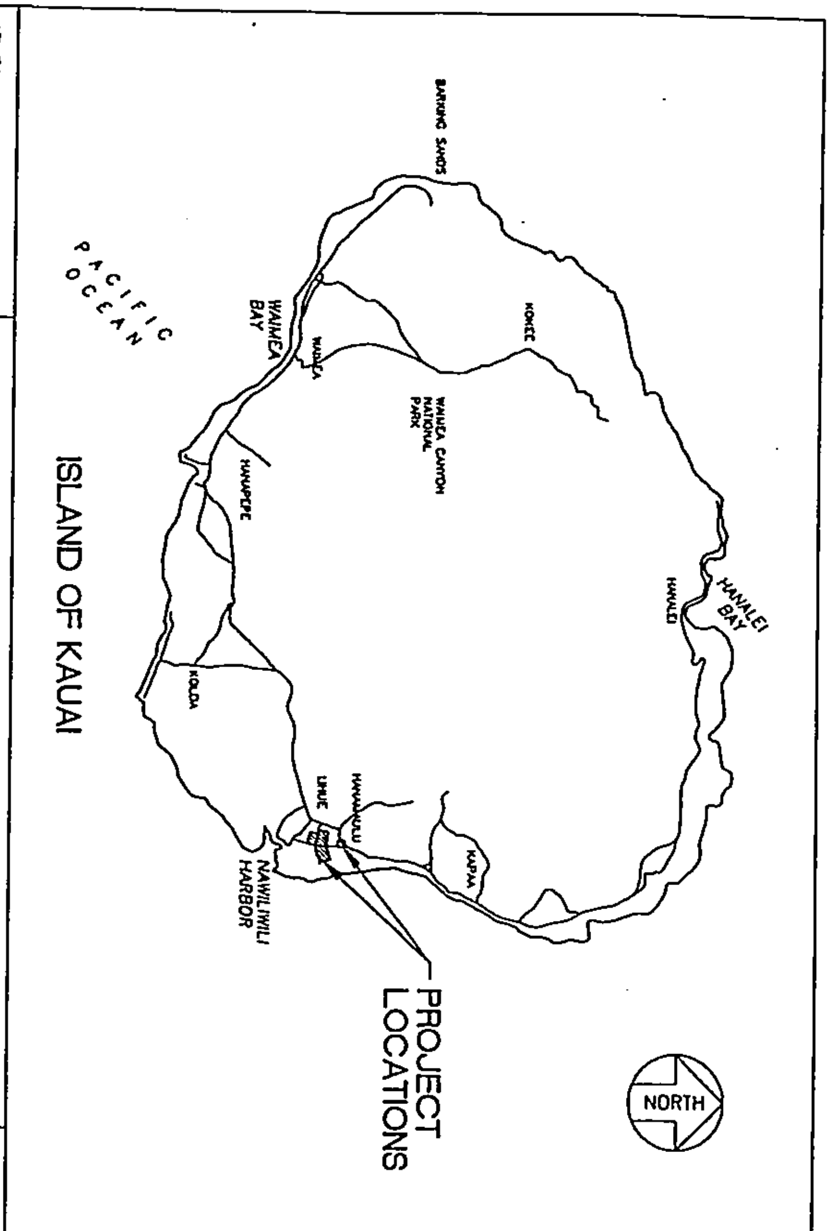

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PROJECT LOCATION MAP

EXHIBIT 1

Molokoa is located in the southwest quadrant of the intersection of Kapule Highway and Ahukini Road. This area is expected to include of 390 single and multi-family dwelling units, 58 acres of retail and office use, a YMCA type facility, police station, judiciary complex, a teen center, park and a veterans service complex. Primary access to the Molokoa area will be off Kapule Highway and Ahukini Road and Rice Street.

Immediately north of Molokoa is Ahukini Mauka. This area will be mainly residential use consisting of 1,144 single and multi-family dwelling units along with 13 acres of retail use, 26 acres of village mix-use/light industrial use and contains a school and park. Access to this area will be off Kapule Highway and Ahukini Road.

Ahukini Makai is located on the airport side of Kapule Highway, north of Ahukini Road, and consists of 102 acres of light industrial use, a County recycling center and a State disinfestation facility. Main access to Ahukini Makai will be off Kapule Highway.

Hanamaulu is the smallest of the four areas, consisting of 266 single- and multi-family dwelling units. The area is located in the southwest quadrant of the intersection of Kuhio Highway and Kapule Highway. Access to the area will be off Kuhio Highway.

The total proposed development consists of 1,800 residential dwelling units, 70 acres of retail/office use, 26 acres of village mix-use/light industrial and 102 acres of industrial use. The total development is planned to be completed by the Year 2016 with initial occupation by the Year 1997. Exhibit 2 illustrates the project areas and Table 1 shows the development schedule.

B. Purpose and Scope

The purpose of the study is to analyze potential development-generated traffic impacts on the roadway system within the study area. Proposed roadway improvements, which are required to allow the street and highway

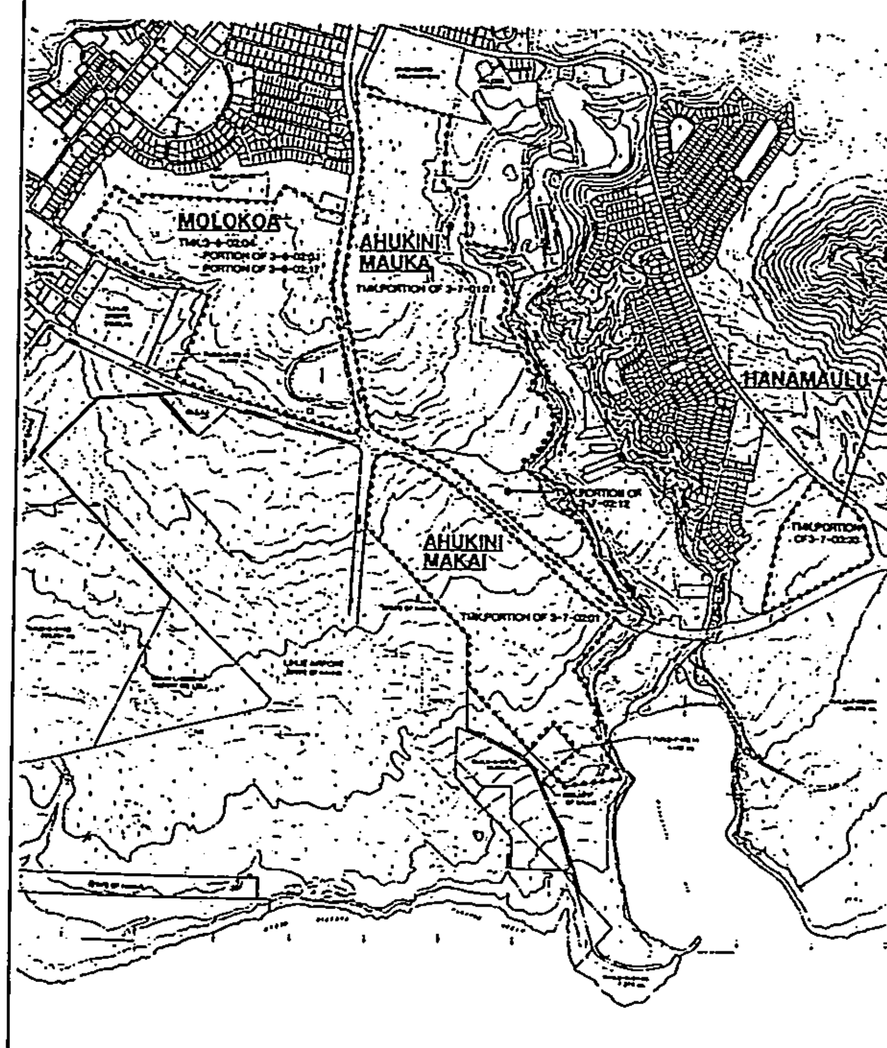
TABLE 1
DEVELOPMENT SCHEDULE

LAND USE	UNITS	PHASE I (1997-2001)	PHASE II (2002-2006)	PHASE III (2007-2011)	PHASE IV (2012-2016)	TOTAL
MOLOKOA						
single family	DU	328				328
multi family	DU	62				62
retail	KSF	122	88		50	260
office	KSF	80	22	51	162	315
YMCA	KSF	40				40
Civic Ctr	KSF	188				188
park	AC	8				8
AHUKINI MAUKA						
single family	DU	90	218	370	52	728
multi family	DU		256	180		410
retail	KSF		25		100	125
elem. school	STD	750				750
park	AC	4		10		14
VMX/Industrial	KSF				283	283
AHUNKINI MAKAI						
industrial	KSF	267	274	303	172	1016
recly ctr	KSF	350				350
disin. facil.	KSF	41				41
HANAMAULU						
single family	DU		94	100		194
multi family	DU	72				72
TOTAL						
single family	DU	418	310	470	52	1250
multi family	DU	134	258	180	-	550
retail	KSF	122	113	-	150	385
office	KSF	80	22	51	162	315
YMCA	KSF	40	-	-	-	40
Civic Center	KSF	188	-	-	-	188
park	AC	12	-	10	-	22
VMX/Industrial	KSF	-	-	-	283	283
industrial	KSF	267	274	303	172	1016

Development schedule based on "Phasing Plan", August 30, 1994 – obtained from PBR Hawaii.

system to accommodate the future traffic volumes after the completion of the development, are identified in this study. The following traffic scenarios are analyzed in the study:

- Existing Conditions - The analysis of existing traffic conditions is intended to provide a basis for the remainder of the study. The existing conditions analysis includes an assessment of land use, streets and highways, traffic volumes, and current operating conditions.
- Year 2006 Base (Without Project) Conditions - This is an analysis of future traffic conditions for the study area in the Year 2006. The objective of this phase of the study is to forecast short-term future traffic conditions for the study area in the Year 2006 without the project, to serve as a basis against which project impacts can be measured.
- Year 2006 With Project Conditions - This is an analysis of future traffic conditions with traffic expected to be generated by the proposed development in the Year 2006 added to Year 2006 Base traffic forecasts, in order to identify impacts of the proposed project on future short-term traffic operating conditions.
- Year 2016 Base (Without Project) Conditions - This is an analysis of future traffic conditions for the study area in the Year 2016 (the anticipated buildout year of the Lihue-Hanamaulu Master Plan Development). The objective of this phase of the study is to forecast future traffic conditions for the study area in the Year 2016 without the project, to serve as a basis against which project impacts can be measured.
- Year 2016 With Project Conditions - This is an analysis of future traffic conditions with traffic expected to be generated by the proposed development in the Year 2016 added to Year 2016 Base traffic forecasts,



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SITE MAP

EXHIBIT 2

in order to identify impacts of the proposed project on future traffic operating conditions.

A total of ten intersections (seven existing and three future) have been identified within the study area which are to be analyzed during the AM and PM peak traffic hours for each of the traffic scenarios described above. Exhibit 3 illustrates the study area and locations of the ten study intersections, which are as follows:

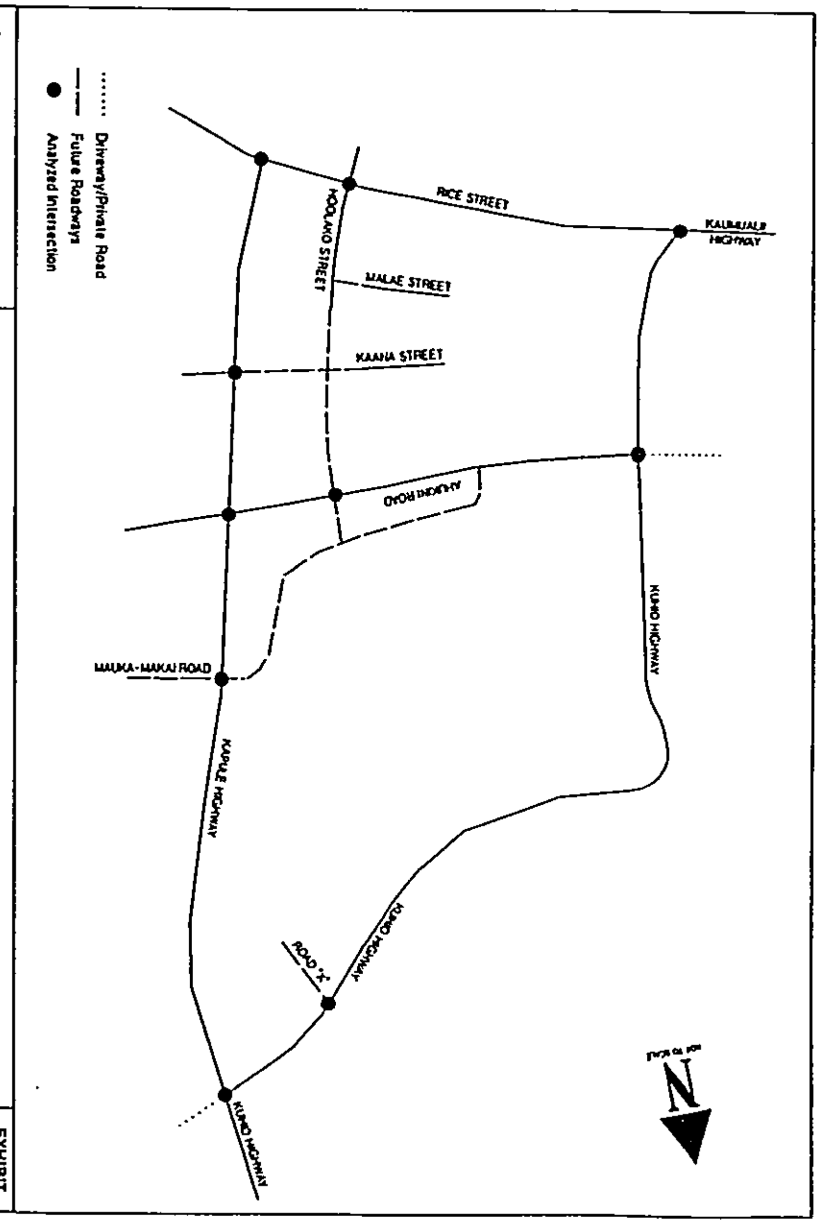
Existing Intersections:

- Kuhio Highway and Kaumualii Highway/Rice Street (signalized)
- Hoolako Street and Rice Street (stop-controlled)
- Kapule Highway and Rice Street (stop-controlled)
- Kuhio Highway and Ahukini Road (signalized)
- Kapule Highway and Ahukini Road (signalized)
- Kapule Highway and Kuhio Highway (signalized)
- Kapule Highway and Post Office Driveway/future Kaana Street extension (stop-controlled)

Future Intersections:

- Hoolako Street Extension and Ahukini Road
- Kapule Highway and Mauka-Makai Road
- Road "X" and Kuhio Highway (Hanamaulu)

The three future intersections will be analyzed as signalized intersections under future conditions with the proposed development.



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STUDY AREA

EXHIBIT 3

II. EXISTING CONDITIONS

An extensive field investigation was undertaken to develop an accurate and detailed description of existing conditions and infrastructure within the study area. Information relevant to the study includes land use, an inventory of streets and highways, traffic volumes, and current operating conditions on the street system.

A. Existing Roadway System

This section describes the existing circulation system serving the study area, including number of travel lanes, street classifications, and traffic control devices.

The project study area, as shown in Exhibit 3, is bounded by Kuhio Highway on the north and west, Rice Street on the south and Kapule Highway/Lihue Airport on the east. Brief descriptions of major facilities within the study area follow:

- Kuhio Highway - Within the study area, Kuhio Highway is a north/south arterial serving Lihue and Hanamaulu and provides linkage to communities to the northeast and southwest of Lihue. Between Kapule Highway and Kapaia Road in Hanamaulu, Kuhio Highway is a two-lane highway fronting commercial and residential uses. Between Kapaia Road and Ahukini Road, Kuhio Highway provides two lanes inbound to Lihue and two lanes outbound to a point midway between Ehiku Street and Eha Street/Wilcox Hospital Entrance where the outbound lane reduces to a single lane. Between Ahukini Road and Rice Street/Kaumualii Highway, Kuhio Highway is a four-lane roadway fronting mainly commercial use. Kuhio Highway is signalized at the intersections of Rice Street/Kaumualii Highway, Ahukini Road, Ehiku Street, Eha Street and Kapule Highway.
- Kapule Highway - Kapule Highway is a north-south, two-lane, access restricted arterial which runs east of Lihue Town, connecting Rice Street

and Kuhio Highway in Hanamaulu. Kapule Highway fronts mostly open space and the Lihue Airport and is signalized at the Ahukini Road intersection and Kuhio Highway intersection. It is stop controlled as it T's into Rice Street.

- Ahukini Road - Ahukini Road is an east-west, two-lane, access restricted, State collector roadway which originates at Lihue Airport, extends mauka, and terminates as a T-intersection at Kuhio Highway. Ahukini Road fronts mostly open space and some commercial use and is signalized at Kuhio Highway and Kapule Highway. Ahukini Road within the Lihue Airport is under the State Airports Division's jurisdiction.
- Rice Street - Rice Street is an east-west collector between Lihue Town and the Nawiliwili Harbor area. Through Lihue Town, Rice Street is a two-lane roadway, with a continuous, two-way, left-turn lane provided between Haleko Road and Hardy Street/Kalena Drive. Rice Street is signalized at the intersections of Kuhio Highway, Umi Street, and Hardy Street/Kalena Drive. Within the study area, Rice Street fronts primarily retail and office uses.

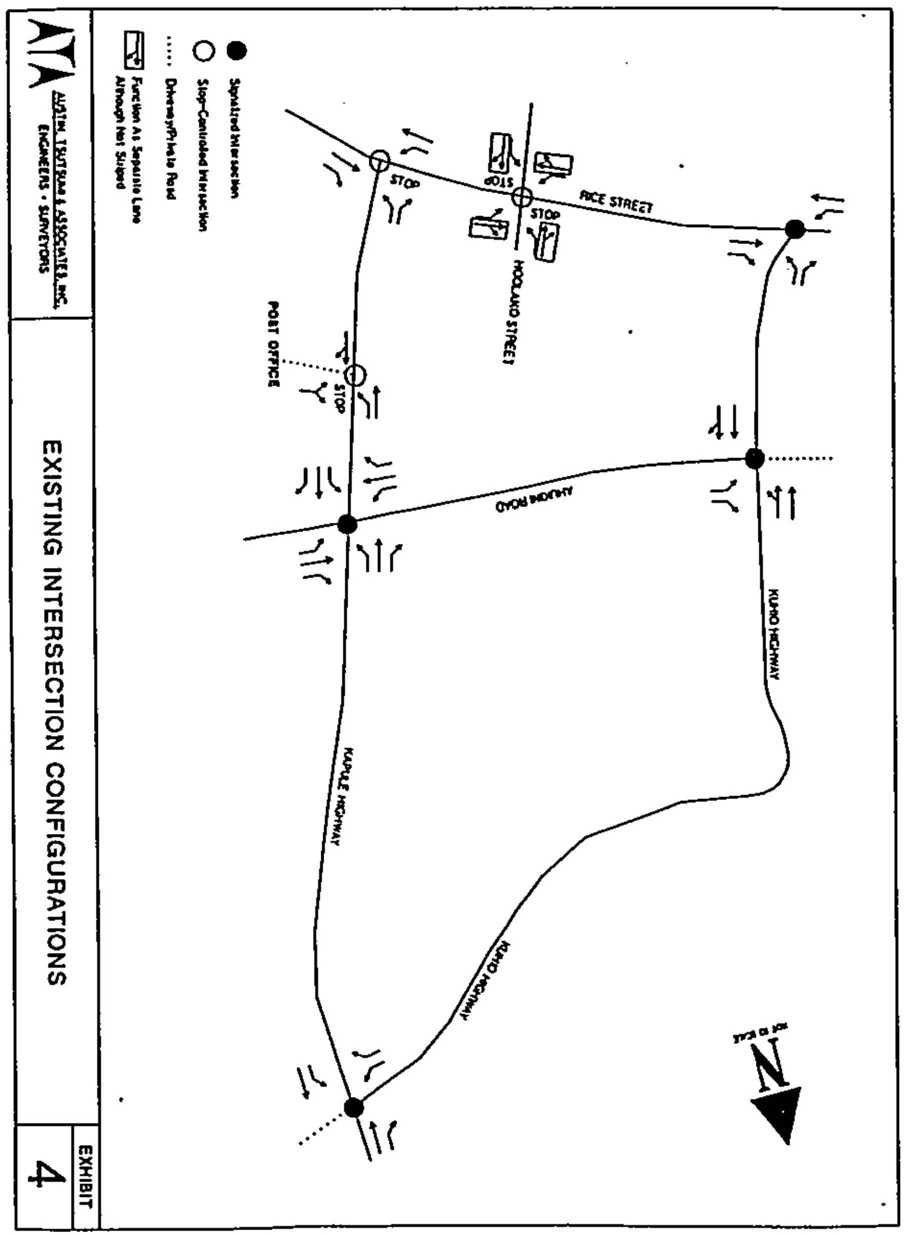
Existing intersection configurations are illustrated in Exhibit 4.

B. Existing Traffic Operations

The following sections present the existing intersection peak hour traffic volumes, a description of the methodology utilized to analyze the intersection traffic conditions, and the resulting level of service conditions at each of the seven analyzed intersections under existing conditions.

1. Existing Traffic Volumes

Morning and evening peak period traffic counts were conducted by ATA as part of this study at each of the existing intersections. The results of the traffic counts conducted are provided in Appendix A.



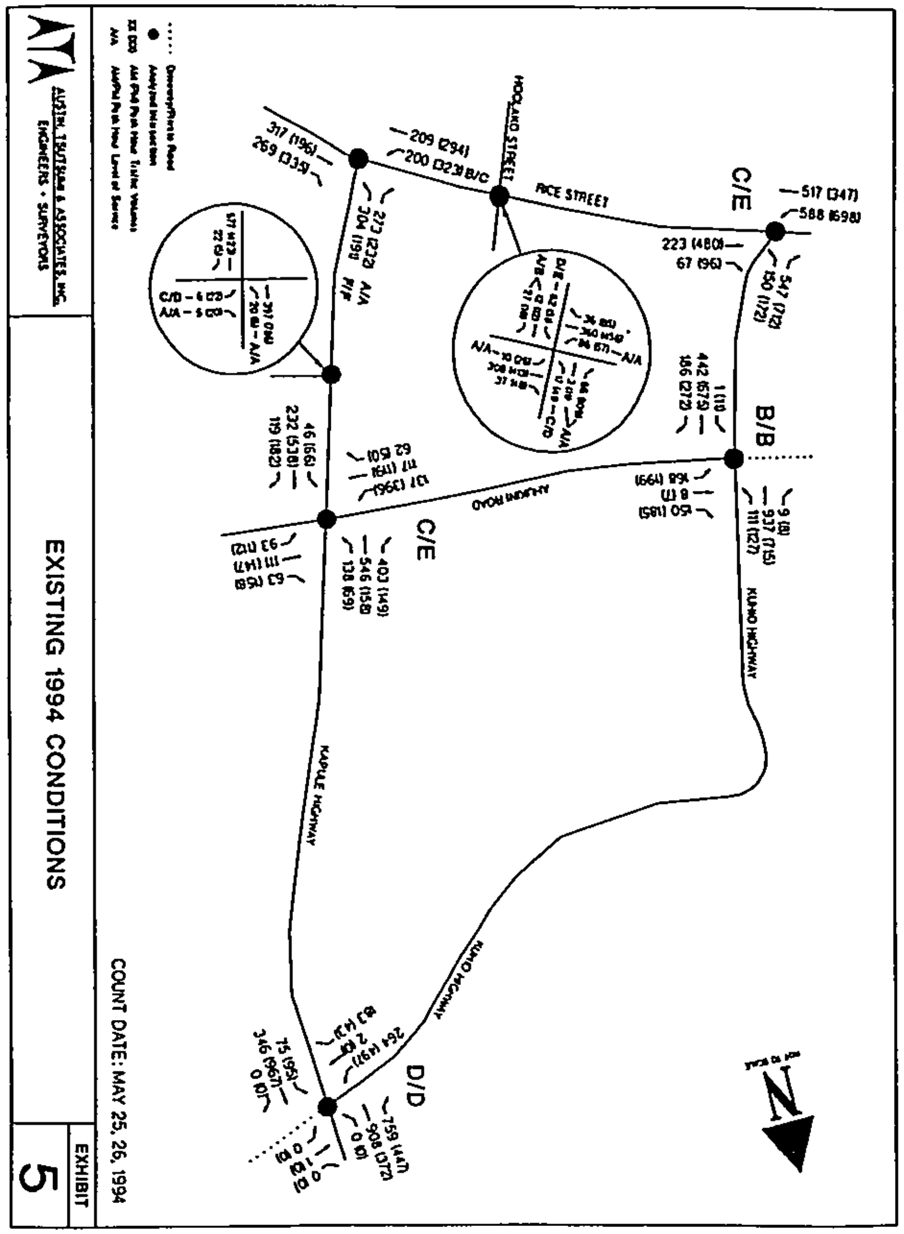
EXISTING INTERSECTION CONFIGURATIONS

EXHIBIT 4

Manual turning movement counts were conducted for both the morning peak period of traffic (6:30 to 8:30 AM) and the evening peak period of traffic (3:00 to 5:00 PM) on May 25 and 26, 1994 at the existing analyzed intersections. Exhibit 5 illustrates the existing AM and PM peak hour traffic volumes within the study area.

Existing morning traffic within the study area is generally moderate. Traffic count data indicates that approximately 1,650 peak hour vehicles enter the study area at Hanamaulu from the north (Kapaa) via Kuhio Highway with approximately 760 vehicles continuing on Kuhio Highway to either Hanamaulu Town, Lihue Town or continuing on Kaumualii Highway toward Puhi. The remaining 900 vehicles utilize Kapule Highway to either Lihue Airport, the Nawiliwili Harbor area or Lihue Town via Rice Street or Ahukini Road. The count data also indicate that approximately 1,100 peak hour vehicles enter the study area from the south (Puhi) via Kaumualii Highway, with approximately 520 vehicles traveling into the central district via Rice Street and the remaining 590 vehicles turning onto Kuhio Highway. Approximately 590 morning peak hour vehicles from the Nawiliwili Harbor area enter the study area, with 320 vehicles traveling into the central district via Rice Street and 270 vehicles turning onto Kapule Highway.

Existing afternoon traffic within the study area is also generally moderate. Traffic count data indicate that approximately 820 peak hour vehicles enter the study area from the north (Kapaa) at Hanamaulu via Kuhio Highway with approximately 450 vehicles continuing on Kuhio Highway to either Hanamaulu Town, Lihue Town or continuing on Kaumualii Highway toward Puhi. The remaining 370 vehicles utilize Kapule Highway to either Lihue Airport, the Nawiliwili Harbor area or Lihue Town via Rice Street or Ahukini Road. Count data also indicates that approximately 1,050 vehicles enter the study area from the south



(Puhi) via Kaumualii Highway, with approximately 350 vehicles traveling into the central district via Rice Street and the remaining 700 vehicles turning onto Kuhio Highway. Approximately 530 afternoon peak hour vehicles from the Nawiliwili Harbor area enter the study area with 335 vehicles traveling into the Central District via Rice Street and 195 vehicles turning onto Kapule Highway and continuing north.

2. **Level Of Service Methodology**

Level of service (LOS) is a qualitative measure used to describe the condition of traffic flow, ranging from free-flow conditions at LOS A to congested conditions at LOS F. This section describes the current LOS of the seven existing intersections. Level of service definitions are included in Appendix B.

The Highway Capacity Manual-Special Report No. 209 "Operational" (Transportation Research Board, 1985) method of intersection volume to capacity (V/C) ratio, average stopped delay/vehicle and corresponding level of service was applied to each of the signalized intersections to be analyzed in this study. At locations where the intersection is controlled by stop signs on minor street approach(es), the "Two-Way Stop Control" method described in the Highway Capacity Manual (Transportation Research Board, 1985) was employed to determine the available reserve capacity and corresponding level of service for each of the constrained movements (approaches from minor streets and left-turn movements from major streets) at the intersection.

3. **Existing Level Of Service**

Four of the seven existing intersections are currently operating at LOS E or F during either the AM or PM peak hour or both. The following describes the intersections that are operating at LOS E or F.

- The Intersection of Kuhio Highway and Kaumualii Highway/Rice Street is currently operating at LOS E during the PM peak hour of traffic. Delay is due to high volume of westbound and southbound left-turns.
- The southbound left-turn at the stop-controlled intersection of Kapule Highway and Rice Street is currently operating at LOS F during both the AM and PM peak hours. Delay is mainly due to heavy eastbound traffic and a high volume of southbound left-turn vehicles.
- The northbound left-turn at the stop-controlled intersection of Hoolako Street and Rice Street is currently operating at LOS E during the PM peak hour of traffic. Delay to these movements is mainly due to the relatively heavy traffic on Rice Street.
- The intersection of Kapule Highway and Ahukini Road is operating at LOS E during the PM peak hour. Delay is due to the heavy eastbound left-turn traffic.

Exhibit 5 also summarizes the existing level of service at each of the seven existing intersections during the AM and PM peak hour of traffic.

III. FUTURE TRAFFIC PROJECTIONS

In order to properly evaluate the potential impact of the proposed Lihue-Hanamaulu Development on local traffic conditions, it is necessary to develop forecasts of future traffic volumes in the study area under conditions both with and without the proposed development traffic. The methodologies and key assumptions used to develop these forecasts are described below.

A. Project Traffic Volumes

The development of traffic projections for the proposed project involves traffic generation, trip distribution, and traffic assignment. A description of each process follows:

1. Project Traffic Generation

Trip generation estimates for the development were developed by applying appropriate trip generation rates to the proposed density figures for each element of the project. This method provides an indication of the total volume of traffic expected to be generated by each land use type within the project.

The traffic expected to be generated by the development was estimated by applying the trip generation rates shown in Table 2 to the individual land uses. These trip generation rates were based upon data from "Trip Generation" 5th Edition, Institute of Transportation Engineers (ITE), 1991. The application of these rates provides an estimate of the total increases in future traffic expected to be generated by the project. Table 3 and 4 summarize the total amount of traffic the proposed development will generate in the Year 2006 and 2016, respectively.

Studies have shown that large residential developments with supporting commercial as well as recreational facilities, such as the proposed Lihue-Hanamaulu Development, satisfy a portion of the traffic

TABLE 2
PROJECT TRIP GENERATION RATES

LANDUSE	ITE CODE	UNITS	DAILY	AM PEAK HOUR IN	AM PEAK HOUR OUT	AM PEAK HOUR TOTAL	PM PEAK HOUR IN	PM PEAK HOUR OUT	PM PEAK HOUR TOTAL
Multi-Family	230	DU	5.86	17%	83%	0.44	66%	34%	0.55
Single Family Residential	210	DU	9.55	26%	74%	0.74	65%	35%	1.01
Commercial (Shopping Center)	820	KSF	[a]	63%	37%	[b]	-	-	-
< 600 ksf			-	-	-	-	50%	50%	[c]
> 600 ksf			-	-	-	-	50%	50%	[d]
Office	939	KSF	[e]	89%	11%	[f]	17%	83%	[g]
Light Industrial	110	KSF	6.97	83%	17%	0.92	12%	88%	0.98
Elementary/Intermediate School	520	STD	1.09	60%	40%	0.30	56%	44%	0.25
Park	412	AC	2.99	72%	28%	2.87	35%	65%	3.14
Civic Center	733	KSF	25.00	89%	11%	2.25	31%	69%	2.66

Source: Institute Of Transportation Engineers, "Trip Generation, 5th Edition", 1991.

[a] ADT: Ln(T)=0.625 Ln(X)+5.985
[b] AM: Ln(T)=0.589 Ln(X)+2.378
[c] PM: Ln(T)=0.637 Ln(X)+3.553
[d] PM: Ln(T)=0.725 Ln(X)+2.987
[e] ADT: Ln(T)=0.756 Ln(X)+3.765
[f] AM: Ln(T)=0.777 Ln(X)+1.674
[g] PM: Ln(T)=0.737 Ln(X)+1.831

where:
Ln = Natural Logarithm
T= Two-way volume of traffic of total trip ends
X= area in 1,000 gross square feet of leasable area.

TABLE 3
YEAR 2006 TOTAL PROJECT TRIP GENERATION SUMMARY

LAND USE	SIZE		DAILY	AM IN	AM OUT	AM TOTAL	PM IN	PM OUT	PM TOTAL
MOLOKOA									
single family	328	du	3,132	63	180	243	215	116	331
multi family	62	du	363	5	23	27	23	12	34
retail	138	ksf	12,782	190	112	302	588	588	1,176
office	102	ksf	1,632	196	24	220	37	182	219
YMCA	40	ksf	553	27	16	43	15	40	55
civic center	188	ksf	4,700	376	47	423	167	371	538
park	8	ac	24	17	6	23	9	16	25
Sub-Total			23,187	874	408	1,281	1,054	1,324	2,378
AHUKINI MAUKA									
single family	306	du	2,922	59	168	226	201	108	309
multi family	256	du	1,500	19	93	113	93	48	141
retail	25	ksf	2,971	45	27	72	136	136	271
elem. school	750	std	818	135	90	225	126	84	210
playground/park	4	ac	12	8	3	11	4	8	13
Sub-Total			8,223	267	381	648	560	384	943
AHUKINI MAKAI									
industrial	541	ksf	3,771	413	85	498	64	467	530
recly ctr	350	ksf	100	10	10	20	10	10	20
distn. facil.	41	ksf	29	9	2	11	1	11	12
Sub-Total			3,899	433	97	529	75	487	562
HANAMAULU									
single family	94	du	898	18	51	70	62	33	95
multi family	72	du	422	5	26	32	26	13	40
Sub-Total			1,320	23	78	101	88	47	135
GRAND TOTAL			36,629	1,596	963	2,559	1,777	2,242	4,019

TABLE 4
YEAR 2016 TOTAL PROJECT TRIP GENERATION SUMMARY

LAND USE	SIZE	DAILY	AM IN	AM OUT	AM TOTAL	PM IN	PM OUT	PM TOTAL
MOLOKOA								
single family	328 du	3,132	63	180	243	215	116	331
multi family	62 du	363	5	23	27	23	12	34
retail	188 ksf	17,365	258	152	410	799	799	1,598
office	315 ksf	4,496	544	67	611	101	496	597
YMCA	40 ksf	553	27	16	43	15	40	55
civic center	188 ksf	4,700	376	47	423	167	371	538
park	8 ac	24	17	6	23	9	16	25
Sub-Total		30,634	1,290	491	1,780	1,329	1,849	3,178
AHUKINI MAUKA								
single family	728 du	6,952	140	399	539	478	257	735
multi family	416 du	2,438	31	152	183	151	78	229
retail	162 ksf	15,933	238	140	378	732	732	1,463
VMX/industrial	226 ksf	1,575	173	35	208	27	195	221
elem. school	750 std	818	135	90	225	126	84	210
playground/park	14 ac	42	29	11	40	15	29	44
Sub-Total		27,758	746	827	1,573	1,528	1,374	2,903
AHUKINI MAKAI								
industrial	1016 ksf	7,082	776	159	935	119	876	996
recly ctr	350 ksf	100	10	10	20	10	10	20
disin. facil.	41 ksf	29	9	2	11	1	11	12
Sub-Total		7,210	795	171	966	131	897	1,028
HANAMAULU								
single family	194 du	1,853	37	106	144	127	69	196
multi family	72 du	422	5	26	32	26	13	40
Sub-Total		2,275	43	133	175	153	82	236
GRAND TOTAL		67,876	2,873	1,621	4,494	3,142	4,202	7,344

demand from within the site. Therefore, it is assumed that a portion of the total vehicle trips generated by the proposed development will commute within the site, and consequently, will not affect roadways outside of the project site. These internal trips are captured mainly between residential and retail. Project trip reduction is based on the following assumptions:

- Retail - 30% of AM and PM peak hour trips will be internal.
- Office (Molokoa area) - 30% of AM and PM peak hour trips will either be internal or travel between the central district via the Kaana Street extension or Malae Street.
- Park - 50% of AM and PM peak hour trips will be internal.
- Industrial - 10% of AM and PM peak hour trips will be airport related.

Tables 5 and 6 summarizes the amount of traffic the proposed development is expected to generate (with trip reduction) in the Year 2006 and 2016, respectively. By the Year 2006, the proposed development is expected to generate an estimated 2,120 vehicles per hour (vph) during the morning peak hour of traffic and 3,225 vph during the evening peak hour of traffic. By the Year 2016, the proposed development is expected to generate an estimated 3,755 vehicles per hour (vph) during the morning peak hour of traffic and 5,890 vph during the evening peak hour of traffic.

2. Project Traffic Distribution

The directional distribution pattern developed for the project site was based on existing traffic distribution pattern and the October 1990, "Kauai County Highway Planning Study" prepared by Kaku Associates, Inc.. Land use forecast contained in the "Kauai County Highway

TABLE 5
YEAR 2006 REDUCED PROJECT TRIP GENERATION SUMMARY

LAND USE	SIZE	DAILY	AM			PM		
			IN	OUT	TOTAL	IN	OUT	TOTAL
MOLOKOA								
single family	328 du	3,132	63	180	243	215	116	331
multi family	62 du	363	5	23	27	23	12	34
retail	138 ksf	8,948	134	78	212	412	412	824
office	102 ksf	1,143	136	17	153	26	127	153
YMCA	40 ksf	553	27	16	43	15	40	55
civic center	188 ksf	3,290	264	33	296	117	260	376
park	8 ac	12	8	3	11	4	8	13
Sub-Total		17,442	636	350	986	812	974	1,787
AHUKINI MAUKA								
single family	306 du	2,922	59	168	226	201	108	309
multi family	256 du	1,500	19	93	113	93	48	141
retail	25 ksf	2,080	32	19	50	95	95	190
elem. school	750 std	572	95	63	158	88	59	147
playground/park	4 ac	6	4	2	6	2	4	6
Sub-Total		7,081	208	344	552	479	314	793
AHUKINI MAKAI								
Industrial	541 ksf	3,394	372	76	448	57	420	477
recly ctr	350 ksf	100	10	10	20	10	10	20
disin. facil.	41 ksf	29	9	2	11	1	11	12
Sub-Total		3,522	391	88	479	69	441	509
HANAMAULU								
single family	94 du	898	18	51	70	62	33	95
multi family	72 du	422	5	26	32	26	13	40
Sub-Total		1,320	23	78	101	88	47	135
GRAND TOTAL		29,364	1,259	860	2,119	1,448	1,775	3,224

TABLE 6
YEAR 2016 REDUCED PROJECT TRIP GENERATION SUMMARY

LAND USE	SIZE	DAILY	AM			PM		
			IN	OUT	TOTAL	IN	OUT	TOTAL
MOLOKOA								
single family	328 du	3,132	63	180	243	215	116	331
multi family	62 du	363	5	23	27	23	12	34
retail	188 ksf	12,156	181	107	288	560	560	1,119
office	315 ksf	3,148	379	47	426	71	347	418
YMCA	40 ksf	553	27	16	43	15	40	55
civic center	188 ksf	3,290	264	33	296	117	260	376
park	8 ac	12	8	3	11	4	8	13
Sub-Total		22,655	927	408	1,335	1,005	1,342	2,347
AHUKINI MAUKA								
single family	728 du	6,952	140	399	539	478	257	735
multi family	416 du	2,438	31	152	183	151	78	229
retail	162 ksf	11,154	167	98	265	512	512	1,024
VMX/industrial	226 ksf	1,575	173	35	208	27	195	221
elem. school	750 std	572	95	63	158	88	59	147
playground/park	14 ac	21	14	6	20	8	14	22
Sub-Total		22,713	620	753	1,372	1,263	1,115	2,379
AHUKINI MAKAI								
Industrial	1016 ksf	6,373	698	143	841	108	789	896
recly ctr	350 ksf	100	10	10	20	10	10	20
disin. facil.	41 ksf	29	9	2	11	1	11	12
Sub-Total		6,502	718	155	873	119	809	928
HANAMAULU								
single family	194 du	1,853	37	106	144	127	69	196
multi family	72 du	422	5	26	32	26	13	40
Sub-Total		2,275	43	133	175	153	82	236
GRAND TOTAL		54,144	2,307	1,448	3,755	2,541	3,348	5,889

Planning Study" for the Traffic Analysis Zones (TAZ) relative to the Lihue-Hanamaulu area was utilized to estimate the future traffic distribution pattern. The general distribution pattern used to distribute future project traffic is illustrated in Exhibit 6.

3. **Project Traffic Assignment**

The trip distribution pattern identified in Exhibit 6 was used to assign the project-generated traffic to the local street and highway network. The assignment to specific streets and intersections was based on the available access into and out of the site and the availability of local routes to access the regional highway system. The resulting estimated Year 2006 and 2016 development-generated peak hour traffic volumes, at each of the ten analyzed intersections, are illustrated in Exhibits 7 and 8, respectively.

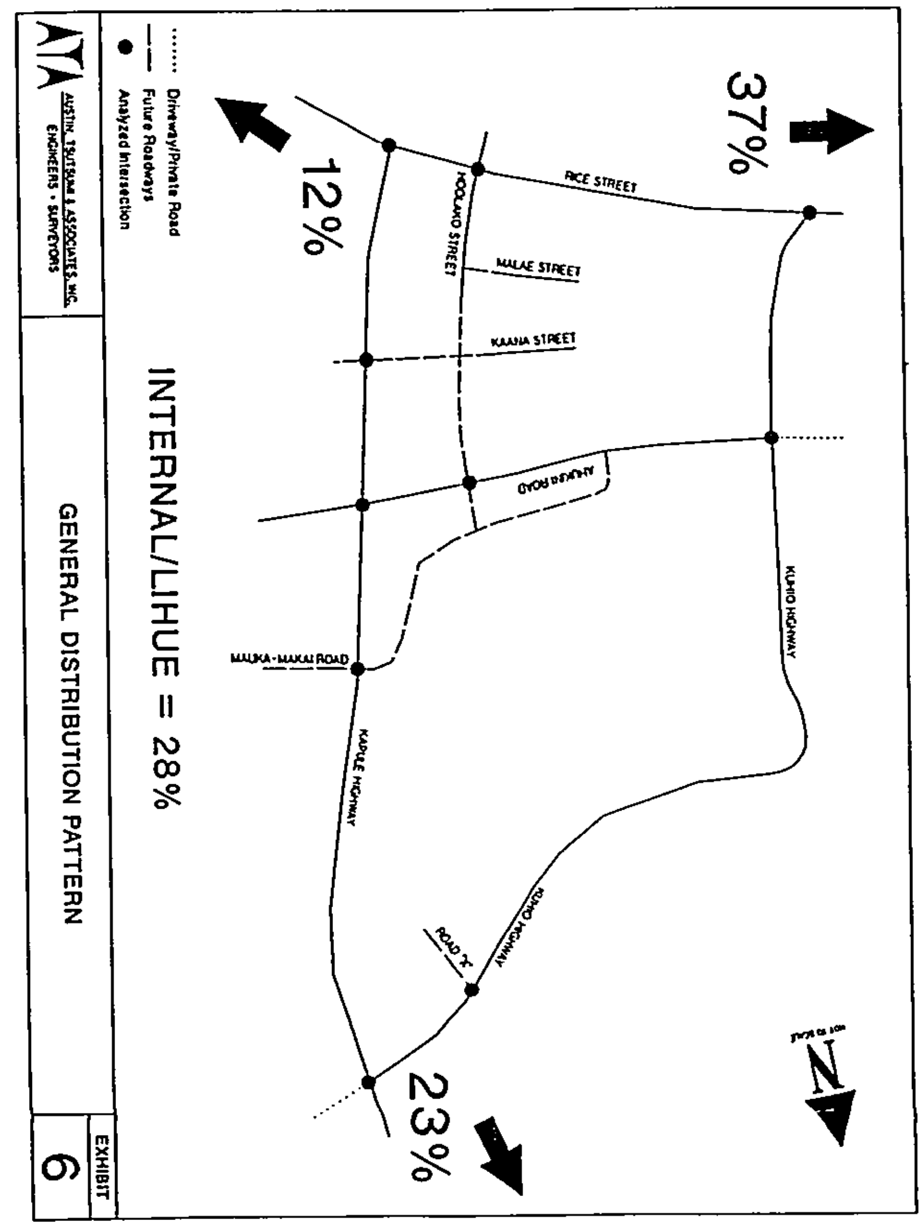
B. **Year 2006 Traffic Projections**

The following sections describe Year 2006 Base (without project) and With Project traffic projections.

1. **Year 2006 Base (Without Project) Traffic Volumes**

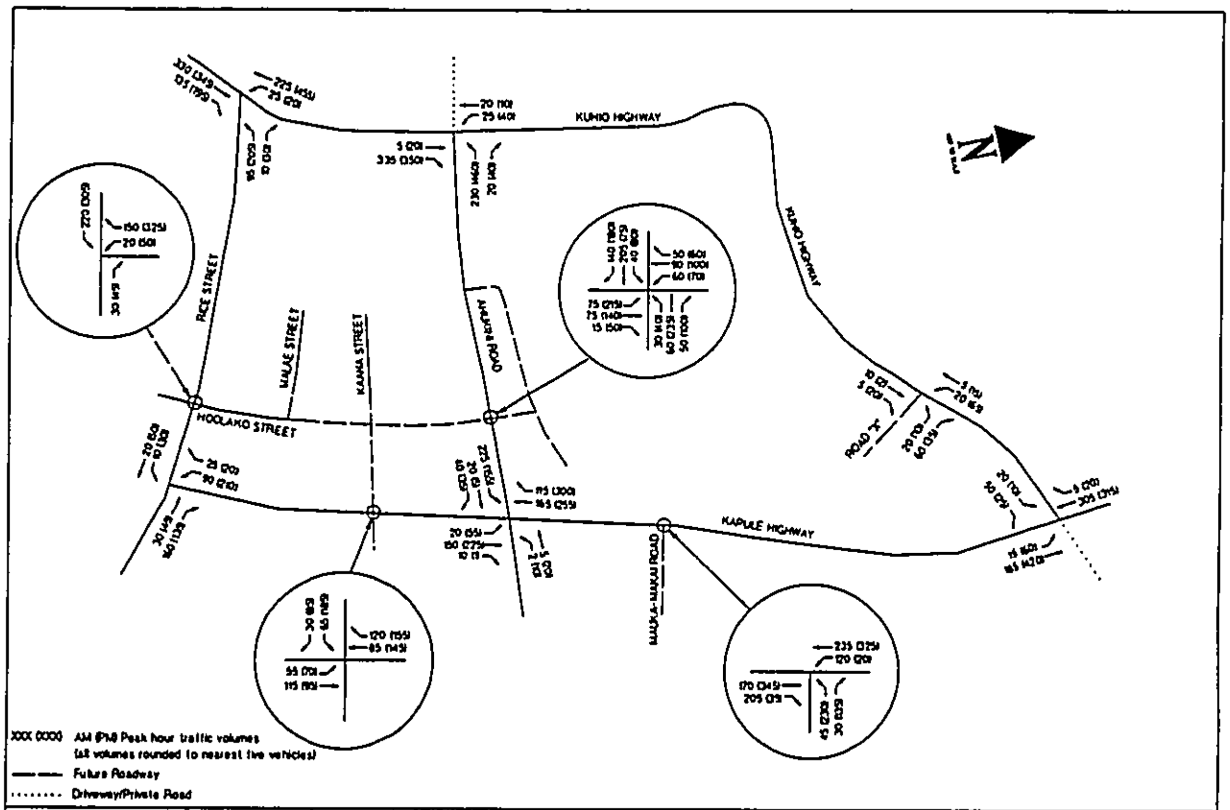
The forecasts of Year 2006 Base traffic without the proposed project are based on yearly growth of existing traffic volumes and proposed related development projects expected to be completed by the Year 2006 which could contribute traffic to the street system within the study area.

The background growth rate, which was applied to existing traffic volumes to estimate Year 2006 Base conditions, is based on the 1990 "Kauai County Highway Planning Study" and historical traffic counts obtained from the State Department of Transportation.



GENERAL DISTRIBUTION PATTERN

EXHIBIT 6



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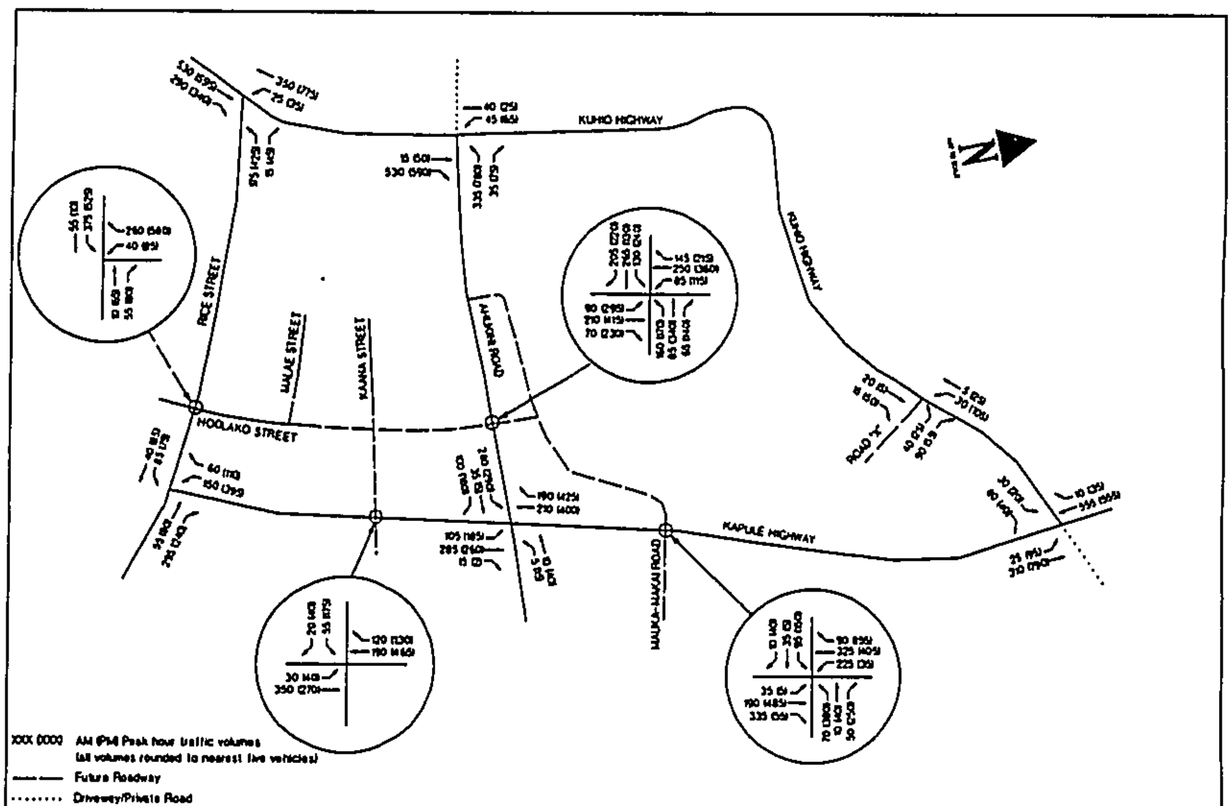
YEAR 2006 PROJECT ONLY TRAFFIC VOLUMES

EXHIBIT
7



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YEAR 2016 PROJECT ONLY TRAFFIC VOLUMES

EXHIBIT
8

The average annual traffic growth rate of approximately 9 percent per year in the Lihue-Hanamaulu area, as contained in the 1990 "Kauai Count Highway Planning Study" was adjusted to reflect the delayed growth in Lihue as a result of Hurricane Iniki. The basic assumption, in the estimation of the average annual growth rate, is the retardation of the Year 2010 forecast to the Year 2020. This assumption implies that: due to Hurricane Iniki, the expected growth in the Lihue area (as well as the whole island of Kauai) will be deferred approximately ten years. Based on existing Year 1994, post Iniki traffic volumes, and the estimated Year 2020 forecast, a 3.9 percent per year growth rate was derived and applied to estimate the Year 2006 and Year 2016 traffic conditions.

Traffic generated by the related developments, expected to be completed by the Year 2006, that would directly impact the analyzed intersections were also assigned to the study area. These related developments include the Wal-Mart Store, Molokoa III and Hanamaulu II.

Table 7 summarizes the trip generation from the related developments mentioned above and Exhibit 9 shows the location of the related projects. Exhibit 10 illustrates Year 2006 Base traffic volumes.

2. Year 2006 With Project Traffic Volumes

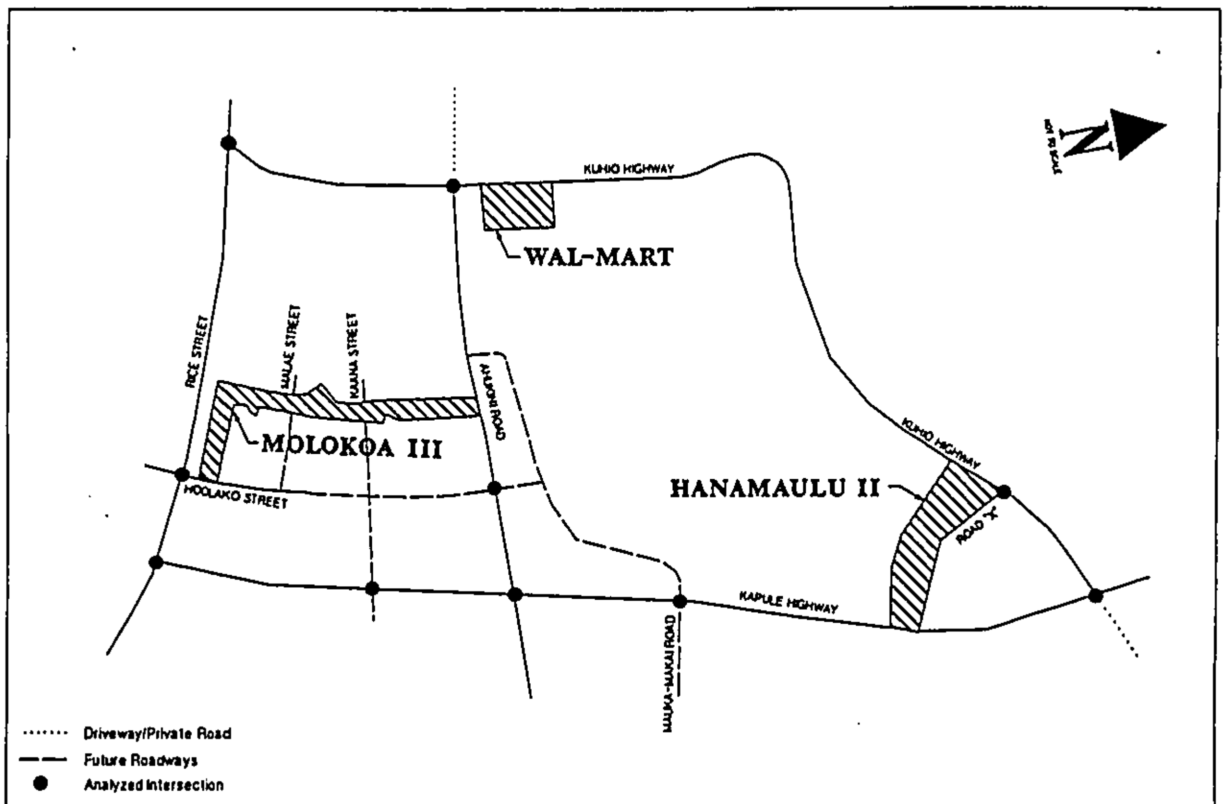
The proposed development generated traffic volumes were then added to Year 2006 Base traffic volumes. The resulting Year 2006 With Project intersection traffic volumes are illustrated on Exhibit 11.

C. Year 2016 Traffic Projections

The following sections describe Year 2016 Base (without project) and With Project traffic projections.

TABLE 7
SUMMARY OF RELATED DEVELOPMENTS TRIP GENERATION

LAND USE	SIZE	DAILY	AM			PM		
			IN	OUT	TOTAL	IN	OUT	TOTAL
WAL-MART	186 ksf	13,044	47	47	95	332	306	638
MOLOKOA III	180 du	1719	35	99	133	118	64	182
HANAMAULU II								
- Single Family	149 du	1423	29	82	110	98	53	150
- Multi-Family	64 du	375	5	23	28	23	12	35
Total	213 du	1798	33	105	138	121	65	186



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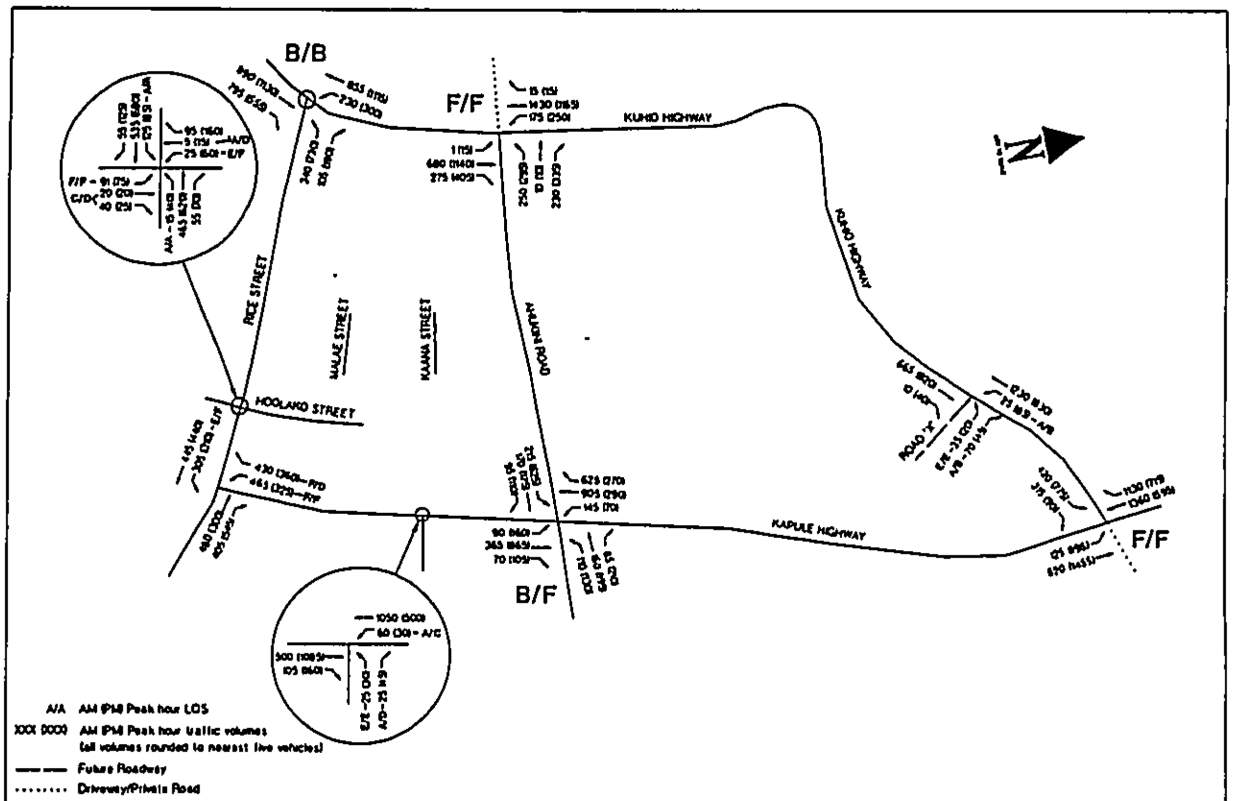
LOCATION OF RELATED DEVELOPMENTS

EXHIBIT
9



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YEAR 2006 BASE (WITHOUT PROJECT) TRAFFIC CONDITIONS

EXHIBIT
10

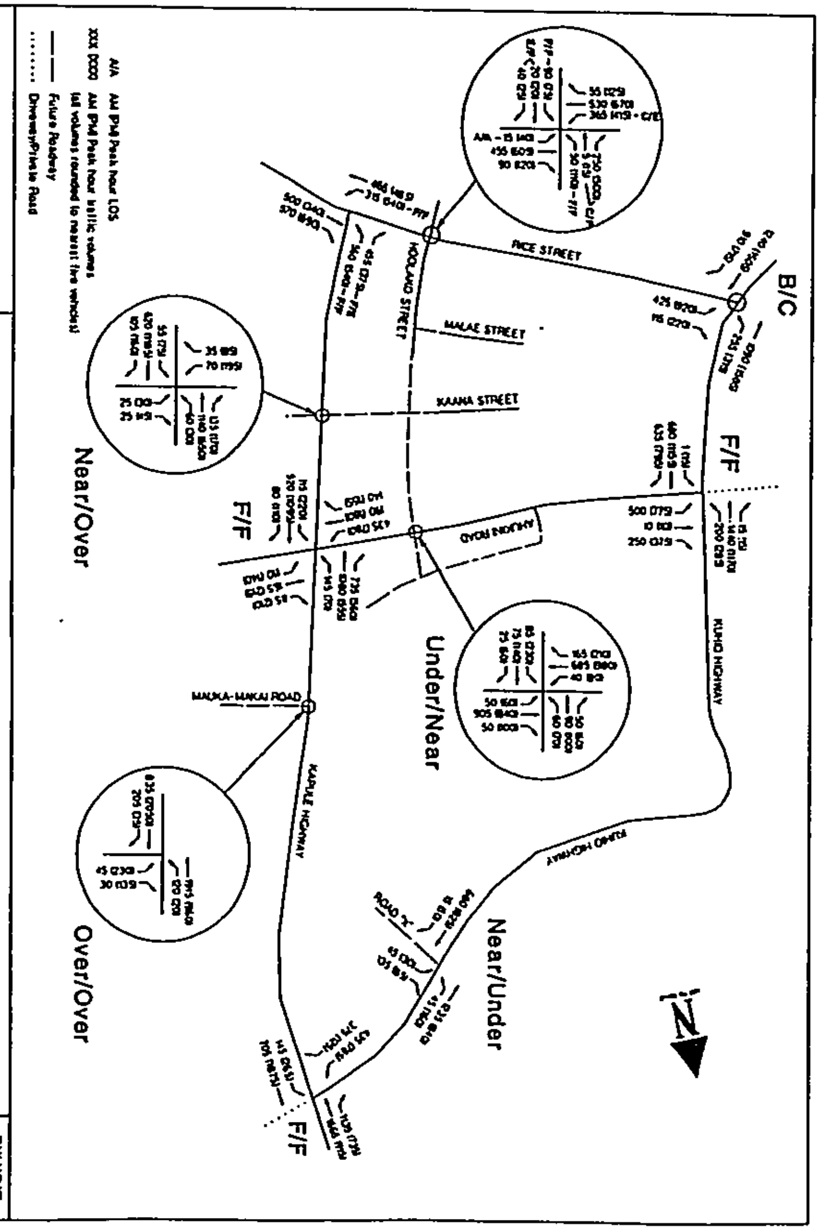
1. **Year 2016 Base (Without Project) Traffic Volumes**

The forecasts of Year 2016 Base traffic without the proposed project are based on yearly growth of existing traffic volumes and proposed related development projects expected to be completed by the Year 2016 which could contribute traffic to the street system within the study area.

The methodology and assumptions used to forecast the Year 2016 Base traffic are similar to the Year 2006 Base forecasts, which was described in the previous section. Exhibit 12 illustrates Year 2016 Base traffic volumes.

2. **Year 2016 With Project Traffic Volumes**

The proposed development generated traffic volumes were then added to Year 2016 Base traffic volumes. The resulting Year 2016 With Project intersection traffic volumes are illustrated on Exhibit 13.



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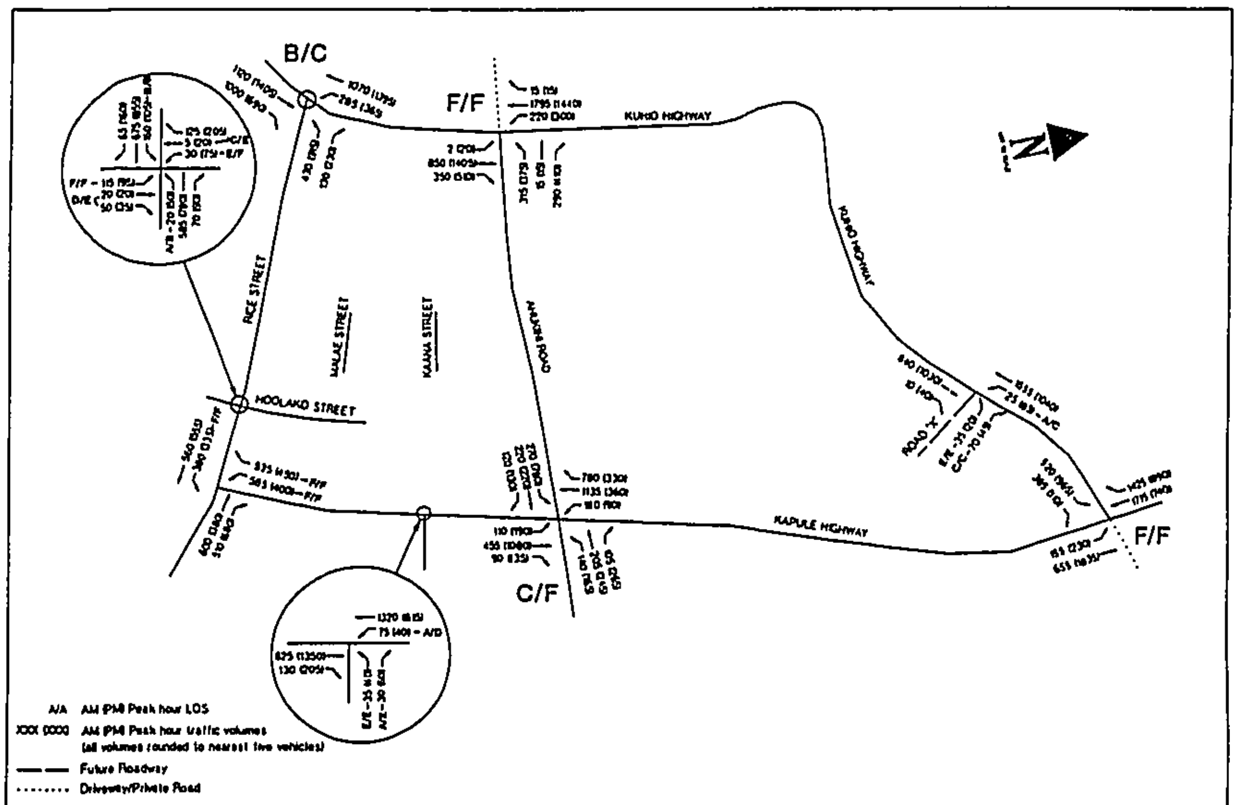
YEAR 2006 WITH PROJECT TRAFFIC CONDITIONS

EXHIBIT 11



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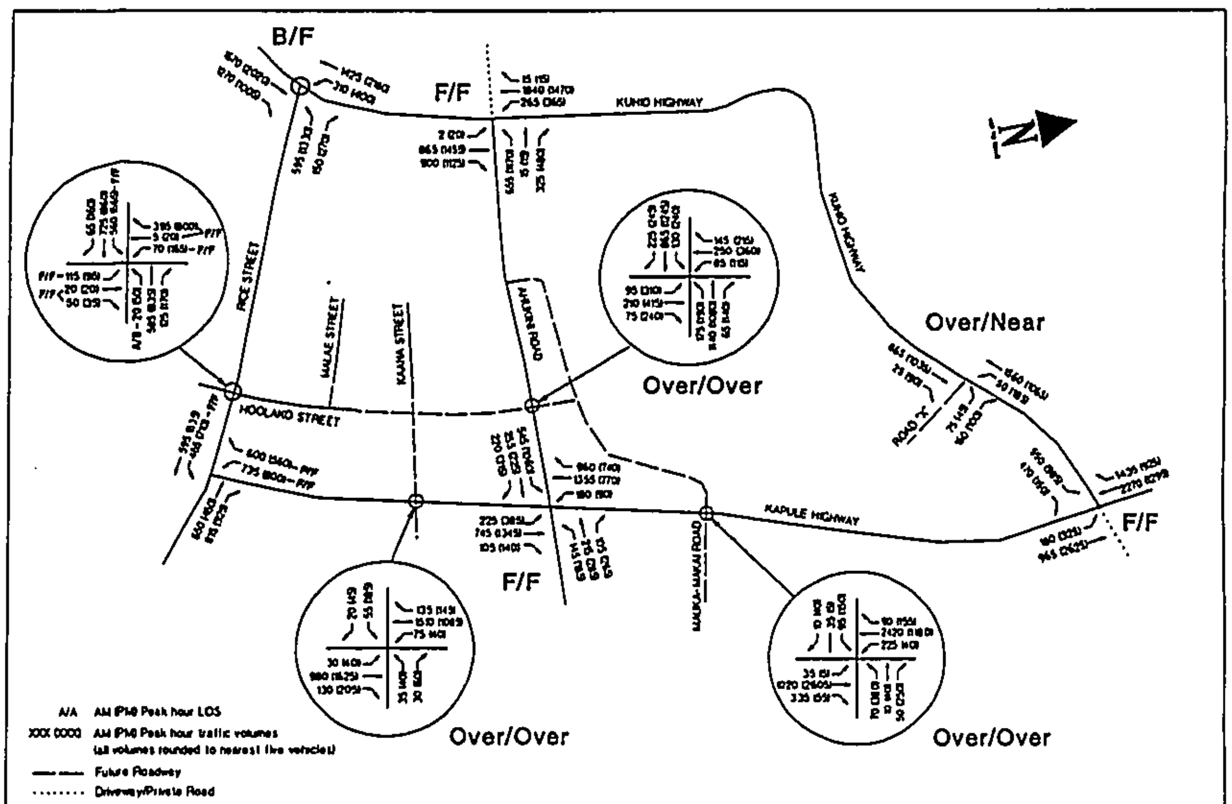
YEAR 2016 BASE (WITHOUT PROJECT) TRAFFIC CONDITIONS

EXHIBIT 12



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YEAR 2016 WITH PROJECT TRAFFIC CONDITIONS

EXHIBIT 13

IV. TRAFFIC IMPACT ANALYSIS

This section provides the results of the traffic impact analysis conducted to assess the potential project impacts on the Year 2006 and Year 2016 traffic conditions, based on the traffic forecasts developed in the previous section. The traffic impact analysis includes an assessment of projected Year 2006 and Year 2016 conditions both without and with the proposed Lihue-Hanamaulu Development for each of the ten analyzed intersections.

The "Planning" method of analysis, as described in the Highway Capacity Manual (Transportation Research Board, 1985), was applied to determine the level of service/capacity of intersections planned or assumed to be signalized. Under all future level of service analyses, signal timing plans were adjusted to reflect optimal level of service.

Potential roadway improvements and mitigation to alleviate traffic impacts within the study area will also be discussed for both Year 2006 and Year 2016 traffic conditions.

A. Year 2006 Traffic Impact Analysis

The following traffic scenarios will be discussed:

- Year 2006 base (without project) traffic impact analysis
- Year 2006 with project traffic impact analysis
- Year 2006 base with improvements
- Year 2006 with project, base improvements and project mitigation.

The Year 2006 traffic analyses assume the widening of Kaumualii Highway from its intersection at Kuhio Highway/Rice Street to Maluhia Road (in the vicinity of Koloa area) is completed. The improvement will include the realignment of Kuhio Highway and Kaumualii Highway to become the major

through roadway and Rice Street will become the minor street terminating as a T-intersection at Kuhio/Kaumualii Highway.

1. Year 2006 Base (Without Project) Traffic Impact Analysis

Exhibit 10 summarizes the Year 2006 Base, level of service at each of the eight analyzed intersections (the remaining other two intersections do not exist under base conditions) for the weekday AM and PM peak hours. Analysis indicates that, under base conditions, seven of the eight analyzed intersections will be operating at LOS E, F or OVER capacity either during the AM or PM peak hour, or both. The intersection of Kuhio Highway/Kaumualii Highway and Rice Street will be operating at LOS B during both AM and PM peak hours. Table 8 summarizes the Year 2006 Base level of service at each of the study intersections.

Traffic in the Lihue-Hanamaulu area is expected to increase and overall growth in the study area, without the Lihue-Hanamaulu Master Plan Development, will result in the deterioration of operating conditions at most major intersections. Recommended roadway improvements to alleviate base traffic impacts are discussed later on in this section.

2. Year 2006 With Project Traffic Impact Analysis

The Year 2006 With Project scenario was analyzed to determine the potential effect of the proposed development on the roadway system. The results indicate seven of the ten analyzed intersections will be operating at LOS E, F or OVER capacity either during the AM or PM peak hour or both. The results of the analysis are provided in Exhibit 11. The following lists the seven intersections operating at LOS E, F or OVER capacity under the Year 2006 With Project analysis:

- Hoolako Street and Rice Street (both AM and PM peak hours)
- Kapule Highway and Rice Street (both AM and PM peak hours)

TABLE 8
SUMMARY OF YEAR 2006 LEVEL OF SERVICE

	Intersection	EXISTING AM V/C	EXISTING AM DELAY	EXISTING AM LOS	EXISTING PM V/C	EXISTING PM DELAY	EXISTING PM LOS	BASE (WITHOUT PROJECT) AM V/C	BASE AM DELAY	BASE AM LOS	BASE PM V/C	BASE PM DELAY	BASE PM LOS	WITH PROJECT AM V/C	WITH PROJECT AM DELAY	WITH PROJECT AM LOS	WITH PROJECT PM V/C	WITH PROJECT PM DELAY	WITH PROJECT PM LOS
1	Kuhio Hwy & Rice St/ Kaumualii Hwy	0.59	16.1	C	0.83	42.8	E	0.50	6.6	B	0.80	10.4	B	0.62	7.5	B	0.65	21.1	C
2	Hoolaka St & Rice St [a]																		
	- southbound left-turn	-	218	C	-	116	D	-	72	E	-	-3	F	-	-32	F	-	-121	F
	- southbound thru & right	-	631	A	-	418	A	-	432	A	-	155	D	-	229	C	-	-367	F
	- northbound left-turn	-	152	D	-	71	E	-	-14	F	-	-38	F	-	-42	F	-	-47	F
	- northbound thru & right	-	443	A	-	320	B	-	241	C	-	126	D	-	73	E	-	-25	F
	- eastbound left-turn	-	735	A	-	664	A	-	529	A	-	449	A	-	230	C	-	40	E
	- westbound left-turn	-	773	A	-	830	A	-	802	A	-	432	A	-	804	A	-	437	A
3	Kapule Hwy & Rice St [a]																		
	- northbound left-turn	-	-248	F	-	-114	F	-	-614	F	-	-377	F	-	-847	F	-	-470	F
	- northbound right-turn	-	480	A	-	841	A	-	-19	F	-	136	D	-	-117	F	-	41	E
	- eastbound left-turn	-	337	B	-	291	C	-	81	E	-	-138	F	-	-22	F	-	-286	F
4	Kuhio Hwy & Ahukini Rd	0.54	6.1	B	0.62	9.8	B	0.86	60.2	F	1.15	164.4	F	1.12	84	F	1.36	123.2	F
5	Kapule Hwy & Ahukini Rd	0.40	18.8	C	0.54	44.9	E	0.57	11.4	B	0.86	83.1	F	0.81	63.8	F	1.03	112.4	F
6	Kapule Hwy & Kuhio Hwy	0.73	27.3	D	0.73	26.9	D	0.81	66.1	F	1.06	100.1	F	1.06	83.1	F	1.31	101.1	F
7	Kapule Hwy & Kaana St [b]													-	1290	Near	-	1443	Over
	- westbound left-turn	-	201	C	-	125	D	-	58	E	-	30	E						
	- westbound right-turn	-	537	A	-	642	A	-	541	A	-	184	D						
	- northbound left-turn	-	547	A	-	748	A	-	538	A	-	236	C						
8	Hoolaka St & Ahukini Rd	-	-	-	-	-	-	-	-	-	-	-	-	-	1130	Under	-	1371	Near
9	Kapule Hwy & Mauka-Makai Rd [b]	-	-	-	-	-	-	-	-	-	-	-	-	-	1980	Over	-	2296	Over
10	Road "X" & Kuhio Rd [a]	-	-	-	-	-	-							-	1329	Near	-	1011	Under
	- northbound left-turn							-	53	E	-	58	E						
	- northbound right-turn							-	403	A	-	339	B						
	- westbound left-turn							-	530	A	-	348	B						

□ Intersection operating at LOS E, F or at OVER capacity.
[a] Stop-controlled intersection, denotes available reserve capacity and corresponding LOS.
[b] Under existing and base conditions, only post office driveway will access Kapule Highway. Kaana Street extension will be in conjunction with the development.

- Kuhio Highway and Ahukini Road (both AM and PM peak hours)
- Kapule Highway and Ahukini Road (both AM and PM peak hours)
- Kapule Highway and Kuhio Highway (both AM and PM peak hours)
- Kapule Highway and Kaana Street (PM peak hour only)
- Kapule Highway and Mauka-Makai Road (both AM and PM peak hours)

Table 8 also summarizes Year 2006 With Project level of service for the ten study intersections.

As discussed earlier, under the Year 2006 Base conditions, the overall growth in the Lihue area will increase the traffic demand on the existing roadway system within the study area, resulting in long vehicular delay at most major intersections. With the addition of the Lihue-Hanamaulu Development traffic, vehicular delay will increase. The following discusses Base roadway improvements and project mitigation.

3. Year 2006 Base With Improvements

The following roadway improvements are recommended to accommodate the Year 2006 traffic demand without the proposed Lihue-Hanamaulu Development. The improvements are from the "Lihue Corridor Improvement Package" as recommended in the 1990 "Kauai Highway Planning study" by Kaku Associates, Inc.:

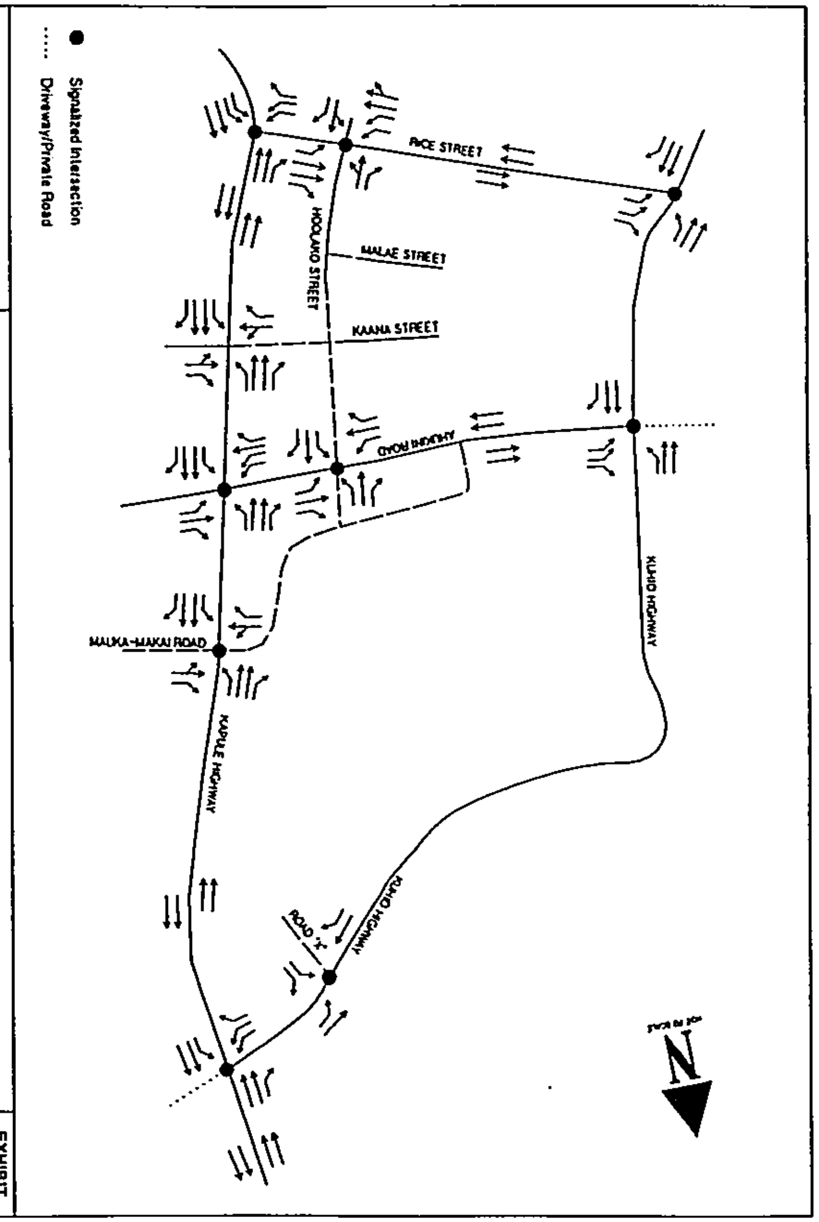
- The widening of Kuhio Highway to four lanes from south of Wailua Bridge to Kapule Highway.
- The widen Kapule Highway to four lanes from Kuhio Highway to Ahukini Road. This will include widening of the existing bridge over Hanamaulu Stream or the construction of a parallel bridge.

As a result of this study, the following additional roadway improvements are recommended to accommodate background traffic growth (without project) to the Year 2006 in the Lihue area:

- The widening of Kapule Highway to four lanes from Ahukini Road to Rice Street.
- Realignment of Kapule Highway and the east-leg of Rice Street to become the major through street while the west-leg of Rice Street will terminate as a T-intersection at Kapule Highway.
- Widen Rice Street to four lanes through Lihue Town (between Kuhio/Kaumualii Highway and to a point east of Kapule Highway)
- At the intersection of Kuhio Highway and Ahukini Road, provide the southbound approach with an exclusive left-turn lane and the northbound approach with an exclusive right-turn lane.
- Signalization of the following intersections:
  - Kapule Highway and Rice Street
  - Hoolako Street and Rice Street
  - Kapule Highway and Post Office Driveway
  - Kuhio Highway and Road "X"

Roadway and intersection configurations associated with the recommended improvements described above are illustrated in Exhibit 14.

Analysis indicates that, under the Year 2006 base with recommended improvements, all eight analyzed intersections will be operating at acceptable level of service during both AM and PM peak hours. Table 9 summarizes the results of the level of service at each of



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YEAR 2006 BASE IMPROVEMENTS & PROJECT MITIGATION - INTERSECTION CONFIGURATIONS

EXHIBIT 14

the eight analyzed intersections assuming the base improvements described above are implemented.

4. **Year 2006 With Project, Recommended Base Improvements and Project Mitigation**

The impact of the project generated traffic on the Year 2006 traffic conditions were analyzed assuming the implementation of the base improvements described above. Table 9 summarizes the level of service results. With the implementation of the recommended base improvements, only the intersection of Kuhio Highway and Ahukini Road will be operating at LOS F (PM peak hour only).

To accommodate the Year 2006 project generated traffic, the following mitigation measures are recommended:

- An additional westbound left-turn lane on Ahukini Road, at the intersection of Kuhio Highway and Ahukini Road is recommended. With this recommended project mitigation, the intersection will operate at LOS B during the PM peak hour of traffic.
- Although the intersection of Hoolako Street and Rice Street is estimated to be operating at UNDER capacity, an additional eastbound left-turn lane and an exclusive westbound right-turn lane on Rice Street are recommended to accommodate the high eastbound left-turn and westbound right-turn traffic, respectively.

With the implementation of the recommended base improvements and project mitigation, all analyzed intersections will be operating at acceptable levels of service.

Intersections configurations illustrating the recommended project mitigation are also illustrated on Exhibit 14.

TABLE 9
SUMMARY OF YEAR 2006 WITH MITIGATION LEVEL OF SERVICE

	Intersection	BASE (WITHOUT PROJECT)						WITH PROJECT						BASE (WITHOUT PROJECT) WITH IMPROVEMENTS						WITH PROJECT + BASE IMPROVEMENTS						WITH PROJECT + BASE IMPROVEMENTS + MITIGATION					
		AM			PM			AM			PM			AM			PM			AM			PM			AM			PM		
		V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS
1	Kuhio Hwy & Rice St/ Kanuali Hwy	0.50	8.6	B	0.56	16.4	B	0.52	7.5	B	0.56	21.1	C	0.50	8.6	B	0.56	18.4	B	0.52	7.5	B	0.56	21.1	C	-	-	-	-	-	-
2	Hoolako St & Rice St [a,b]													-	534	Under	-	609	Under	-	790	Under	-	1060	Under	-	845	Under	-	732	Under
	- southbound left-turn	-	72	[illegible]	-	-3	[illegible]	-	-32	[illegible]	-	-121	[illegible]																		
	- southbound thru & right	-	432	A	-	156	D	-	329	C	-	-547	[illegible]																		
	- northbound left-turn	-	-14	[illegible]	-	-36	[illegible]	-	-82	[illegible]	-	-47	[illegible]																		
	- northbound thru & right	-	241	C	-	129	D	-	73	[illegible]	-	-25	[illegible]																		
	- eastbound left-turn	-	328	A	-	449	A	-	330	C	-	46	[illegible]																		
	- westbound left-turn	-	682	A	-	432	A	-	604	A	-	437	A																		
3	Kapule Hwy & Rice St [a,b]													-	877	Under	-	803	Under	-	754	Under	-	743	Under	-	-	-	-	-	-
	- southbound left-turn	-	-414	[illegible]	-	-377	[illegible]	-	-447	[illegible]	-	-638	[illegible]																		
	- southbound right-turn	-	-15	[illegible]	-	136	D	-	-117	[illegible]	-	41	[illegible]																		
	- eastbound left-turn	-	81	[illegible]	-	-139	[illegible]	-	-22	[illegible]	-	-266	[illegible]																		
4	Kuhio Hwy & Ahukini Rd	0.95	60.2	[illegible]	1.15	104.4	[illegible]	1.12	64	[illegible]	1.50	123.2	[illegible]	0.56	6.8	B	0.64	8.6	B	0.70	8.6	B	0.90	72.1	[illegible]	0.56	7.1	B	0.76	12.6	B
5	Kapule Hwy & Ahukini Rd	0.57	11.4	B	0.99	65.1	[illegible]	0.81	83.9	[illegible]	1.03	112.4	[illegible]	0.42	8.3	B	0.50	11.3	B	0.60	13.0	B	0.66	15.8	C	-	-	-	-	-	-
6	Kapule Hwy & Kuhio Hwy	0.91	66.1	[illegible]	1.06	100.1	[illegible]	1.06	83.1	[illegible]	1.31	101.1	[illegible]	0.63	7.3	B	0.62	8.4	B	0.70	8.6	B	0.75	10.4	B	-	-	-	-	-	-
7	Kapule Hwy & Kaana St [b,d]							-	1290	Near	-	1443	Over	-	542	Under	-	606	Under	-	666	Under	-	616	Under	-	-	-	-	-	-
	- westbound left-turn	-	64	[illegible]	-	60	[illegible]																								
	- westbound right-turn	-	641	A	-	104	D																								
	- southbound left-turn	-	536	A	-	236	C																								
8	Hoolako St & Ahukini Rd [b]	-	-	-	-	-	-	-	1130	Under	-	1371	Near	-	-	-	-	-	-	-	1130	Under	-	1371	Near	-	-	-	-	-	-
9	Kapule Hwy & Mauka-Makai Rd [b]	-	-	-	-	-	-	-	1060	Over	-	2250	Over	-	-	-	-	-	-	-	1003	Under	-	1274	Near	-	-	-	-	-	-
10	Road "X" & Kuhio Rd [a]							-	1329	Near	-	1011	Under	-	1290	Near	-	926	Under	-	1329	Near	-	1011	Under	-	-	-	-	-	-
	- northbound left-turn	-	63	[illegible]	-	66	[illegible]																								
	- northbound right-turn	-	403	A	-	333	B																								
	- westbound left-turn	-	536	A	-	344	B																								

Intersection operating at LOS E, F or at OVER capacity.
[a] Stop-controlled intersection, denotes available reserve capacity and corresponding LOS.
[b] Analyzed as a signalized intersection under "future with improvements" conditions. HCM Planning Method used, denotes critical volume and LOS (Under, Near or Over capacity).
[c] Intersection LOS improves due to signal-timing optimization.
[d] Under existing and base conditions, only post office driveway will access Kapule Highway. Kaana Street extension will be in conjunction with the development.

B. Year 2016 Traffic Impact Analysis

The following traffic scenarios will be discussed:

- Year 2016 base (without project) traffic impact analysis
- Year 2016 with project traffic impact analysis
- Year 2016 base with improvements
- Year 2016 with project, base improvements and project mitigation.

The Year 2016 traffic analyses assume the widening of Kaumualii Highway from its intersection at Kuhio Highway/Rice Street to Maluhia Road (in the vicinity of Koloa area) is completed. The improvement will include the realignment of Kuhio Highway and Kaumualii Highway to become the major through roadway and Rice Street will become the minor street which will terminate as a T-intersection at Kuhio/Kaumualii Highway.

1. Year 2016 Base (Without Project) Traffic Impact Analysis

Exhibit 12 summarizes the Year 2016 Base, level of service at each of the eight analyzed intersections (the remaining other two intersections do not exist under base conditions) for the weekday AM and PM peak hours. Under base conditions, seven of the eight analyzed intersections will be operating at LOS E, F or OVER capacity either during the AM or PM peak hour, or both. The intersection of Kuhio/Kaumualii Highway and Rice Street will be operating at LOS B and LOS C during the AM and PM peak hours, respectively. Table 10 summarizes the Year 2016 Base level of service at each of the study intersections.

Traffic in the Lihue-Hanamaulu area is expected to increase and overall growth in the study area (without the Lihue-Hanamaulu Master Plan Development), will result in traffic congestion at most major intersections. Recommended roadway improvements to alleviate base traffic impacts are discussed later on in this section.

TABLE 10
SUMMARY OF YEAR 2016 LEVEL OF SERVICE

	Intersection	EXISTING						BASE (WITHOUT PROJECT)						WITH PROJECT					
		AM			PM			AM			PM			AM			PM		
		V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS
1	Kuhio Hwy & Rice St/ Kaumualii Hwy	0.58	16.1	C	0.63	42.6	E	0.85	8.8	B	0.83	21.7	C	0.83	14.9	B	1.14	82.6	F
2	Hoolako St & Rice St [a]																		
	- southbound left-turn	-	218	C	-	118	D	-	18	E	-	-35	F	-	-82	F	-	-190	F
	- southbound thru & right	-	631	A	-	418	A	-	279	C	-	34	E	-	-443	F	-	-447	F
	- northbound left-turn	-	152	D	-	71	E	-	-80	F	-	-82	F	-	-133	F	-	-118	F
	- northbound thru & right	-	463	A	-	329	B	-	118	D	-	96	E	-	-43	F	-	-84	F
	- eastbound left-turn	-	736	A	-	664	A	-	347	B	-	316	B	-	-117	F	-	-387	F
	- westbound left-turn	-	773	A	-	620	A	-	481	A	-	311	B	-	450	A	-	318	B
3	Kapule Hwy & Rice St [a]																		
	- southbound left-turn	-	-348	F	-	-114	F	-	-478	F	-	-443	F	-	-483	F	-	-929	F
	- southbound right-turn	-	480	A	-	641	A	-	-348	F	-	-47	F	-	-404	F	-	-296	F
	- eastbound left-turn	-	337	B	-	281	C	-	-119	F	-	-388	F	-	-335	F	-	-582	F
4	Kuhio Hwy & Ahukini Rd	0.54	8.1	B	0.62	9.8	B	1.22	142.4	F	1.41	181.8	F	1.49	123.4	F	2.12	124.8	F
5	Kapule Hwy & Ahukini Rd	0.40	18.8	C	0.58	48.9	E	0.73	22.1	C	1.04	115.8	E	1.06	67.8	E	1.36	125.9	F
6	Kapule Hwy & Kuhio Hwy	0.73	27.3	D	0.75	28.9	D	1.14	83.9	F	1.36	101.8	F	1.43	64.7	F	1.77	121.4	E
7	Kapule Hwy & Kaana St [b]																		
	- westbound left-turn	-	201	C	-	125	D	-	45	E	-	31	E	-	21	E	-	12	E
	- westbound right-turn	-	537	A	-	842	A	-	435	A	-	96	E	-	355	C	-	78	E
	- southbound left-turn	-	587	A	-	748	A	-	414	A	-	140	D	-	234	C	-	140	D
8	Hoolako St & Ahukini Rd	-	-	-	-	-	-	-	-	-	-	-	-	-	1815	Over	-	2100	Over
9	Kapule Hwy & Mauka-Makai Rd [b]	-	-	-	-	-	-	-	-	-	-	-	-	-	2562	Over	-	3031	Over
10	Road "X" & Kuhio Rd [a]	-	-	-	-	-	-							-	1636	Over	-	1278	Near
	- northbound left-turn							-	52	E	-	51	E						
	- northbound right-turn							-	300	C	-	238	C						
	- westbound left-turn							-	423	A	-	245	C						

☐ Intersection operating at LOS E, F or at OVER capacity.
[a] Stop-controlled intersection, denotes available reserve capacity and corresponding LOS.
[b] Under existing and base conditions, only post office driveway will access Kapule Highway. Kaana Street extension will be in conjunction with the development.

2. **Year 2016 With Project Traffic Impact Analysis**

The Year 2016 With Project scenario was analyzed to determine the potential effect of the proposed development on the base roadway system. The results of the analysis are provided in Exhibit 13.

The results indicate all ten analyzed intersections will be operating at LOS E, F or OVER capacity either during the AM or PM peak hour or both. Table 10 summarizes the Year 2016 With Project level of service for the ten analyzed intersections.

As discussed earlier, under the Year 2016 Base conditions, the overall growth in the Lihue area will increase the traffic demand on the existing roadway system within the study area, resulting in traffic congestion at most major intersections. With the addition of the Lihue-Hanamaulu Master Plan Development traffic, vehicular delay at most intersections will increase. The following discusses Base roadway improvements and project mitigation.

3. **Year 2016 Base With Improvements**

The following roadway improvements are recommended to be implemented to accommodate the Year 2016 traffic demand <u>without</u> the proposed Lihue-Hanamaulu Master Plan Development as recommended in the 1990 "Kauai Highway Planning study".

- The widening of Kuhio Highway to four lanes from south of Wailua Bridge to Kapule Highway.
- The widening of Kapule Highway to four lanes from Kuhio Highway to Ahukini Road. This will include the widening of the existing bridge over Hanamaulu Stream or the construction of a parallel bridge to the existing bridge.

- The construction of a mauka Lihue bypass highway from the vicinity north of the intersection of Kapule Highway and Kuhio Highway and extending southwest, connecting at Kaumualii Highway west of Puhi.
- The realignment and widening of Ahukini Road to four lanes from Kapule Highway to Kuhio Highway. Although no alignment has been determined, possible realignment of Ahukini Road with Ehiku Street via the cane-haul road may be the most feasible option.
- The extension of the four-lane Ahukini Road mauka from Kuhio Highway to the future bypass highway.

As a result of this study, the following are additional roadway and intersection improvements recommended to accommodate background traffic growth (without project) to the Year 2016:

- The widening of Kapule Highway to four lanes from Ahukini Road to Rice Street.
- Realignment of Kapule Highway and the east-leg of Rice Street to become the major through street while the west-leg of Rice Street will terminate as a T-intersection at Kapule Highway/Rice Street.
- Widening of Rice Street to four lanes through Lihue Town (between Kuhio/Kaumualii Highway and to a point east of Kapule Highway)
- Signalization of the following intersections:
  - Kapule Highway and Rice Street
  - Hoolako Street and Rice Street
  - Kapule Highway and Post Office Driveway
  - Kuhio Highway and Road "X".

Lane configurations of intersection improvements associated with the recommended improvements listed above are illustrated in Exhibit 15.

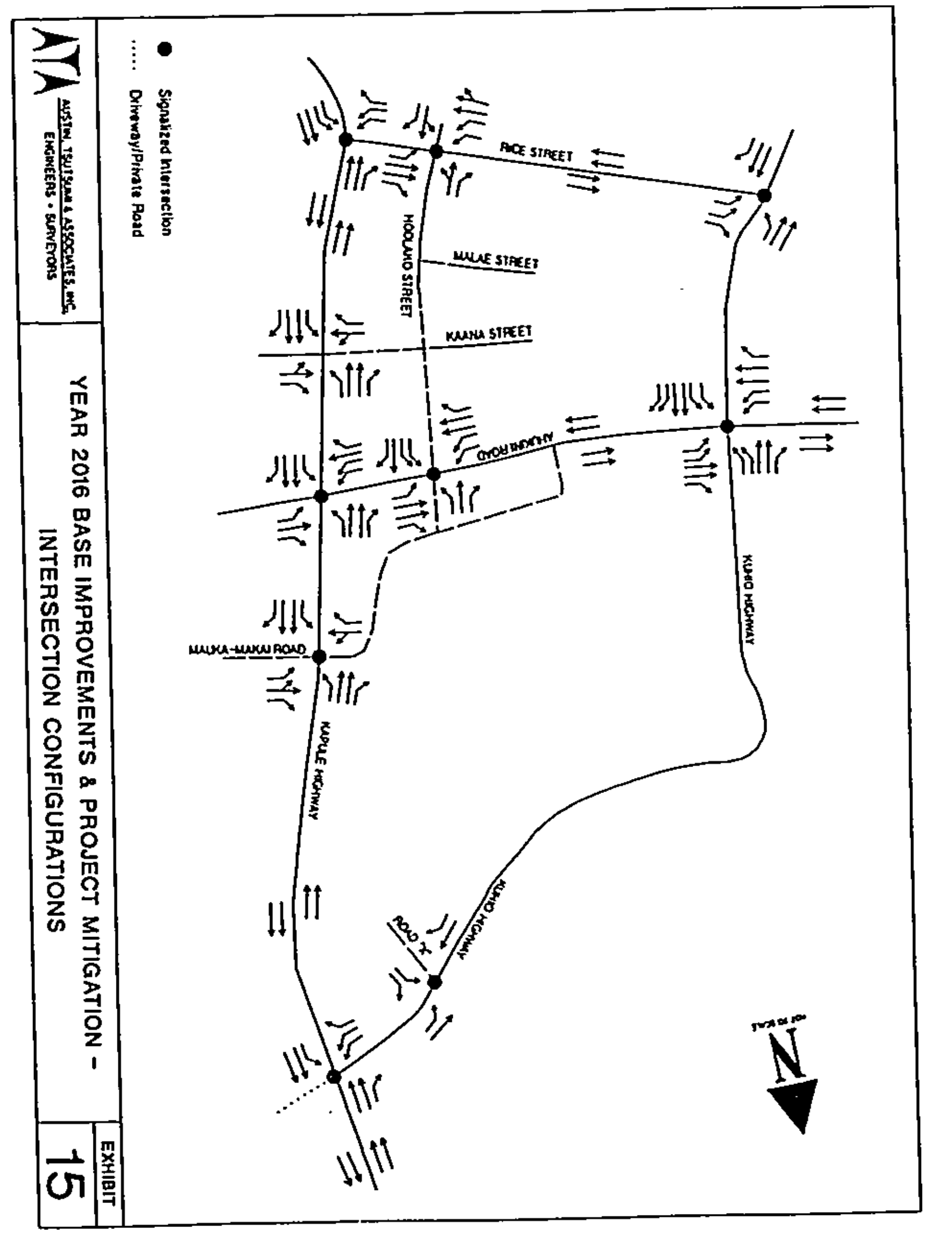
Under the Year 2016 base (without project) with recommended improvements, all eight analyzed intersections will be operating at acceptable level of service during both AM and PM peak hours. Exhibit 16 illustrates the level of service results and Table 11 summarizes the results of the level of service at each of the eight analyzed intersections.

4. **Year 2016 With Project, Recommended Base Improvements and Project Mitigation**

The Year 2016 with project generated traffic were analyzed assuming the implementation of the Year 2016 base improvements described above. With the implementation of the recommended Year 2016 base improvements, only the intersection of Kuhio Highway and Ahukini Road will be operating at LOS F during the PM peak hour. The remaining nine intersections will be operating at acceptable level of service. Table 11 summarizes the level of service results.

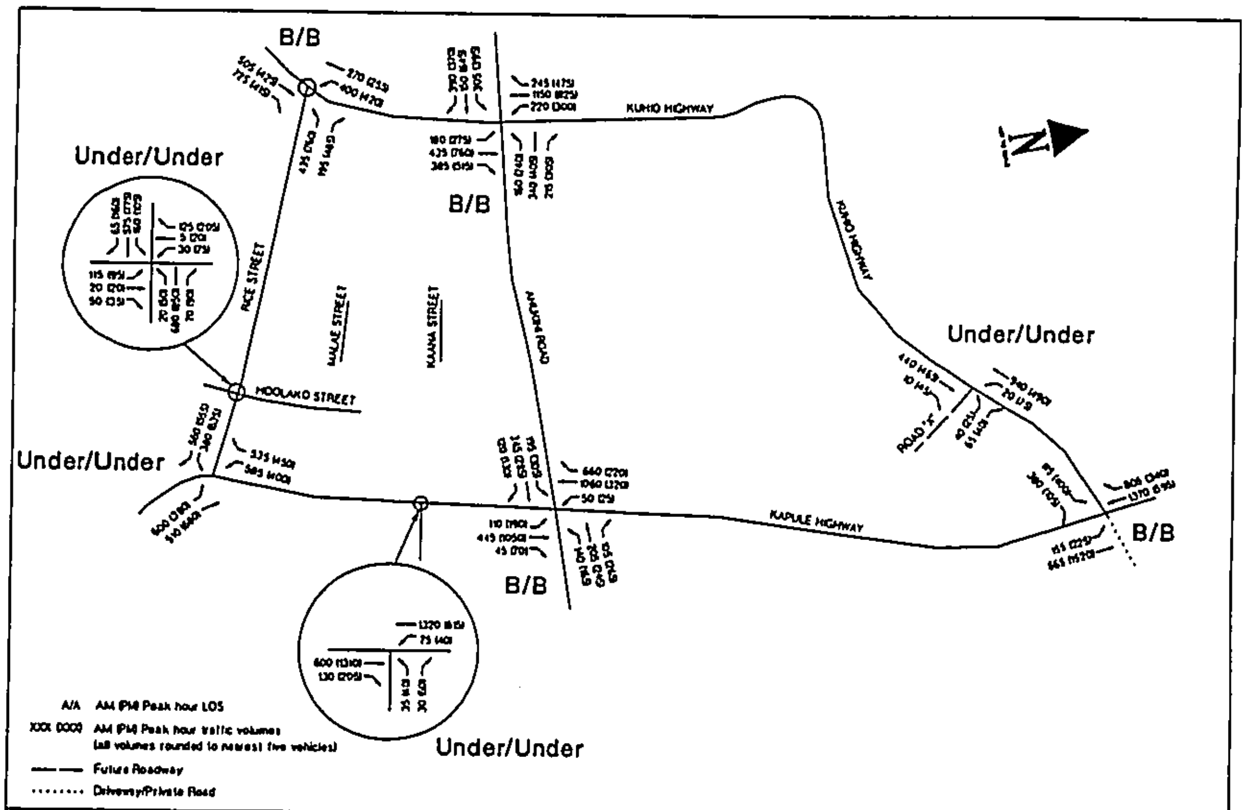
The following mitigation measures are recommended to accommodate the Year 2016 project generated traffic:

- At the intersection of Kuhio Highway and Ahukini Road, provided each of the approaches with dual, exclusive left-turn lanes. In addition, provide the northbound approach with a dual exclusive right-turn lane from Kuhio Highway to Ahukini Road. With the implementation of the recommended mitigation, the intersection of Kuhio Highway and Ahukini Road will be operating at LOS D during the PM peak hour.
- Although the intersection of Hoolako Street and Rice Street is estimated to be operating at Under and Near capacity (AM and PM



YEAR 2016 BASE IMPROVEMENTS & PROJECT MITIGATION - INTERSECTION CONFIGURATIONS

EXHIBIT 15



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YEAR 2016 BASE WITH IMPROVEMENTS TRAFFIC CONDITIONS

EXHIBIT 16

TABLE 11
SUMMARY OF YEAR 2016 WITH MITIGATION LEVEL OF SERVICE

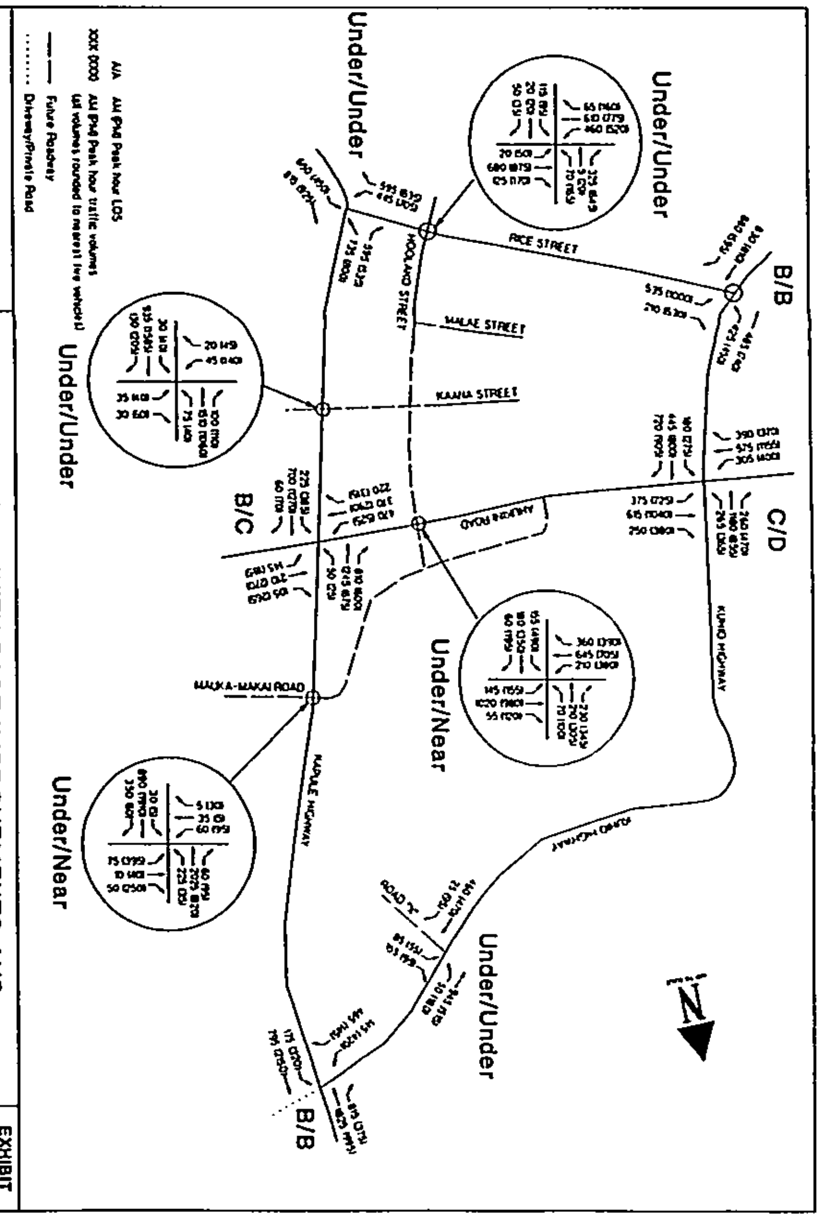
	Intersection	BASE (WITHOUT PROJECT)						WITH PROJECT						BASE (WITHOUT PROJECT) WITH BASE IMPROVEMENTS						WITH PROJECT AND BASE IMPROVEMENTS						WITH PROJECT + BASE IMPROVEMENTS + MITIGATION					
		AM			PM			AM			PM			AM			PM			AM			PM			AM			PM		
		V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS	V/C	DELAY	LOS
1	Kuhio Hwy & Rice St/ Kaumualii Hwy	0.66	8.8	B	0.83	21.7	C	0.83	14.9	B	1.14	82.8	[illegible]	0.46	8.8	B	0.45	9.3	B	0.64	8.5	B	0.80	11.8	B						
2	Hoolako St & Rice St [a,b]													-	711	Under	-	789	Under	-	1076	Under	-	1345	Near	-	723	Under	-	888	Under
	- southbound left-turn	-	18	[illegible]	-	-36	[illegible]	-	-82	[illegible]	-	-180	[illegible]																		
	- southbound thru & right	-	270	C	-	34	[illegible]	-	-443	[illegible]	-	-847	[illegible]																		
	- northbound left-turn	-	-60	[illegible]	-	-62	[illegible]	-	-133	[illegible]	-	-110	[illegible]																		
	- northbound thru & right	-	110	D	-	44	[illegible]	-	-43	[illegible]	-	-84	[illegible]																		
	- eastbound left-turn	-	347	B	-	318	B	-	-117	[illegible]	-	-387	[illegible]																		
	- westbound left-turn	-	491	A	-	311	B	-	480	A	-	318	B																		
3	Kapule Hwy & Rice St [a,b]													-	784	Under	-	787	Under	-	1088	Under	-	1038	Under						
	- southbound left-turn	-	-878	[illegible]	-	-443	[illegible]	-	-483	[illegible]	-	-820	[illegible]																		
	- southbound right-turn	-	-348	[illegible]	-	-87	[illegible]	-	-404	[illegible]	-	-286	[illegible]																		
	- eastbound left-turn	-	-119	[illegible]	-	-384	[illegible]	-	-334	[illegible]	-	-482	[illegible]																		
4	Kuhio Hwy & Ahukini Rd	1.22	142.4	[illegible]	1.41	181.8	[illegible]	1.40	123.4	[illegible]	2.12	124.8	[illegible]	0.54	13.2	B	0.66	14.4	B	0.77	20.4	C	0.83	46.4	[illegible]	0.70	17.8	C	0.87	38.3	D
5	Kapule Hwy & Ahukini Rd	0.73	22.1	C	1.04	118.9	[illegible]	1.08	87.8	[illegible]	1.38	136.9	[illegible]	0.53	11.5	B	0.60	10.7	B	0.60	15.0	B	0.72	15.0	C						
6	Kapule Hwy & Kuhio Hwy	1.14	63.9	[illegible]	1.36	101.8	[illegible]	1.40	84.7	[illegible]	1.77	121.4	[illegible]	0.53	6.4	B	0.51	6.6	B	0.67	6.8	B	0.71	8.8	B						
7	Kapule Hwy & Kaana St [b,d]													-	882	Under	-	738	Under	-	841	Under	-	1013	Under						
	- westbound left-turn	-	45	[illegible]	-	31	[illegible]	-	21	[illegible]	-	12	[illegible]																		
	- westbound right-turn	-	436	A	-	86	[illegible]	-	265	C	-	78	[illegible]																		
	- southbound left-turn	-	414	A	-	140	D	-	234	C	-	140	D																		
8	Hoolako St & Ahukini Rd [b]	-	-	-	-	-	-	-	1618	[illegible]	-	2106	[illegible]	-	-	-	-	-	-	-	803	Under	-	1233	Near						
9	Kapule Hwy & Maalo-Makai Rd [b]	-	-	-	-	-	-	-	2642	Over	-	3031	Over	-	-	-	-	-	-	-	1179	Under	-	1311	Near						
10	Road "X" & Kuhio Hwy [a]							-	1636	Over	-	1270	Near	-	877	Under	-	588	Under	-	1049	Under	-	793	Under						
	- northbound left-turn	-	52	[illegible]	-	61	[illegible]																								
	- northbound right-turn	-	300	C	-	239	C																								
	- westbound left-turn	-	423	A	-	345	C																								

[~] Intersection operating at LOS E, F or at OVER capacity.
[a] Stop-controlled intersection, denotes available reserve capacity and corresponding LOS.
[b] Analyzed as a signalized intersection under "future with improvements" conditions. HCM Planning Method used, denotes critical volume and LOS (Under, Near or Over capacity).
[c] Intersection LOS improves due to signal-timing optimization.
[d] Under existing and base conditions, only post office driveway will access Kapule Highway. Kaana Street extension will be in conjunction with the development.

peak hour, respectively), under the Year 2016 with project and base improvements, an additional exclusive eastbound left-turn lane and exclusive westbound right-turn lane on Rice Street are recommended to accommodate the high eastbound left-turn and westbound right-turn traffic, respectively.

With the implementation of the recommended base improvements and project mitigation, all ten analyzed intersections will be operating at acceptable levels of service.

Intersection configurations illustrating the recommended project mitigation are also illustrated on Exhibit 15. Exhibit 17 summarizes the Year 2016 With Project, base improvements and project mitigation traffic conditions.



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YEAR 2016 WITH BASE IMPROVEMENTS AND PROJECT MITIGATION TRAFFIC CONDITIONS

EXHIBIT 17

V. CONCLUSIONS AND RECOMMENDATIONS

This study was undertaken to analyze the potential traffic impacts of the proposed Lihue-Hanamaulu Master Plan Development. The following summarizes the conclusions and recommendations of the study.

A. Conclusions

- Existing traffic entering Lihue Town is moderate and is presently accommodated without significant vehicular delays.
- Under existing conditions, four of the seven analyzed intersections are operating at LOS E or F during either the AM or PM peak hours, or both.
- By the Year 2006, the Proposed Lihue-Hanamaulu Development will generate a total of 2,120 vehicular trips during the AM peak hour of traffic and a total of 3,225 vehicular trips during the PM peak hour of traffic.
- By the Year 2016, the Proposed Lihue-Hanamaulu Development will generate a total of 3,755 vehicular trips during the AM peak hour of traffic and a total of 5,890 vehicular trips during the PM peak hour of traffic.
- Approximately 40% of the traffic generated by the development's residential uses will remain in the combined Lihue/Nawiliwili area. The remaining 60% of traffic generated by residential use will be outbound (from Lihue) and will be travelling against the peak inbound (into Lihue) traffic.
- Approximately 30% of the traffic generated by retail and office uses will be from within the Lihue area.
- Under Year 2006 Base (without project) conditions, seven of the eight analyzed intersections will be operating at LOS E, F or OVER capacity during either the AM or PM peak hour or both. The forecasted traffic demand on the existing major roadways (without base improvements) in Lihue will exceed the traffic handling capacity.

- Under Year 2006 With Project conditions (without base improvements or project mitigation), seven of the ten analyzed intersections will be operating at LOS E, F or OVER capacity during either the AM or PM peak hour, or both.
- Under Year 2016 Base (without project) conditions, seven of the eight analyzed intersections will be operating at LOS E, F or OVER capacity during either the AM or PM peak hour or both. The forecasted traffic demand on the existing major roadways (without base improvements) in Lihue will exceed the traffic handling capacity.
- Under Year 2016 With Project conditions (without base improvements or project mitigation), all ten analyzed intersections will be operating at LOS E, F or OVER capacity during either the AM or PM peak hour, or both.

B. Recommendations

- Based on the October 1990 "Kauai County Highway Planning Study" prepared by Kaku Associates, Inc., the following base roadway improvements are recommended to accommodate Year 2006 base (without project) traffic demand within the study area.

1. The widening of Kuhio Highway to four lanes from south of Wailua Bridge to Kapule Highway.
2. The widening of Kapule Highway to four lanes from Kuhio Highway to Ahukini Road.

As a result of this study, the following are additional base improvements recommended to alleviate Year 2006 Base (without project) traffic:

1. The widening of Kapule Highway to four lanes from Ahukini Road to Rice Street.

2. Realignment of Kapule Highway and the east-leg of Rice Street to become the major through street while the west-leg of Rice Street will terminate as a T-intersection at Kapule Highway/Rice Street.
3. Widening of Rice Street to four lanes through Lihue Town.
4. At the intersection of Kuhio Highway and Ahukini Road, provide the southbound approach with an exclusive left-turn lane and the northbound approach with an exclusive right-turn lane.
5. Signalization of the following intersections:
   - Kapule Highway and Rice Street
   - Hoolako Street and Rice Street
   - Kapule Highway and Post Office Driveway
   - Kuhio Highway and Road "X".

In addition, the following project mitigation are required to accommodate the Year 2006 with project traffic.

1. At the intersection of Kuhio Highway and Ahukini Road, provide the westbound approach on Ahukini Road with an additional left-turn lane. The westbound approach will include two exclusive left-turn lanes and one right-turn lane.
2. At the intersection of Hoolako Street and Rice Street, provide the westbound approach on Rice Street with an exclusive right-turn lane. The westbound approach will include one exclusive left-turn lane, two through lanes, and one exclusive right-turn lane. Also, provide the eastbound approach on Rice Street with and additional exclusive left-turn lane. The eastbound approach will include two exclusive left-turn lanes, one through lane and one shared through and right-turn lane.

With the base improvements and project mitigation described above, all ten analyzed intersections will be operating at acceptable level of service under the Year 2006 with project traffic conditions.

- The following describes the recommended intersection configurations at intersections with project access roadways and existing roadways under the Year 2006 with project traffic conditions:

  Ahukini Road And Hoolako Street - Signalize the intersection and provide both the northbound and southbound approaches on Hoolako Street with one exclusive left-turn lane, one through lane and one exclusive right-turn lane. Provide both the eastbound and westbound approaches on Ahukini Road with one exclusive left-turn lane and one exclusive right-turn lane from Ahukini Road to Hoolako Street.

  Kapule Highway And Kaana Street - Signalize the intersection and provide the eastbound approach on Kaana Street with one shared left-turn and through lane and one exclusive right-turn lane. Provide the northbound approach on Kapule Highway with an exclusive left-turn and the southbound approach with an exclusive right-turn lane from Kapule Highway to Kaana Street.

  Kapule Highway And Mauka-Makai Road - Signalize the intersection and provide the westbound approach on the Mauka-Makai Road with one exclusive left-turn lane and one exclusive right-turn lane. Also, provide the northbound approach on Kapule Highway with an exclusive right-turn lane and the southbound approach with an exclusive left-turn lane.

  Kuhio Highway And Road "X" - Signalize the intersection and provide the northbound approach on Road "X" with an exclusive left-turn lane and an exclusive right-turn lane. Also, provide the westbound approach on Kuhio Highway with an exclusive left-turn lane and an exclusive right-turn lane in the eastbound approach.

- Based on the October 1990 "Kauai County Highway Planning Study" prepared by Kaku Associates, Inc., the following base roadway improvements are recommended to accommodate Year 2016 base (without project) traffic demand through Lihue Town.

  1. The widening of Kuhio Highway to four lanes from south of Wailua Bridge to Kapule Highway.
  2. The widening of Kapule Highway to four lanes from Kuhio Highway to Ahukini Road.
  3. The construction of a mauka bypass highway from the vicinity north of the intersection of Kapule Highway at Kuhio Highway and extending southwest, connecting at Kaumualii Highway west of Puhi.
  4. The realignment and widening of Ahukini Road to four lanes from Kapule Highway to the Kuhio Highway. Although no alignment has been determined, possible realignment of Ahukini Road with Ehiku Street via the cane-haul road may be the most feasible option.
  5. The extension of the four-lane Ahukini Road mauka from Kuhio Highway to the future bypass highway.

  As a result of this study, the following are additional base improvements recommended to alleviate Year 2006 Base (without project) traffic conditions:

  1. The widening of Kapule Highway to four lanes from Ahukini Road to Rice Street.
  2. Realignment of Kapule Highway and the east-leg of Rice Street to become the major through street while the west-leg of Rice Street will terminate as a T-intersection at Kapule Highway/Rice Street.
  3. Widening of Rice Street to four lanes through Lihue Town.

  4. Signalization of the following intersections:
     - Kapule Highway and Rice Street
     - Hoolako Street and Rice Street
     - Kapule Highway and Post Office Driveway
     - Kuhio Highway and Road "X".

  In addition, the following project mitigation are required to accommodate the Year 2016 With Project traffic.

  1. At the Intersection of Kuhio Highway and Ahukini Road, provide double, exclusive left-turn lanes at all approaches to the intersection. In addition, provide the northbound approach with double, exclusive right-turn lane from Kuhio Highway to Ahukini Road.
  2. At the intersection of Hoolako Street and Rice Street, provide the westbound approach on Rice Street with an exclusive right-turn lane. The westbound approach will include one exclusive left-turn lane, two through lanes, and one exclusive right-turn lane. Also, provide the eastbound approach on Rice Street with and additional exclusive left-turn lane. The eastbound approach will include two exclusive left-turn lanes, one through lane and one shared through and right-turn lane.

  With the base improvements and project mitigation described above, all ten analyzed intersections will be operating at acceptable level of service under the Year 2016 with project traffic conditions.

- The following describes the recommended intersection configurations at intersections with project access roadways and existing roadways under the Year 2016 traffic conditions:

Ahukini Road And Hoolako Street - Signalize the intersection and provide the northbound approach on Hoolako Street with two exclusive left-turn lanes, one through lane and an exclusive right-turn lane. Provide the southbound approach on Hoolako Street with an exclusive left-turn lane, one through lane and an exclusive right-turn lane. Provide the eastbound approach on Ahukini Road with two exclusive left-turn lanes and one exclusive right-turn lane to Hoolako Street. Also, provide the westbound approach on Ahukini Road with an exclusive left-turn lane and an exclusive right-turn lane to Hoolako Street.

Kapule Highway And Kaana Street - Signalize the intersection and provide the eastbound approach on Kaana Street with one shared left-turn and through lane and an exclusive right-turn lane. Provide the northbound approach on Kapule Highway with an exclusive left-turn and the southbound approach with an exclusive right-turn lane from Kapule Highway to Kaana Street.

Kapule Highway And Mauka-Makai Road - Signalize the intersection and provide the westbound approach on the Mauka-Makai Road with one exclusive left-turn lane, one shared left-turn and through lane and one exclusive right-turn lane. Provide the eastbound approach on the Mauka-Makai Road with one shared left-turn and through lane and an exclusive right-turn lane. Also, provide the both the northbound and southbound approaches of Kapule Highway with an exclusive left-turn lane and an exclusive right-turn lane.

Kuhio Highway And Road "X" - Signalize the intersection and provide the northbound approach on Road "X" with an exclusive left-turn lane and an exclusive right-turn lane. Also, provide the westbound approach on Kuhio Highway with an exclusive left-turn lane and an exclusive right-turn lane in the eastbound approach.

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

REFERENCES

Institute of Transportation Engineers, Trip Generation, 5th Edition, 1991.

Transportation Research Board, Highway Capacity Manual, Special Report 209, 1985.

Kaku Associates, Inc., Kauai County Highway Planning Study, October 1990.

Austin, Tsutsumi & Associates, Inc., Lihue Traffic Circulation Study, April 1987.

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

APPENDIX A

TRAFFIC COUNTS

ATA INC. 01-Aug-94

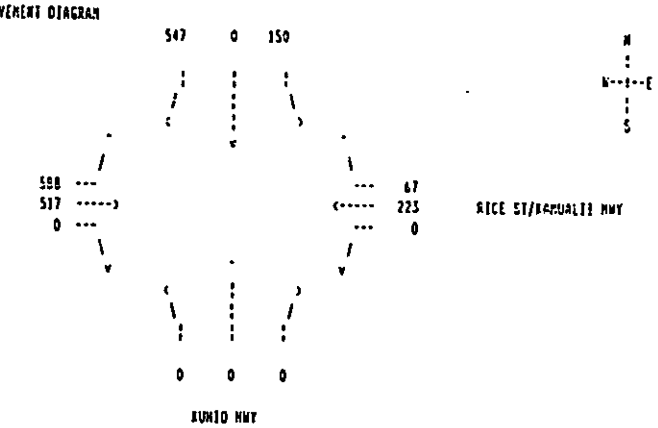
INTERSECTION COUNT SURVEY SUMMARY

North/South Street : KUNIO HWY
East/West Street : RICE ST/KAMUALII HWY
Weather : CLEAR

Period: AM
Date: 7/29/94
Day : FRIDAY

15 MINUTE PERIOD	KUNIO HWY NORTHBOUND LEFT	THRU	RGHT	KUNIO HWY SOUTHBOUND LEFT	THRU	RGHT	RICE ST/KAMUALII HWY EASTBOUND LEFT	THRU	RGHT	RICE ST/KAMUALII HWY WESTBOUND LEFT	THRU	RGHT	TOTAL VOLUME 15 MIN	HOURLY
630 - 645	0	0	0	27	0	125	136	95	0	0	29	16	426	
645 - 700	0	0	0	32	0	157	118	83	0	0	35	17	442	
700 - 715	0	0	0	27	0	123	146	114	0	0	40	15	465	
715 - 730	0	0	0	40	0	109	138	129	0	0	56	14	486	1,819
730 - 745	0	0	0	35	0	158	156	153	0	0	48	15	565	1,958
745 - 800	0	0	0	44	0	149	161	128	0	0	68	19	569	2,085
800 - 815	0	0	0	31	0	131	133	107	0	0	51	19	472	2,092
815 - 830	0	0	0	34	0	106	125	104	0	0	52	26	447	2,053
PEAK 15 MINUTE PERIOD: 745 - 800	0	0	0	44	0	149	161	128	0	0	68	19	569	--
PEAK HOUR PERIOD: 715 - 815	0	0	0	150	0	547	588	517	0	0	223	67	--	2092
PEAK HOUR FACTOR: 715 - 815	-	-	-	0.85	-	0.97	0.91	0.84	-	-	0.82	0.88		
					0.90			0.89			0.83			

PEAK HOUR TURNING MOVEMENT DIAGRAM



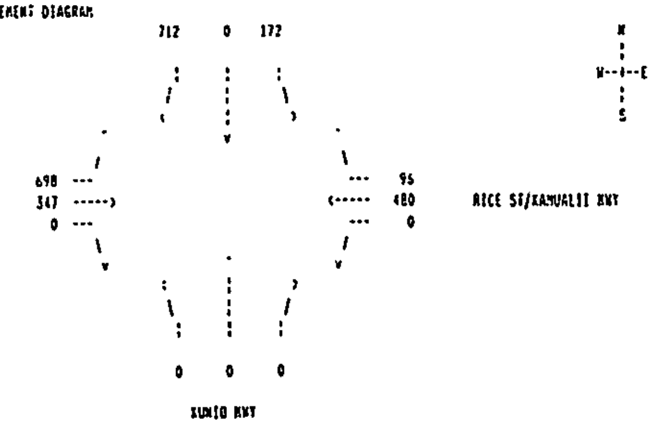
INTERSECTION COUNT SURVEY SUMMARY

North/South Street : KUNIO HWY
East/West Street : RICE ST/KAMUALII HWY
Weather : CLEAR

Period: PM
Date: 7/28/94
Day : THURSDAY

15 MINUTE PERIOD	KUNIO HWY NORTHBOUND LEFT	THRU	RGHT	KUNIO HWY SOUTHBOUND LEFT	THRU	RGHT	RICE ST/KAMUALII HWY EASTBOUND LEFT	THRU	RGHT	RICE ST/KAMUALII HWY WESTBOUND LEFT	THRU	RGHT	TOTAL VOLUME 15 MIN	HOURLY
300 - 315	0	0	0	38	0	181	159	85	0	0	81	15	559	
315 - 330	0	0	0	37	0	175	144	87	0	0	86	27	556	
330 - 345	0	0	0	49	0	203	152	90	0	0	116	9	619	
345 - 400	0	0	0	45	0	169	158	95	0	0	101	36	604	2,333
400 - 415	0	0	0	36	0	187	185	95	0	0	114	25	642	2,421
415 - 430	0	0	0	43	0	170	178	89	0	0	112	23	615	2,480
430 - 445	0	0	0	48	0	186	177	68	0	0	153	12	644	2,505
445 - 500	0	0	0	45	0	175	156	63	0	0	138	24	601	2,502
500 - 515	0	0	0	41	0	166	151	63	0	0	124	13	558	2,418
515 - 530	0	0	0	38	0	154	170	73	0	0	92	21	548	2,351
PEAK 15 MINUTE PERIOD:														
430 - 445	0	0	0	48	0	186	177	68	0	0	153	12	644	--
PEAK HOUR PERIOD:														
345 - 445	0	0	0	172	0	712	698	347	0	0	480	96	--	2505
PEAK HOUR FACTOR:														
345 - 445	-	-	-	0.90	-	0.95	0.94	0.91	-	-	0.78	0.67		
		-			0.94			0.93			0.87			

PEAK HOUR TURNING MOVEMENT DIAGRAM



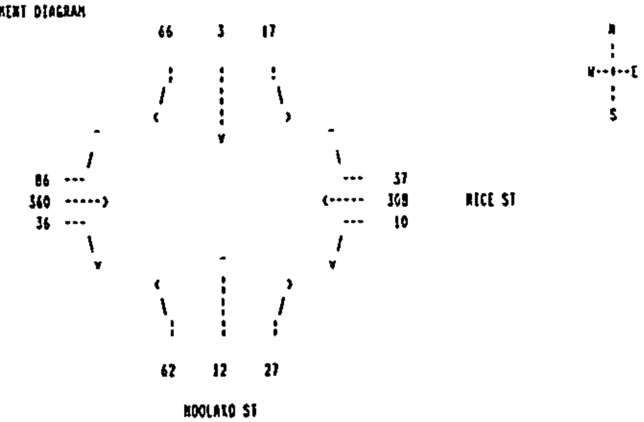
INTERSECTION COUNT SURVEY SUMMARY

North/South Street : KOOLAKO ST
East/West Street : RICE ST
Weather : CLEAR

Period: AM
Date: 7/28/94
Day : THURSDAY

15 MINUTE PERIOD	KOOLAKO ST NORTHBOUND LEFT	THRU	RGHT	KOOLAKO ST SOUTHBOUND LEFT	THRU	RGHT	RICE ST EASTBOUND LEFT	THRU	RGHT	RICE ST WESTBOUND LEFT	THRU	RGHT	TOTAL VOLUME 15 MIN	HOURLY
630 - 645	15	1	6	1	1	5	26	63	2	0	36	1	157	
645 - 700	14	5	4	1	1	15	19	86	1	5	50	5	205	
700 - 715	16	1	3	2	1	14	27	89	9	3	59	3	227	
715 - 730	9	0	6	6	0	8	18	84	9	2	80	13	235	825
730 - 745	16	6	10	6	1	21	17	95	9	1	69	12	263	931
745 - 800	21	5	8	3	1	23	24	92	9	4	100	9	299	1,024
800 - 815	7	1	5	4	0	12	15	85	8	0	74	7	218	1,015
815 - 830	14	2	3	3	0	26	15	60	5	4	84	10	226	1,006
PEAK 15 MINUTE PERIOD:														
745 - 800	21	5	8	3	1	23	24	92	9	4	100	9	299	--
PEAK HOUR PERIOD:														
700 - 800	62	12	27	17	3	66	86	360	36	10	308	37	--	1024
PEAK HOUR FACTOR:														
700 - 800	0.74	0.50	0.68	0.71	0.75	0.72	0.80	0.95	1.00	0.63	0.77	0.71		
		0.74			0.77			0.96			0.79			

PEAK HOUR TURNING MOVEMENT DIAGRAM



ATA INC. 01-Aug-94

INTERSECTION COUNT SURVEY SUMMARY

North/South Street : WOOLAKO ST
East/West Street : RICE ST
Weather : CLEAR

Period: PM
Date: 7/27/94
Day : WEDNESDAY

15 MINUTE PERIOD	WOOLAKO ST NORTHBOUND LEFT	THRU	RGHT	SOUTHBOUND LEFT	THRU	RGHT	RICE ST EASTBOUND LEFT	THRU	RGHT	WESTBOUND LEFT	THRU	RGHT	TOTAL VOLUME 15 MIN	HOURLY
300 - 315	12	1	3	9	0	13	17	114	16	5	95	7	292	
315 - 330	12	2	6	3	0	16	12	118	12	3	91	7	282	
330 - 345	7	0	5	11	0	45	11	87	15	13	109	12	315	
345 - 400	14	3	8	4	2	30	21	122	18	5	94	16	337	1,226
400 - 415	10	4	2	13	4	21	14	90	23	5	111	8	305	1,239
415 - 430	11	0	6	11	1	24	10	116	29	10	104	15	337	1,294
430 - 445	16	5	2	13	4	34	12	128	15	6	104	9	348	1,327
445 - 500	10	5	6	15	5	13	19	114	26	8	75	11	307	1,297
500 - 515	11	3	4	7	2	17	12	101	35	10	73	4	279	1,271
515 - 530	23	2	2	5	0	19	7	75	22	4	72	0	231	1,165
PEAK 15 MINUTE PERIOD: 430 - 445	16	5	2	13	4	34	12	128	15	6	104	9	348	--
PEAK HOUR PERIOD: 345 - 445	51	12	18	41	11	109	57	456	85	26	413	48	--	1327
PEAK HOUR FACTOR: 345 - 445	0.80	0.60	0.56	0.79	0.69	0.80	0.68	0.89	0.73	0.65	0.93	0.75		
		0.81			0.79			0.93			0.94			

PEAK HOUR TURNING MOVEMENT DIAGRAM

109 11 41

57
456
65

49
413
25

RICE ST

51 12 18

WOOLAKO ST

N
W--+--E
S

ATA INC. 26-May-94

INTERSECTION COUNT SURVEY SUMMARY

North/South Street : ~~RICE ST~~ KAPULE HWY
East/West Street : ~~KAPULE HWY~~ RICE ST
Weather : CLEAR

Period: AM
Date: 5/26/94
Day : THURSDAY

15 MINUTE PERIOD	RICE ST NORTHBOUND LEFT	THRU	RGHT	SOUTHBOUND LEFT	THRU	RGHT	KAPULE HWY EASTBOUND LEFT	THRU	RGHT	WESTBOUND LEFT	THRU	RGHT	TOTAL VOLUME 15 MIN	HOURLY
630 - 645	0	0	0	44	0	32	47	46	0	0	26	38	233	
645 - 700	0	0	0	63	0	46	53	35	0	0	38	55	290	
700 - 715	0	0	0	64	0	65	49	46	0	0	56	50	330	
715 - 730	0	0	0	87	0	54	57	80	0	0	83	72	433	1,286
730 - 745	0	0	0	81	0	83	45	114	0	0	109	74	506	1,555
745 - 800	0	0	0	72	0	71	49	59	0	0	69	73	393	1,662
800 - 815	0	0	0	47	0	42	70	36	0	0	39	45	279	1,611
815 - 830	0	0	0	51	0	50	63	38	0	0	43	63	308	1,486
PEAK 15 MINUTE PERIOD: 730 - 745	0	0	0	81	0	83	45	114	0	0	109	74	506	--
PEAK HOUR PERIOD: 700 - 800	0	0	0	304	0	273	200	299	0	0	317	269	--	1662
PEAK HOUR FACTOR: 700 - 800	-	-	-	0.87	-	0.82	0.88	0.66	-	-	0.73	0.91		
		-			0.88			0.78			0.80			

PEAK HOUR TURNING MOVEMENT DIAGRAM

273 0 304

200
299
0

269
317
0

RICE ST.
~~KAPULE HWY~~

0 0 0

~~RICE ST~~ KAPULE HWY.

N
W--+--E
S

ATA INC. 26-May-94

INTERSECTION COUNT SURVEY SUMMARY

North/South Street : ~~RICE ST~~ [illegible]
East/West Street : ~~KAPULE HWY~~ [illegible]
Weather : CLEAR

Period: PM
Date: 5/25/94
Day : WEDNESDAY

15 MINUTE PERIOD	RICE ST NORTHBOUND LEFT	THRU	RGHT	SOUTHBOUND LEFT	THRU	RGHT	KAPULE HWY EASTBOUND LEFT	THRU	RGHT	WESTBOUND LEFT	THRU	RGHT	TOTAL VOLUME 15 MIN	HOURLY
300 - 315	0	0	0	34	0	56	55	38	0	0	58	67	308	
315 - 330	0	0	0	50	0	45	52	46	0	0	56	66	313	
330 - 345	0	0	0	74	0	44	70	41	0	0	66	110	405	
345 - 400	0	0	0	47	0	59	71	37	0	0	54	81	349	1,375
400 - 415	0	0	0	50	0	62	84	44	0	0	44	105	389	1,456
415 - 430	0	0	0	52	0	61	83	67	0	0	56	67	386	1,529
430 - 445	0	0	0	48	0	62	84	65	0	0	46	82	407	1,531
445 - 500	0	0	0	41	0	47	72	98	0	0	50	81	389	1,571
PEAK 15 MINUTE PERIOD: 430 - 445	0	0	0	48	0	62	84	85	0	0	46	82	407	--
PEAK HOUR PERIOD: 400 - 500	0	0	0	191	0	232	323	294	0	0	196	335	--	1571
PEAK HOUR FACTOR: 400 - 500	-	-	-	0.92	-	0.94	0.96	0.75	-	-	0.88	0.80		
		-			0.94			0.91			0.89			

PEAK HOUR TURNING MOVEMENT DIAGRAM

232 0 191

323 294 0 — 335 196 0 KAPULE HWY [illegible]

0 0 0

~~RICE ST~~ [illegible]

N / W--+--E / S

ATA INC. 26-May-94

INTERSECTION COUNT SURVEY SUMMARY

North/South Street : KUNIO HWY
East/West Street : AKUKINI RD
Weather : CLEAR

Period: AM
Date: 5/25/94
Day : WEDNESDAY

15 MINUTE PERIOD	KUNIO HWY NORTHBOUND LEFT	THRU	RGHT	SOUTHBOUND LEFT	THRU	RGHT	AKUKINI RD EASTBOUND LEFT	THRU	RGHT	WESTBOUND LEFT	THRU	RGHT	TOTAL VOLUME 15 MIN	HOURLY
630 - 645	1	105	48	16	176	1	0	0	0	33	1	10	391	
645 - 700	0	91	46	20	190	1	0	0	0	29	4	29	410	
700 - 715	1	95	37	26	198	5	0	0	0	32	1	23	418	
715 - 730	0	115	60	24	250	1	0	0	0	53	3	42	548	1,767
730 - 745	0	103	41	32	268	2	0	0	0	40	4	47	537	1,913
745 - 800	0	129	48	29	221	1	0	0	0	43	0	38	509	2,012
800 - 815	0	84	20	27	172	1	0	0	0	47	1	23	375	1,969
815 - 830	0	98	35	29	159	5	0	0	0	37	0	19	382	1,903
PEAK 15 MINUTE PERIOD: 715 - 730	0	115	60	24	250	1	0	0	0	53	3	42	548	--
PEAK HOUR PERIOD: 700 - 800	1	442	186	111	937	9	0	0	0	168	8	150	--	2012
PEAK HOUR FACTOR: 700 - 800	0.25	0.86	0.78	0.87	0.87	0.45	-	-	-	0.79	0.50	0.80		
		0.89			0.88			-			0.83			

PEAK HOUR TURNING MOVEMENT DIAGRAM

9 937 111

0 0 0 — 150 8 168 AKUKINI RD

1 442 186

KUNIO HWY

N / W--+--E / S

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

ATA INC.

26-May-94

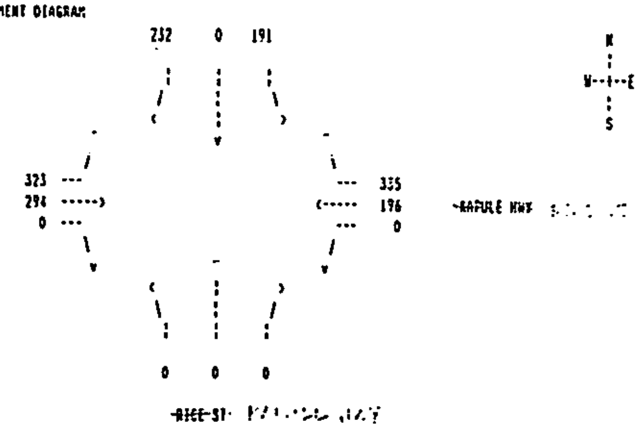
INTERSECTION COUNT SURVEY SUMMARY

North/South Street : ~~RICE ST~~
East/West Street : ~~KAPULE HWY~~
Weather : CLEAR

Period: PM
Date: 5/25/94
Day : WEDNESDAY

15 MINUTE PERIOD	RICE ST						KAPULE HWY						TOTAL VOLUME	
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND				
	LEFT	THRU	RGHT	LEFT	THRU	RGHT	LEFT	THRU	RGHT	LEFT	THRU	RGHT	15 MIN	HOURLY
300 - 315	0	0	0	34	0	56	55	38	0	0	58	67	308	
315 - 330	0	0	0	50	0	43	52	46	0	0	56	66	313	
330 - 345	0	0	0	74	0	44	70	41	0	0	66	110	405	
345 - 400	0	0	0	47	0	59	71	37	0	0	54	81	349	1,375
400 - 415	0	0	0	50	0	62	84	44	0	0	44	105	389	1,456
415 - 430	0	0	0	52	0	61	83	67	0	0	56	67	386	1,529
430 - 445	0	0	0	48	0	62	84	85	0	0	46	82	407	1,531
445 - 500	0	0	0	41	0	47	72	98	0	0	50	81	389	1,571
PEAK 15 MINUTE PERIOD: 430 - 445	0	0	0	48	0	62	84	85	0	0	46	82	407	--
PEAK HOUR PERIOD: 400 - 500	0	0	0	191	0	232	323	294	0	0	196	335	--	1571
PEAK HOUR FACTOR: 400 - 500	-	-	-	0.92	-	0.94	0.96	0.75	-	-	0.89	0.80		
		-			0.94			0.91			0.89			

PEAK HOUR TURNING MOVEMENT DIAGRAM



ATA INC.

26-May-94

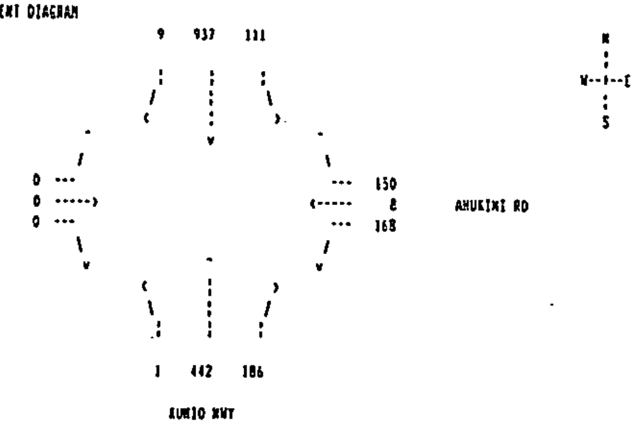
INTERSECTION COUNT SURVEY SUMMARY

North/South Street : KUHIO HWY
East/West Street : AHUKINI RD
Weather : CLEAR

Period: AM
Date: 5/25/94
Day : WEDNESDAY

15 MINUTE PERIOD	KUHIO HWY						AHUKINI RD						TOTAL VOLUME	
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND				
	LEFT	THRU	RGHT	LEFT	THRU	RGHT	LEFT	THRU	RGHT	LEFT	THRU	RGHT	15 MIN	HOURLY
630 - 645	1	105	48	16	176	1	0	0	0	33	1	10	391	
645 - 700	0	91	46	20	190	1	0	0	0	29	4	29	410	
700 - 715	1	95	37	26	198	5	0	0	0	32	1	23	418	
715 - 730	0	115	60	24	250	1	0	0	0	53	3	42	548	1,767
730 - 745	0	103	41	32	268	2	0	0	0	40	4	47	537	1,913
745 - 800	0	129	48	29	221	1	0	0	0	43	0	38	509	2,012
800 - 815	0	84	20	27	172	1	0	0	0	47	1	23	375	1,969
815 - 830	0	98	35	29	159	5	0	0	0	37	0	19	392	1,803
PEAK 15 MINUTE PERIOD: 715 - 730	0	115	60	24	250	1	0	0	0	53	3	42	548	--
PEAK HOUR PERIOD: 700 - 800	1	442	186	111	937	9	0	0	0	168	8	150	--	2012
PEAK HOUR FACTOR: 700 - 800	0.25	0.86	0.78	0.87	0.87	0.45	-	-	-	0.79	0.50	0.80		
		0.89			0.88			-			0.83			

PEAK HOUR TURNING MOVEMENT DIAGRAM



ATA INC. 26-May-94

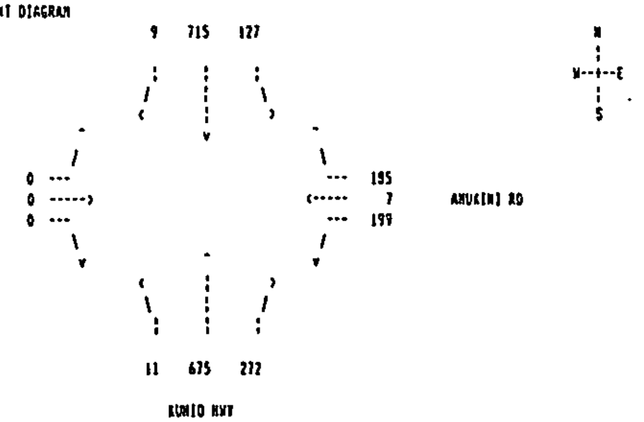
INTERSECTION COUNT SURVEY SUMMARY

North/South Street : KUHIO HWY
East/West Street : AHUKINI RD
Weather : CLEAR

Period: PM
Date: 5/24/94
Day : TUESDAY

15 MINUTE PERIOD	KUHIO HWY NORTHBOUND LEFT	THRU	RGHT	SOUTHBOUND LEFT	THRU	RGHT	AHUKINI RD EASTBOUND LEFT	THRU	RGHT	WESTBOUND LEFT	THRU	RGHT	TOTAL VOLUME 15 MIN	HOURLY
300 - 315	0	162	46	18	159	1	0	0	0	39	3	34	462	
315 - 330	1	150	66	26	174	1	0	0	0	45	3	41	507	
330 - 345	3	163	73	47	189	5	0	0	0	53	1	45	579	
345 - 400	1	176	66	25	170	1	0	0	0	48	2	56	545	2,093
400 - 415	2	168	73	29	180	2	0	0	0	51	3	47	555	2,186
415 - 430	5	168	60	26	176	1	0	0	0	47	1	37	521	2,200
430 - 445	0	183	80	29	177	1	0	0	0	48	4	52	574	2,195
445 - 500	4	158	59	24	191	5	0	0	0	42	2	49	534	2,184
PEAK 15 MINUTE PERIOD: 330 - 345	3	163	73	47	189	5	0	0	0	53	1	45	579	--
PEAK HOUR PERIOD: 330 - 430	11	675	272	127	715	9	0	0	0	199	7	185	--	2200
PEAK HOUR FACTOR: 330 - 430	0.55	0.96	0.93	0.68	0.95	0.45	-	-	-	0.94	0.58	0.83		
		0.99			0.88			-			0.92			

PEAK HOUR TURNING MOVEMENT DIAGRAM



ATA INC. 25-May-94

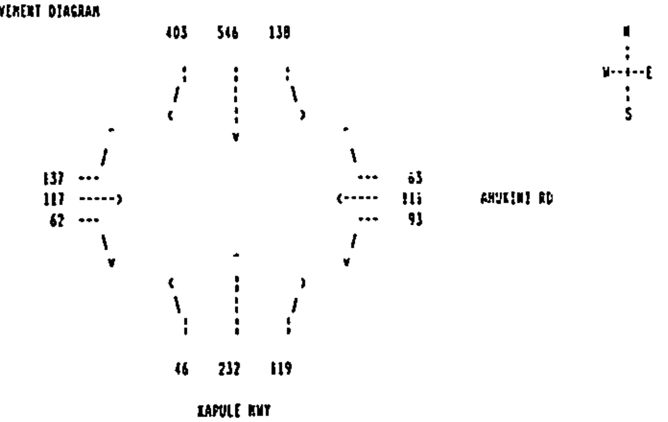
INTERSECTION COUNT SURVEY SUMMARY

North/South Street : KAPULE HWY
East/West Street : AHUKINI RD
Weather : CLEAR

Period: AM
Date: 5/26/94
Day : THURSDAY

15 MINUTE PERIOD	KAPULE HWY NORTHBOUND LEFT	THRU	RGHT	SOUTHBOUND LEFT	THRU	RGHT	AHUKINI RD EASTBOUND LEFT	THRU	RGHT	WESTBOUND LEFT	THRU	RGHT	TOTAL VOLUME 15 MIN	HOURLY
630 - 645	2	38	15	39	101	54	33	30	3	20	22	9	366	
645 - 700	12	29	26	50	144	66	36	27	25	17	18	7	457	
700 - 715	11	37	32	30	122	84	25	27	9	26	22	14	439	
715 - 730	11	51	20	32	145	104	36	24	16	24	43	17	523	1,785
730 - 745	10	84	31	32	163	118	37	35	16	20	23	15	584	2,003
745 - 800	14	60	36	44	116	97	39	31	21	23	23	17	521	2,067
800 - 815	5	65	27	40	81	70	32	43	11	14	29	18	435	2,063
815 - 830	7	61	52	34	70	56	38	38	18	29	26	26	455	1,995
PEAK 15 MINUTE PERIOD: 730 - 745	10	84	31	32	163	118	37	35	16	20	23	15	584	--
PEAK HOUR PERIOD: 700 - 800	46	232	119	138	546	403	137	117	62	93	111	63	--	2067
PEAK HOUR FACTOR: 700 - 800	0.82	0.69	0.83	0.78	0.84	0.85	0.88	0.84	0.74	0.89	0.65	0.93		
		0.79			0.87			0.87			0.79			

PEAK HOUR TURNING MOVEMENT DIAGRAM



ATA INC. 26-May-94

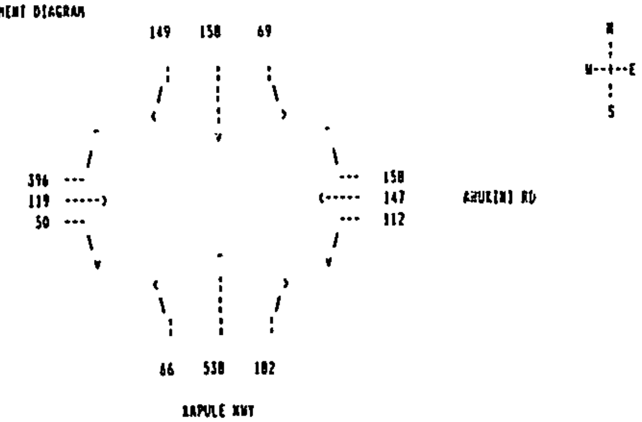
INTERSECTION COUNT SURVEY SUMMARY

North/South Street : KAPULE HWY
East/West Street : AKUIKI RD
Weather : CLEAR

Period: PM
Date: 5/25/94
Day : WEDNESDAY

15 MINUTE PERIOD	KAPULE HWY NORTHBOUND LEFT	THRU	RGHT	KAPULE HWY SOUTHBOUND LEFT	THRU	RGHT	AKUIKI RD EASTBOUND LEFT	THRU	RGHT	AKUIKI RD WESTBOUND LEFT	THRU	RGHT	TOTAL VOLUME 15 MIN	HOURLY
300 - 315	30	109	35	14	51	43	58	20	17	27	55	34	493	
315 - 330	13	84	34	21	67	45	54	31	18	33	38	43	481	
330 - 345	19	106	38	27	53	37	88	31	13	31	35	53	531	
345 - 400	15	121	46	17	64	40	74	29	14	27	37	28	512	2,017
400 - 415	19	161	58	21	0	32	89	24	15	36	29	41	525	2,049
415 - 430	18	99	41	15	56	38	83	25	9	28	37	42	491	2,059
430 - 445	14	144	45	17	45	39	133	29	11	21	29	27	554	2,082
445 - 500	15	134	38	16	57	40	91	41	15	27	52	48	574	2,144
500 - 515	13	123	26	19	52	33	109	24	15	27	39	35	515	2,134
515 - 530	14	104	24	19	49	30	80	20	12	20	27	47	446	2,089
530 - 545	0	0	0	14	63	0	0	0	0	0	0	0	77	1,612
PEAK 15 MINUTE PERIOD: 445 - 500	15	134	38	16	57	40	91	41	15	27	52	48	574	--
PEAK HOUR PERIOD: 400 - 500	66	538	182	69	158	149	396	119	50	112	147	158	--	2144
PEAK HOUR FACTOR: 400 - 500	0.87	0.84	0.78	0.82	0.69	0.93	0.74	0.73	0.83	0.78	0.71	0.82		
		0.83			0.83			0.82			0.82			

PEAK HOUR TURNING MOVEMENT DIAGRAM



ATA INC. 26-May-94

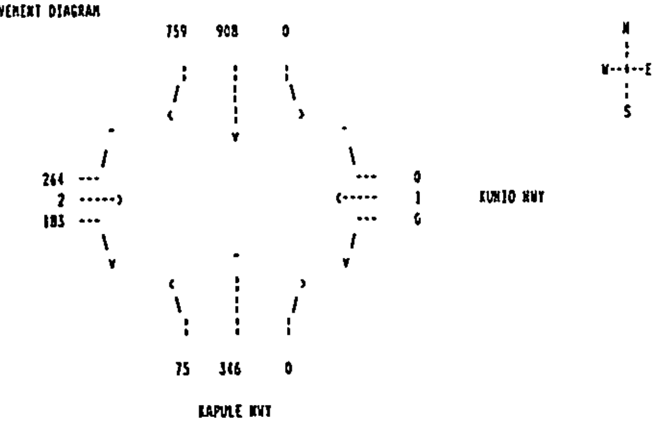
INTERSECTION COUNT SURVEY SUMMARY

North/South Street : KAPULE HWY
East/West Street : KUHIO HWY
Weather : CLEAR

Period: AM
Date: 5/26/94
Day : THURSDAY

15 MINUTE PERIOD	KAPULE HWY NORTHBOUND LEFT	THRU	RGHT	KAPULE HWY SOUTHBOUND LEFT	THRU	RGHT	KUHIO HWY EASTBOUND LEFT	THRU	RGHT	KUHIO HWY WESTBOUND LEFT	THRU	RGHT	TOTAL VOLUME 15 MIN	HOURLY
630 - 645	2	78	0	0	172	147	51	1	32	0	0	0	483	
645 - 700	4	71	0	0	220	174	38	3	27	0	0	0	537	
700 - 715	15	63	0	0	206	157	70	1	37	0	0	0	549	
715 - 730	17	75	0	0	244	191	50	1	48	0	1	0	627	2,196
730 - 745	22	112	0	0	243	229	79	0	51	0	0	0	736	2,449
745 - 800	21	96	0	0	215	182	65	0	47	0	0	0	626	2,538
800 - 815	18	95	0	0	148	128	58	0	25	0	0	0	472	2,461
815 - 830	18	111	0	0	134	149	61	0	20	0	1	0	494	2,328
PEAK 15 MINUTE PERIOD: 730 - 745	22	112	0	0	243	229	79	0	51	0	0	0	736	--
PEAK HOUR PERIOD: 700 - 800	75	346	0	0	908	759	264	2	183	0	1	0	--	2538
PEAK HOUR FACTOR: 700 - 800	0.85	0.77	-	-	0.93	0.83	0.84	0.50	0.90	-	0.25	-		
		0.79			0.88			0.66			0.25			

PEAK HOUR TURNING MOVEMENT DIAGRAM



ATA INC. 26-May-94

INTERSECTION COUNT SURVEY SUMMARY

North/South Street : KAPULE HWY
East/West Street : KUHIO HWY
Weather : CLEAR

Period: PM
Date: 5/25/94
Day : WEDNESDAY

15 MINUTE PERIOD	KAPULE HWY NORTHBOUND LEFT	THRU	RGHT	SOUTHBOUND LEFT	THRU	RGHT	KUHIO HWY EASTBOUND LEFT	THRU	RGHT	WESTBOUND LEFT	THRU	RGHT	TOTAL VOLUME 15 MIN	HOURLY
300 - 315	18	183	0	0	97	121	107	0	12	0	1	0	539	
315 - 330	21	156	0	0	121	82	95	0	16	0	1	1	493	
330 - 345	27	211	0	0	101	110	135	0	11	0	1	1	597	
345 - 400	22	199	0	0	101	121	122	0	18	0	0	0	583	2,212
400 - 415	36	236	0	0	98	116	122	0	5	0	0	0	613	2,286
415 - 430	16	220	0	0	97	116	136	0	12	0	0	0	597	2,390
430 - 445	24	259	0	0	92	108	103	0	8	0	0	0	594	2,367
445 - 500	19	252	0	0	85	107	136	0	18	0	0	0	617	2,421
500 - 515	16	234	0	0	90	100	133	0	13	0	1	1	558	2,396
PEAK 15 MINUTE PERIOD:														
445 - 500	19	252	0	0	85	107	136	0	18	0	0	0	617	--
PEAK HOUR PERIOD:														
400 - 500	95	967	0	0	372	447	497	0	43	0	0	0	--	2421
PEAK HOUR FACTOR:														
400 - 500	0.66	0.93	-	-	0.95	0.96	0.91	-	0.60	-	-	-		
		0.94			0.96			0.88			-			

PEAK HOUR TURNING MOVEMENT DIAGRAM

```
                 447   372    0
                                                      N
                                                      :
                                                   W--+--E
                                                      :
                                                      S
        497 ---
          0 ----->               <-----   0      KUHIO HWY
         43 ---                     ---   0
                                    ---   0

                  95   967    0

                   KAPULE HWY
```

APPENDIX B

LEVEL OF SERVICE DEFINITIONS

LEVEL OF SERVICE OF SIGNALIZED INTERSECTIONS

Level of service for signalized intersections is defined in terms of delay. Delay is a measure of driver discomfort, frustration, fuel consumption and lost travel time. specifically, level-of-service criteria are stated in terms of the average stopped delay per vehicle for a 15-minute analysis period. The criteria are given in Table A-1.

Table A-1. Level-of Service Criteria for Signalized Intersections

Level of Service	Stopped Delay for Vehicle (SEC)
A	$\leq$ 5.0
B	5.1 to 15.0
C	15.1 to 25.0
D	25.1 to 40.0
E	40.1 to 60.0
F	> 60.0

Delay is a complex measure, and is dependent on a number of variables, including the quality of progression, the cycle length, the green ratio, and the v/c ratio for the lane group or approach in question.

Level-of-service A describes operations with very low delay, i.e., less than 5.0 seconds per vehicle. This occurs when progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.

Level-of-service B describes operations with delay in the range of 5.1 to 15.0 seconds per vehicle. This generally occurs with good progression and/or short cycle lengths. More vehicles stop than for LOS A, causing higher levels of average delay.

Level-of-service C describes operations with delay in the range of 15.1 to 25.0 seconds per vehicle. These higher delays may result from fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear in this level. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.

Level-of-service D describes operations with delay in the range of 25.1 to 40.0 seconds per vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.

Level-of-service E describes operations with delay in the range of 40.1 to 60.0 seconds per vehicle. This is considered to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths and high v/c ratios. Individual cycle failures are frequent occurrences.

LEVEL OF SERVICE OF SIGNALIZED INTERSECTIONS (CONTINUED)

Level-of-service F describes operations with delay in excess of 60.0 seconds per vehicle. This is considered to be unacceptable to most drivers. This condition often occurs with oversaturation, i.e., when arrival flow rates exceed the capacity of the intersection. It may also occur at high v/c ratios below 1.00 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS

Level of Service definitions for unsignalized intersections is determined by the reserve or unused capacity of a lane. The potential capacity is determined by the size and frequency in gaps in conflicting traffic that can accommodate the side street demand. The reserve capacity is equal to the potential capacity minus the traffic demand. A lower Level of Service translates into longer side street delay. The Levels of Service criteria are shown in the following table:

Level-of-Service Criteria
for Unsignalized Intersections

Reserve Capacity (PCPH)	Level of Service	Expected Delay to Minor Street Traffic
≥ 400	A	Little or no delay
300-399	B	Short traffic delays
200-299	C	Average traffic delays
100-199	D	Long traffic delays
0- 99	E	Very long traffic delays
< 0	F	Extreme traffic delays

LEVEL OF SERVICE CRITERIA FOR SIGNALIZED INTERSECTIONS - PLANNING ANALYSIS

The Planning Analysis provides a broad indication of the capacity conditions at a signalized intersection. This methodology is appropriate to determine if a signalized intersection has adequate laneage without detailed information on the traffic signal timing and phasing.

The Planning Analysis for signalized intersection considers the conflicting movements at the intersection, such as the left turn and the opposing through movement. The sum of these critical movements is utilized in determining the capacity conditions, which are categorized as identified below:

Maximum Sum of Critical Volumes (vehicles per hour)	Capacity Conditions
0 to 1,200	Under Capacity
1,201 to 1,400	Near Capacity
Greater than 1,400	Over Capacity

E-1

Lihue-Hanamaulu Infrastructure Report
Interior Roadway Network

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

TED S. KAWAHIGASHI, P.E.
GEORGE M. NEUFFER, P.E.
KENNETH K. KUROKAWA, P.E.
THOMAS S. OTAGURO
IVAN K. NAKATSUKA, P.E.

LIHUE-HANAMAULU INFRASTRUCTURE REPORT
INTERIOR ROADWAY NETWORK

I. PROJECT DESCRIPTION

Amfac/JMB Hawaii, Inc.'s proposed residential, commercial and light industrial development in the Lihue area, and residential development in the Hanamaulu area, can be broken down into four areas. (See Figure 1.) They are identified as the following:

- Molokoa
- Ahukini Mauka
- Ahukini Makai
- Hanamaulu

Molokoa is located in the southwest quadrant of the intersection of Kapule Highway and Ahukini Road. This area will include 390 single- and multi-family dwelling units, 80 acres of retail and office use, a YMCA-type facility, police station, judiciary complex, a teen center and a veterans service complex. A park is also proposed for this area. Primary access to the Molokoa area will be off Kapule Highway and Ahukini Road.

North of Molokoa is Ahukini Mauka. This area will be mainly residential use consisting of 1,144 single- and multi-family dwelling units, 13 acres of retail and office use and 26 acres of service/light industrial use. A school, park and open space are also proposed for this area. Access to this area will be off Kapule Highway and Ahukini Road.

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OFFICES IN
HONOLULU, HAWAII
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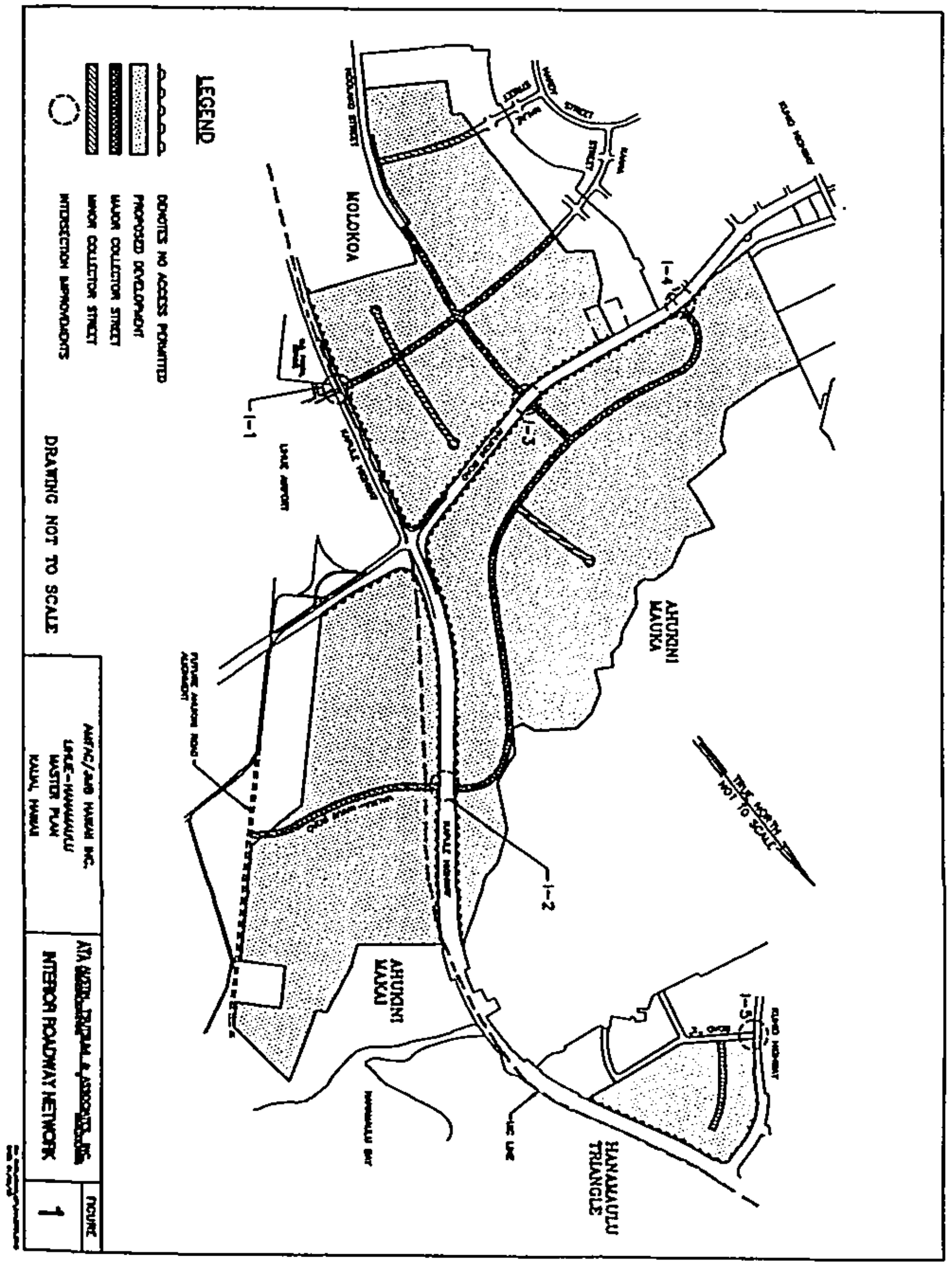


Ahukini Makai is located on the airport side of Kapule Highway, north of Ahukini Road. Proposed for this area is 141 acres of light industrial use which includes a County recycling center and a State disinfestation facility. Main access to Ahukini Makai will be off Kapule Highway.

Hanamaulu is the smallest of the four areas, consisting of 266 single- and multi-family dwelling units. The area is located in the southwest quadrant of the intersection of Kuhio Highway and Kapule Highway. Access to the area will be off Kuhio Highway.

The total proposed development will consist of a maximum 1,800 residential dwelling units, 93 acres of retail/office and public use and 167 acres of industrial use. The total development is planned to be completed by the Year 2016.

II. EXISTING CONDITIONS

Amfac/JMB Hawaii, Inc.'s proposed residential, commercial and light industrial development in the Lihue area, and residential development in Hanamaulu, are primarily serviced by three major roadways. They are Kapule Highway, Kuhio Highway and Ahukini Road. Primary access to the proposed development areas will be off these State arterial roads.

With the exception of several existing agricultural cane haul roads, there are no existing interior roadways within the proposed development areas.

III. PROPOSED IMPROVEMENTS

The proposed improvements covered under this report will be limited to only the interior spine roadway network. Improvements proposed at the major access intersections to each of these development areas from the arterial roadways are covered under the Traffic Impact Report for this project.

A. Design Criteria

Roadway design standards for the County of Kauai were considered for all proposed interior spine roadways. Roads were classified as either major collector streets or minor collector streets. Definitions for these two street classifications are as follows:

(1) Major Collector Street

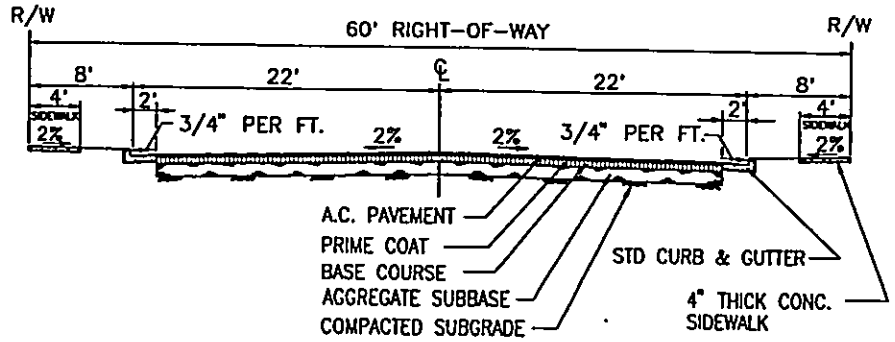
A traffic artery which serves or is to serve between various communities within a regional area of the County. Minimum right-of-way width for a major collector street is 60 feet.

(2) Minor Collector Street

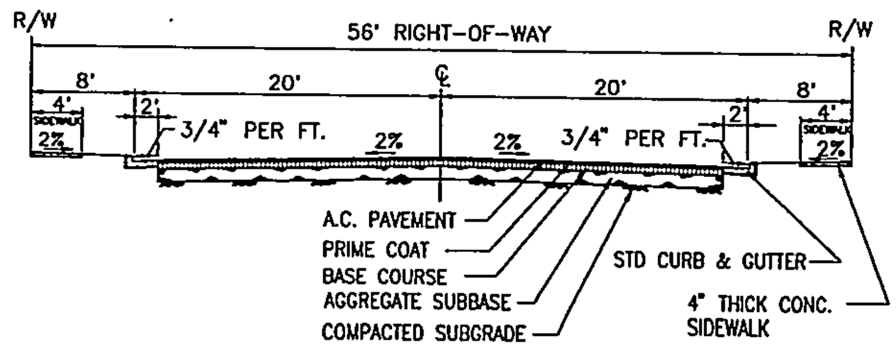
A street within a subdivision or adjacent thereto which, because of its location with reference to other streets or other sources of traffic, carries or will carry traffic from minor streets to major streets or thoroughfares; and includes the principal entrance streets of residential developments and streets for circulation of traffic within such developments. Minimum right-of-way width for a minor collector street is 56 feet.

Major collector streets within the proposed residential/commercial areas were set at 60 feet right-of-way width with a 44-foot curb-to-curb pavement section. This right-of-way width provides for four lanes of traffic, if required, with no on-street parking. Minor collector streets were set at 56 feet right-of-way with a 40-foot curb-to-curb pavement section. This right-of-way width provides for two lanes of traffic with on-street parking allowed on both sides. All proposed streets within the residential/commercial areas will have four-foot wide concrete sidewalks on both sides. (See Figure 2.)

Within the proposed industrial area, all streets were considered major collector streets and have a 60 foot right-of-way with a 44-foot curb-to-curb pavement section. No sidewalks are proposed for streets within the proposed industrial area.



PROPOSED MAJOR COLLECTOR STREET SECTION
60' R.O.W. WITH 44' TRAVELLED WAY
N.T.S.



PROPOSED MINOR COLLECTOR STREET SECTION
56' R.O.W. WITH 40' TRAVELLED WAY
N.T.S.

AMFAC/JMB HAWAII INC. LIHUE-HANAMAULU MASTER PLAN KAUAI, HAWAII	ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC. PROPOSED STREET SECTIONS	FIGURE 2

B. Proposed Improvements

(1) Molokoa

The extension of Hoolaka Street and Kaana Street through the Molokoa development will be classified as major collector streets. These streets will have a 60-foot right-of-way width and a 44-foot curb-to-curb pavement section. The other spine roadways within this development will be considered as minor collector streets and will have a 56-foot right-of-way width with a 40-foot curb-to-curb pavement section. Both major collector and minor collector streets will have four-feet wide sidewalks on both sides.

(2) Ahukini Mauka

The proposed major collector street within the Ahukini Mauka area will parallel Ahukini Road and the Hanamaulu-Ahukini Cutoff Road. It will be a 60-foot right-of-way width with a 44-foot curb-to-curb pavement section. The other spine roadways within this development will be considered minor collector streets with a 56-foot right-of-way width and a 40-foot curb-to-curb pavement section. Again, both major collector and minor collector streets will have four-feet wide concrete sidewalks on both sides.

(3) Ahukini Makai

The proposed west-east roadway which runs through Ahukini Makai will be a 60-foot right-of-way width with a 44-foot curb-to-curb pavement section. No sidewalks are proposed for this industrial area. Roadway widths in the industrial area should be wide enough to accommodate 40-foot and 50-foot tractor-trailer combinations.

(4) Hanamaulu

The proposed collector street within Hanamaulu will have a 60-foot right-of-way width with a 44-foot curb-to-curb pavement section. This street, however, will be constructed under another phase of the

Hanamaulu development. As such, only one minor collector street is proposed for this phase of the development. This minor street would have a 56-foot right-of-way width with a 40-foot curb-to-curb pavement section with four-feet wide sidewalks on both sides of the street.

C. Preliminary Construction Cost Estimate

The preliminary construction cost for the proposed Lihue-Hanamaulu development interior roadway network, in 1994 dollars, is as follows:

Project Area	Construction Cost
Molokoa	$3,675,000
Ahukini Mauka	3,725,000
Ahukini Makai	897,000
Hanamaulu	550,000
Total	$8,847,000

The preliminary construction cost for the proposed intersection improvements, in 1994 dollars, is as follows: (Reference Figure 1 for locations of intersection improvements.)

Intersection No.	Location	Construction Cost
I-1	Kaana Street Extension and Kapule Highway	$ 275,000
I-2	Kapule Highway and Mauka-Makai Road	275,000
I-3	Hoolako Street Extension and Ahukini Road	250,000
I-4	Ahukini Road and Mauka-Makai Road	250,000
I-5	Road "X" and Kuhio Highway	250,000
		$1,300,000

F

Market Analysis of the Lihue-Hanamaulu Master Plan

MARKET ANALYSIS OF THE LIHUE-HANAMAULU MASTER PLAN
AT MOLOKOA, AHUKINI AND HANAMAULU, KAUAI

FOR

LIHUE PLANTATION CO., LTD. AND
AMFAC/JMB HAWAII, INC.

OCTOBER 1994

Prepared by:

ARTHUR ANDERSEN & CO.

MARKET ANALYSIS OF THE LIHUE-HANAMAULU MASTER PLAN
AT MOLOKOA, AHUKINI AND HANAMAULU, KAUAI

FOR

LIHUE PLANTATION CO., LTD. AND
AMFAC/JMB HAWAII, INC.

TABLE OF CONTENTS

SECTION I: SUMMARY OF FINDINGS....1
- Project Description....1
  - Project Area....1
  - Locational Attributes....1
  - Planned Land Uses....2
- County of Kauai and Lihue District Economic Growth Potentials....2
- Residential Market Potentials....5
  - Lower Market Capture Scenario....6
  - Higher Market Capture Scenario....6
- Retail Space Potentials....7
- Office Space Potentials....8
- Industrial Space Potentials....9

SECTION II: PROJECT DESCRIPTION....12
- Project Area....12
- Locational Attributes....12
- Planned Land Uses....13

SECTION III: SOCIOECONOMIC SETTING....16
- Visitor Industry....16
- Sugar....16
- Defense Expenditures....17
- Diversified Agriculture....17
- Secondary Industries....17
- Regional Socioeconomic Considerations....17
  - Population....17
  - Visitation....21
  - Employment....21
  - Per Capita Income....21
- The Effects Of Hurricane Iniki....27
- Projections For The 1995 To 2020 Period....29
  - Population....29
  - Visitation....31
  - Employment....31
  - Per Capita Income....31

SECTION IV: ANALYSIS OF RESIDENTIAL MARKET POTENTIALS....38
- Methodology....38
- Market Area Definitions....38

Regional Market Definition.....39
Lihue District Definition.....39
Household Size.....40
Regional Housing Trends.....41
Housing Absorption Rates.....41
Lihue District Socioeconomic Trends.....45
General Characteristics.....45
Economic Sector Analysis.....45
Visitor Industry.....45
Sugar.....45
Shipping.....46
Government/Civic Center.....46
Lihue District Population Growth Projections.....46
Housing Market Trends - Lihue District.....52
Demand For Permanent Resident Housing - Lihue District.....52
Planned Competitive Development.....56
Potential Capture Of Residential Demand - Project Area.....56
SECTION V: ANALYSIS OF RETAIL MARKET POTENTIALS.....60
Methodology.....60
Market Area Or Trade Area.....60
Primary Market Area (PMA).....61
Secondary Market Area (SMA).....62
Retail Demand.....62
Demand Sectors.....63
Resident Population.....63
Primary Market Area (PMA).....63
Secondary Market Area (SMA).....63
Visitor Population.....63
Personal Income.....66
Retail Expenditure Potentials.....66
Primary Market Area (PMA).....66
Secondary Market Area (SMA).....66
Distribution of Resident Retail Demand By Retail Category.....69
Projected Demand For Retail Goods.....69
Retail Demand Generated By Visitors.....69
Projected Sales Demand Capture.....80
Shopper Goods/Heavy Commercial.....82
Convenience Goods.....83
Eating and Drinking.....83
Existing And Planned Supply Of Retail Space.....83
Resident-Oriented Facilities.....83
Visitor-Oriented Retail Facilities.....84
Planned Facilities.....84
Market Potentials At The Project Area.....89
Neighborhood Center Potential.....89
Convenience Center Potential.....90

Heavy Commercial/Automobile Related Commercial Potential.....90
Visitor Related Potential.....90
SECTION VI: ANALYSIS OF OFFICE MARKET POTENTIALS.....92
Employment - County Of Kauai.....92
Existing Supply Of Office Space.....95
Employment Projections - County Of Kauai.....95
Office Space Development Potential - County Of Kauai.....95
Office Space Development Potential - Lihue District.....95
Office Space Potential - Project Area.....96
SECTION VII: ANALYSIS OF INDUSTRIAL MARKET POTENTIALS.....100
Existing And Planned Light Industrial Activity - County Of Kauai.....100
Employment - County Of Kauai.....100
Industrial Space Potential - County Of Kauai.....100
Employment Projections - County Of Kauai.....101
Industrial Space Potential - Lihue District.....103
Industrial Space Potential - Project Area.....103

SECTION I: SUMMARY OF FINDINGS

The major findings regarding the market potentials for urban uses of the Lihue Plantation Molokoa, Ahukini and Hanamaulu properties (the "Project Area") are presented below.

Project Description

This section provides a description of the Project Area and the major locational attributes of the Project Area.

Project Area

The area referred to in this report as the "Project Area" is located in the County of Kauai, on the Island of Kauai, in the Lihue District, in four parcel areas between the existing town area of Lihue and the Lihue airport along Ahukini Road, and in Hanamaulu near the intersection of Kapule Highway and Kuhio Highway. More specifically, the area is located within the following parcels:

Tax Map Key Number	Area
4-3-6-2-1 (por.); -4 (por.)	159.4 acres
4-3-6-2-17	0.1 acres
4-3-7-1-1 (por.);	221.7 acres
4-3-7-2-1 (por.) -12 (por.)	143.8 acres
4-3-7-3-20 (por.)	30.0 acres
Total:	555.0 acres

Locational Attributes

The parcels in the project area are excellent locations for urban development due to their relative proximity to existing activities and due to the ease of access provided by Kapule Highway, Kuhio Highway and Ahukini Road from the properties to:

- Major employment centers in the Lihue, Kawaihau and Koloa districts;
- Lihue Airport;
- Nawiliwili Harbor;
- Wilcox Hospital;
- Lihue business district;
- Wilcox School;
- Kauai High School;
- Kauai Community College; and
- Vidinha Stadium.

Planned Land Uses

A variety of urban land uses are planned for the project area, including residential, commercial, industrial, open space, and institutional (public/quasi-public) uses. The table below summarizes the approximate acreage distribution of planned land uses by type of use.

Type of Use	Acres
Residential	
Single Family	180
Multi-Family	35
Retail/Office	70
Service/Light Industrial	26
Industrial	102
Main Roads	24
Parks, Open Space	48
Public/Quasi-Public	70
Total:	555

County of Kauai and Lihue District Economic Growth Potentials

The economic potentials of the County of Kauai and the Lihue District (the boundaries of which are coterminous with the Lihue judicial district) are linked to the growth opportunities of Kauai's primary industries: the visitor industry, defense activities, and agriculture. Kauai's other economic activities are generally supported by income generated by the primary industries.

The visitor industry was seriously affected by Hurricane Iniki which struck Kauai on September 11, 1992. The hurricane damaged almost all of Kauai's major hotels, and dropped its average daily visitor count from 19,000 a day to virtually zero. As more hotels reopen, the visitor industry is slowly recovering. Full recovery, however, may not occur until the late 1990s.

While there is significant opportunity for economic growth generated by the visitor industry over the longer term, in the near to intermediate future the main effort will be to reopen all of the existing hotel properties and to return visitation to its pre-hurricane levels.

When the visitor industry is fully recovered, it is anticipated that the County of Kauai will enjoy the general pattern of growth that it had experienced for the two decades prior to Hurricane Iniki.

Defense activities are centered around the Pacific Missile Range Facility at Barking Sands on the west end of Kauai. Its future is dependent upon the number and scale of missions assigned to the facility, which is the leading three dimensional training area in the Pacific for the U.S. Navy. While subject to the general pattern of cutbacks being implemented throughout the armed forces the Pacific Missile Range Facility has opportunities to add new missions to its current inventory, and may be a generator of economic growth in the future.

Sugar cultivation is the leading agricultural activity on Kauai, though it is likely to shrink in scale over the next ten years. The anticipated losses may be partially replaced by diversified agricultural activities such as the production of coffee and ornamental plants.

Summarizing, the County of Kauai and the Lihue District should experience economic growth generated by the recovery and expansion of the visitor industry and the possible expansion of other primary industries. The rate of such growth in the County and in the Lihue District could be affected by the following major issues:

- The timing of the return of major hotels to active business;
- The development of new visitor facilities and activities;
- The success of alternative agricultural crops; and
- The success of efforts to develop new high technology industries.

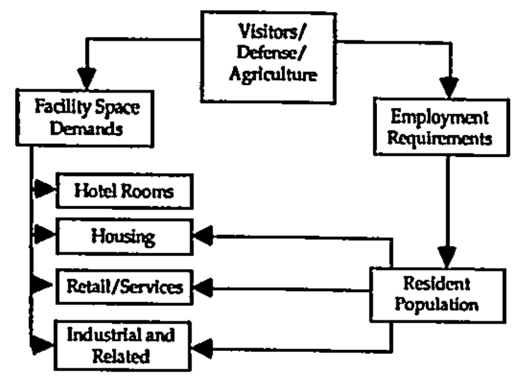
Prior to Hurricane Iniki the County of Kauai and the Lihue District showed substantial growth in both the visitor industry and in resident population. During the 1980 to 1990 period the County of Kauai had an average annual rate of population growth of 2.73 percent, and the Lihue District had an average annual rate of growth of 2.19 percent, both well above the State of Hawaii's 1.40 percent. In 1990 the Lihue District with its population of 10,663 persons accounted for 20.8 percent of the County's total population. Population projections based on adjustments to the State of Hawaii's State, Land Use District Boundary Review for Kauai indicate that the Lihue

District's population could increase to 27,548 persons by 2020 and account for 28.8 percent of the County's total population representing an annual increase of 563 new district residents over the 30-year period. A substantial portion of this increase should come from Kauai residents relocating from other districts to take advantage of the locational benefits associated with proximity to the town of Lihue.

The Lihue District also offers a number of locational advantages for commercial and industrial activities as well. The town of Lihue serves as Kauai's commercial and professional center, is the seat of county government, and is the home for most state and federal district offices. The Lihue District is served by Kauai's main highways, and contains Kauai's primary airport and commercial harbor. It also has 1,636 hotel rooms and visitor condos, representing nearly 9.0 percent of Kauai's total hotel room and visitor condo inventory.

Figure I-1 illustrates the relationship between factors contributing to regional economic growth and land requirements.

Figure I-1.
Diagram of Regional Economic Growth
And Land Use Requirements



Residential Market Potentials

The demand for residential development in the Project Area is determined through a review of regional market forces in the County of Kauai as well as local trends within the immediate Lihue District area surrounding the property. The housing market for the Lihue District is considered to be generally oriented towards residents of the County of Kauai.

Cumulative demand for new housing in the Lihue District is projected at 5,733 units over the 1995 to 2020 period. An aggressively valued residential development program in the Project Area can reasonably expect to capture approximately 30 percent to 40 percent of the demand for single family units and approximately 35 to 45 percent of the demand for multi-family units. The table below summarizes the projected demand for residential units in the Project Area during the 1997 to 2016 period under the assumptions of a Lihue District market capture rates for lower and higher market capture scenarios. The projections in these scearios are generally consistent with the 1,400 to 1,800 units called for in the Lihue-Hanamaulu Master Plan.

Lower Market Capture Scenario

The lower market capture scenario is based on assumptions that the project area's single family units will capture an average of 30% of the Lihue District's demand for single family units and 35% of the Lihue District's demand for multi-family units.

Period	Single Family	Multiple Family	Period Total	Cumulative Total
1997 to 2000	87	25	112	113
2000 to 2001	296	86	382	495
2005 to 2010	370	108	478	972
2010 to 2015	234	68	302	1,275
2015 to 2016	22	11	33	1,308
Totals:	1,009	299		

Higher Market Capture Scenario

The higher market capture scenario is based on assumptions that the project area's single family units will capture an average of 40% of the Lihue District's demand for single family units and 45% of the Lihue District's demand for multi-family units.

Period	Single Family	Multiple Family	Period Total	Cumulative Total
1997 to 2000	116	33	149	149
2000 to 2005	394	111	505	654
2005 to 2010	493	139	632	1,286
2010 to 2015	312	88	400	1,686
2015 to 2016	50	14	64	1,750
Totals:	1,366	384		

The potential mix of housing products may include single family units at affordable, gap, and market prices, and multi-family units at market, affordable and rental market prices. The table below presents the potential mix of units in terms of price range for different types of residential products.

Product Type	Price Range
SF Affordable	$145,000 to $155,000
SF Gap	$175,000 to $190,000
SF Market	$200,000 to $225,000
MF Affordable	$110,000 to $120,000
MF Rental[1].	N/A

Retail Space Potentials

The market potential for retail goods and supportable retail space is primarily a function of market area resident and visitor populations, personal income, and the proportion of income which is spent for various retail goods, and spending patterns. The Primary Market Area for the Project Area was defined as the geographic area coterminous with the Lihue District. The Secondary Market Area was defined as the four remaining judicial districts of the County of Kauai.

The projected 1995 total capturable retail sales in the Lihue District is projected at $301.3 million in 1990 constant dollars. This figure is anticipated by 2020 to reach $670.6 million annually as measured in 1990 constant dollars.

The Project Area has the potential to capture 30 to 40 percent of the increase in demand for retail space in the Lihue District. At these capture rates an additional 246,431 to 328,574 square feet of gross leasable area will be supportable at the Project Area between 1997 and 2016.

The Project Area should be able to support several types of retail centers by 2016, including: 1) a community/ neighborhood center offering a major drugstore and supermarket as anchor tenants ranging in size from 100,000 to 125,000 square feet; 2) a visitor-oriented specialty retail center; 3) a convenience center; and 4) a heavy commercial/automobile-related center.

Under the assumption that the Project Area can capture 40 percent of the projected Lihue District capture of demand for retail space, the following table summarizes the projections for the absorption of retail space at the Project Area.

[1]Note: It is assumed that the underlying unit value is the same as MF Affordable

Period	Period Square Feet GLA	Cumulative Square Feet GLA
1997 to 2000	43,724	43,724
2000 to 2005	69,092	112,816
2005 to 2010	94,996	207,812
2010 to 2015	85,704	293,516
2015 to 2016	35,058	328,574

Office Space Potentials

The demand for office space was determined through an examination of current and future market forces as well as a review of the current supply of office space in the Lihue area. Given the likely continuation of Lihue's role as the civic and commercial center of Kauai and the anticipated growth of the Lihue District, significant demand for new private office space in the area is projected to arise both from resident based demand and perceived economies of agglomeration. The anticipated growth for the County of Kauai will undoubtedly require that additional space for governmental activities also be provided in the area.

The Project Area has excellent potential to serve as a location for office space. The site is located near employment generating areas such as the existing central business district, Nawiliwili Harbor, the Lihue Airport, the Lihue Industrial subdivision, and the Kauai Lagoons resort area. Between 1997 and 2016 the Project Area should be able to support the addition of 157,905 to 189,486 square feet of commercial office space.

Under the assumption that the Project Area can capture 60 percent of the projected Lihue District capture of demand for office space, the following table summarizes the projections for the absorption of office space at the Project Area.

Period	Period Square Feet GLA	Cumulative Square Feet GLA
1997 to 2000	21,834	21,834
2000 to 2005	43,362	64,746
2005 to 2010	54,054	118,800
2010 to 2015	50,490	169,290
2015 to 2016	20,196	189,486

Industrial Space Potentials

Due to its central location in terms of population distribution and transportation corridors, the Lihue District is likely to continue as the primary location for industrial activities on Kauai.

The Project Area has a number of locational advantages which make it a desirable site for industrial activities, including close proximity to the Lihue Airport and Nawiliwili Harbor, good roadway access to all parts of Kauai, the presence of the existing Lihue Industrial subdivision, and its convenient access to commercial areas in Lihue. There is a mix of activities which should engender a substantial demand for industrial land. Those businesses which should require industrial land in the future include:

- Motor vehicle-oriented activities servicing transportation companies, state and county governments and local residents such as car rental yards, commercial passenger vehicle staging areas, repair and servicing centers, and used rental vehicle sales centers;
- Service facilities for airport-related activities such as aircraft maintenance, catering and cleaning services;
- Wholesalers serving retail, restaurant and hotel operators who need warehousing facilities;
- Firms which conduct food processing and packaging for sale on Kauai or for export;
- Businesses providing services and supplies to the building industry;
- Contract construction storage yards and other storage facilities, including public storage; and
- Local consumer-oriented businesses.

Between 1997 and 2016 the Project Area should be able to support the addition of 712,012 to 949,520 square feet of industrial building space. Under the assumption that the Project Area can capture 40 percent of the projected Lihue District capture of demand for industrial space, the following table summarizes the projections for the absorption of industrial space at the Project Area.

Period	Period Square Feet GLA	Cumulative Square Feet GLA
1997 to 2000	198,653	198,653
2000 to 2005	205,856	404,509
2005 to 2010	227,088	631,597
2010 to 2015	227,088	858,685
2015 to 2016	90,835	949,520

Table I-1 summarizes the projected potential capture of demand for residential units, retail space, office space and industrial space by the Project Area over the 1997 to 2016 period. Two scenarios are projected: 1) a lower general market capture; and 2) a higher general market capture.

Table I-1.

Summary of Period Market Demand For Residential, Commercial and Industrial
Project Area 1997 - 2018

	1997 to 1999	2000 to 2004	2005 to 2009	2010 to 2014	2015 to 2018
Lower Market Capture (1)					
SF Units by Period	87	296	370	234	22
SF Units Cumulative	87	383	753	987	1,009
MF Units	25	86	108	68	11
MF Units Cumulative	25	112	220	288	299
Total Units	113	382	477	302	33
Total Units Cumulative	113	495	972	1,275	1,308
Retail GLA	32,793	51,819	71,247	64,278	26,293
Retail GLA Cumulative	32,793	84,612	155,859	220,137	246,431
Office GLA	17,820	36,135	45,045	42,075	16,830
Office GLA Cumulative	17,820	53,955	99,000	141,075	157,905
Industrial GLA	148,990	154,392	170,318	170,316	67,999
Industrial GLA Cumulative	148,990	303,382	473,698	644,014	712,012
Higher Market Capture (2)					
SF Units by Period	118	394	493	312	50
SF Units Cumulative	118	511	1,003	1,316	1,366
MF Units	33	111	139	88	14
MF Units Cumulative	33	144	282	370	384
Total Units	149	505	631	400	64
Total Units Cumulative	149	654	1,286	1,686	1,750
Retail GLA	43,724	69,092	94,996	85,704	35,058
Retail GLA Cumulative	43,724	112,816	207,812	293,518	328,574
Office GLA	21,384	43,362	54,054	50,490	20,196
Office GLA Cumulative	21,384	64,746	118,800	169,290	189,486
Industrial GLA	198,653	205,856	227,088	227,088	90,835
Industrial GLA Cumulative	198,653	404,509	631,597	858,685	949,520

Note: (1) 1997 to 2018 market capture figures derived from 1995 to 2020 demand projections
(2) Lower Market Capture - Portion of Lihue District demand 30% SF Res, 35% MF Res, 30% Retail, 50% Office, 30% Industrial
(3) Higher Market Capture - Portion of Lihue District demand 40% SF Res, 45% MF Res, 40% Retail, 60% Office, 40% Industrial

SECTION II: PROJECT DESCRIPTION

Project Area

The project area referred to in this report as the "Project Area" is located in the County of Kauai, on the Island of Kauai, in the Lihue District, in four parcel areas between the existing town area of Lihue and the Lihue airport, along Ahukini Road, and in Hanamaulu near the intersection of Kapule Highway and Kuhio Highway. More specifically, the area is located within the following parcels:

The project area includes all or portions of the parcels of land listed below.

Tax Map Key Number	Area
4-3-6-2-1 (por.); -4 (por.)	159.400 acres
4-3-6-2-17	0.104 acres
4-3-7-1-1 (por.); -12 (por.)	221.698 acres
4-3-7-2-1 (por.)	143.842 acres
4-3-7-3-20 (por.)	29.982 acres
Total:	555.026 acres

Figure II-1 presents a map showing the general location of the project area in relation to the greater Lihue area. Figure II-2 presents a more detailed map of the project area shown the specific location of the parcels in which the project area is included.

The project area is currently used for the cultivation of sugar cane. The parcels generally have gentle slopes.

Locational Attributes

The parcels in the project area are excellent locations for urban development due to the ease of access provided by Kapule Highway, Kuhio Highway and Ahukini Road to and from:

- Major employment centers in the Lihue, Kawaihau and Koloa districts
- Lihue Airport
- Nawiliwili Harbor
- Wilcox Hospital

- Lihue business district
- Wilcox School
- Kauai High School
- Kauai Community College
- Vidinha Stadium

Planned Land Uses

A variety of urban land uses are planned for the project area, including residential, commercial, industrial, open space, and institutional (public/quasi-public) uses. The table below summarizes the approximate distribution of planned land uses by type.

Type of Use	Acres
Residential	
Single Family	180
Multi-Family	35
Retail/Office	70
Service/Light Industrial	26
Industrial	102
Main Roads	24
Parks, Open Space	48
Public/Quasi-Public	70
Total:	555

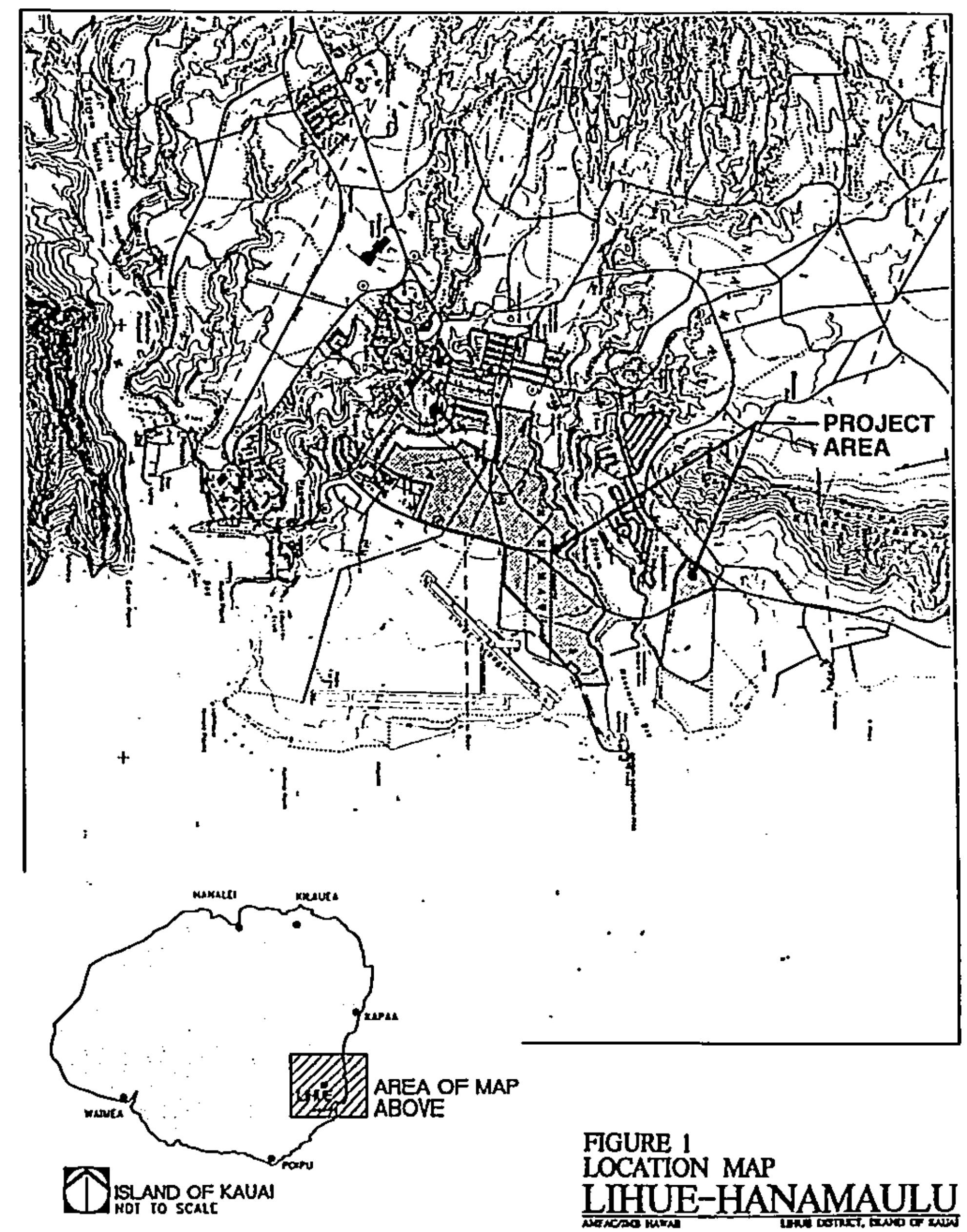
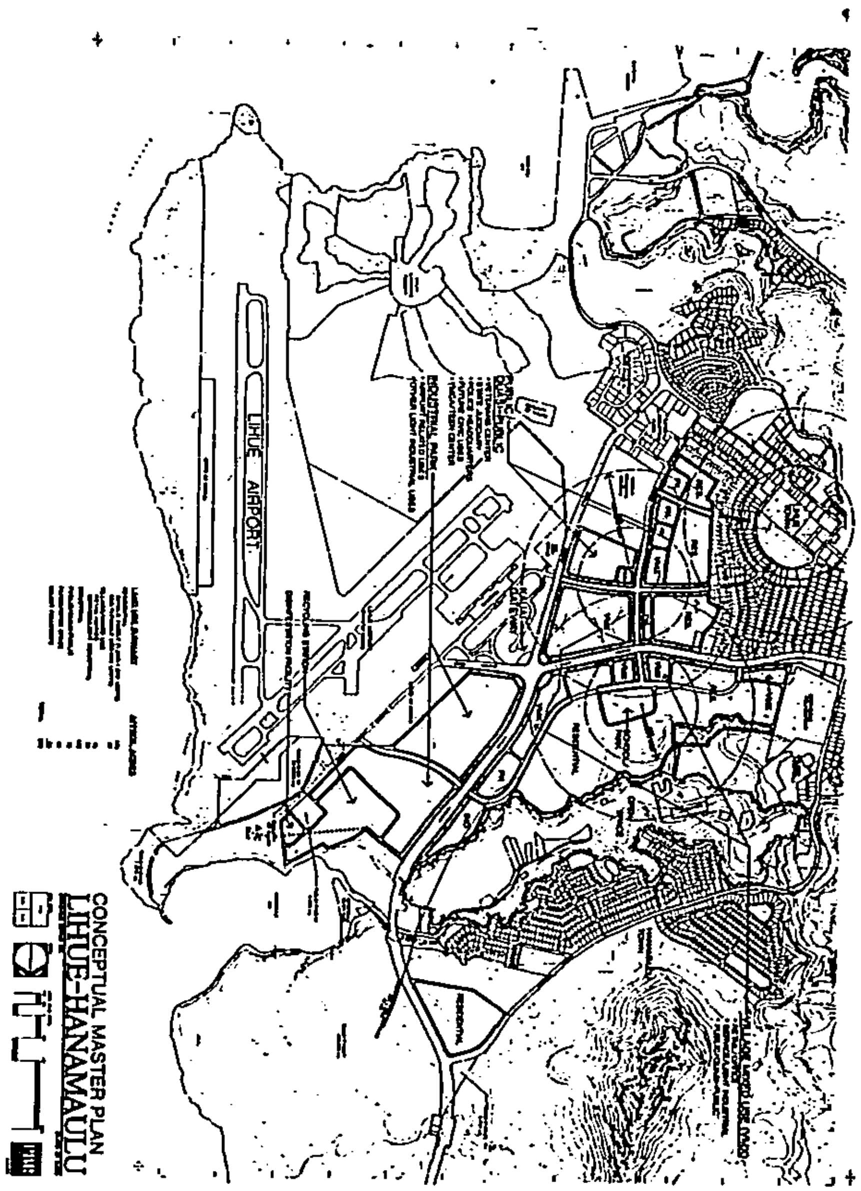


FIGURE 1
LOCATION MAP
LIHUE-HANAMAULU



SECTION III: SOCIOECONOMIC SETTING

This section presents brief descriptions of Kauai's primary industries and presents information on key demographic factors, which provides background for projections related to the potential demand for urban uses in the Project Area.

Visitor Industry

Prior to Hurricane Iniki, the visitor industry was the island's largest industry and export activity, and generated over $1.1 billion for Kauai in 1991. In that year Kauai had nearly 8,000 visitor rooms or units and accommodated 1.3 million visitors. Direct employment in hotels and other accommodations totaled about 4,600 persons, and the visitor industry as a whole provided about 10,860 jobs, which were distributed among the many companies, from grocery stores to gas stations, that came into contact with visitors.

When the impact of visitor industry spending on secondary industries is accounted for, it is estimated that the visitor industry on Kauai supported 17,000 jobs in 1991, or 60 percent of the total job count.

While it is generally expected that daily and annual visitor counts for Kauai will return back to and later exceed pre-Iniki levels, one critical issue will be the timing of completion of repairs to major hotels such as the Marriott (previously Westin) in Nawiliwili; the Sheraton, the Waiohai and Poipu Beach hotels in Poipu; and the Coco Palms in Wailua. The reopening of the 1,880 rooms, or the 24 percent of Kauai's total visitor accommodation facilities, that these hotels represent, will be necessary to accommodate larger numbers of visitors to the island.

Sugar

Kauai's sugar industry, which includes growing and processing, has been in long-term decline, but in 1991 still contributed about $80 million to Kauai's economy and directly employed 800 workers. DBEDT estimates that directly and indirectly the industry supports about 1,400 jobs on Kauai. The future of sugar generally on Kauai will depend on the economics of individual plantations, and the ability of the industry as a whole to operate profitably in a complex and difficult global marketplace.

Defense Expenditures

Defense activity on Kauai through the Pacific Missile Range Facility (PMRF) generated $78 million in spending and directly supported more than 800 jobs during fiscal year 1992. Located at Barking Sands on the west end of Kauai, PMRF provides air, surface, and underwater training facilities for the U.S. Pacific Fleet; conducts missile test launches; and hosts a number of tenant organizations. It is estimated that the facility and its civilian tenants both directly and indirectly support about 1,500 jobs on Kauai.

Diversified Agriculture

In 1991 diversified agriculture on Kauai employed about 750 people, including self-employed and family workers. Most of Kauai's $12.9 million output of diversified agricultural products in 1990 was exported to Oahu or out of state.

Diversified agriculture on Kauai includes a wide range of crops and products including fruits, flowers and nursery products, livestock, forage and grains, and taro. The McBryde plantation also cultivated macadamia nuts and coffee, but due to the extent and nature of damage from Hurricane Iniki has decided to end macadamia nut production.

Secondary Industries

The secondary industries supply the balance of jobs and income on the island, although they are dependent on the earnings of the export industries. Secondary activities include most retailing and service businesses which are conducted primarily with local residents and business firms.

Regional Socioeconomic Considerations

Regional socioeconomic elements include population, visitor counts, employment and income. This section presents historical information for each of those elements.

Population

The historic and projected population and household characteristics of the residents of the County of Kauai are primary influences in the determination of the potential for future development in the Project Area. The County of

Kauai experienced significant population growth in the 1970s and 1980s after a period of decline during the 1940s and 1950s and a virtually dormant period during the decade of the 1960s. As shown in Table III-1 the County has reversed the trend where it represented a declining percentage of the State's total population. The County has increased its share of total State residents from a low of 3.9 percent in 1970 to 4.6 percent by 1990. Between 1970 and 1990 the population in the County rose from 29,176 persons to 51,177 persons, a net increase of 21,416 persons or over 1,000 persons annually over 20 years. The annual growth rate for the population in the County from 1970 to 1990 was 2.75 percent; and from 1980 to 1990 2.7 percent. In comparison, the annual population growth rate for the State of Hawaii from 1970 to 1990 was 1.8 percent; and from 1980 to 1990, 1.4 percent.

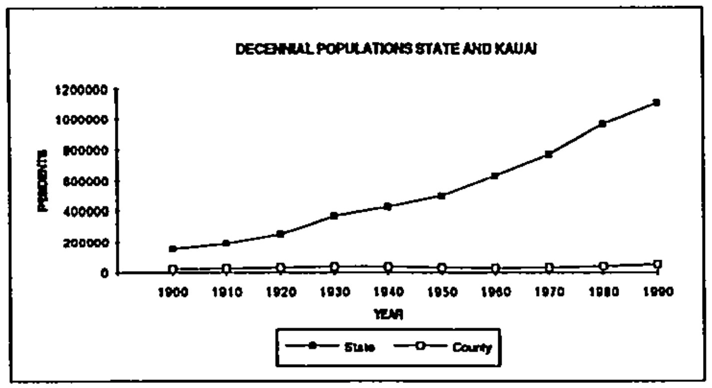
Table III-2 presents annual population change for the County of Kauai for the 1980 to 1992 period which shows a pattern of continued growth during that twelve year period.

Table III-1.

Decennial Population Change
State of Hawaii and County of Kauai
1900 to 1990

Year	State	County	County As % Of State
1900	154,001	20,734	13.46%
1910	191,874	23,952	12.48%
1920	255,881	29,438	11.50%
1930	368,300	35,942	9.76%
1940	422,770	35,818	8.47%
1950	499,794	29,905	5.98%
1960	632,772	28,176	4.45%
1970	769,913	29,761	3.87%
1980	964,691	39,082	4.05%
1990	1,108,229	51,177	4.62%

Annual % Change	State	County
1900-1990	2.22%	1.01%
1960-1990	1.89%	2.01%
1970-1990	1.84%	2.75%
1980-1990	1.40%	2.73%



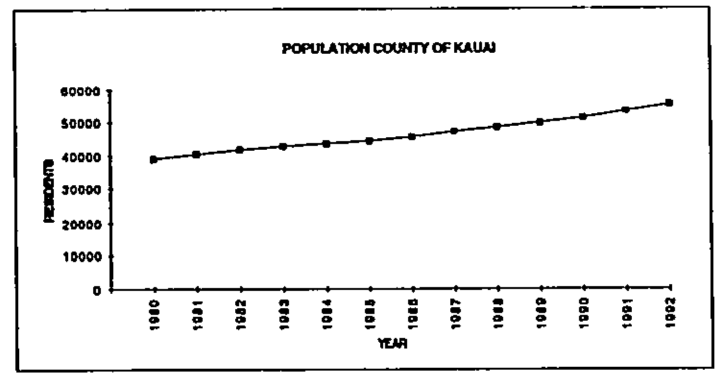
Source: Schmitt, Robert C., Historical Statistics of Hawaii; DBEDT Data Book, 1992

Table III-2.

Annual Population Change
County of Kauai
1980 to 1992

Year	Population	Change	% Change
1980	39,082		
1981	40,500	1,418	3.63%
1982	41,800	1,300	3.21%
1983	42,800	1,000	2.39%
1984	43,600	800	1.87%
1985	44,400	800	1.83%
1986	45,600	1,200	2.70%
1987	47,200	1,600	3.51%
1988	48,500	1,300	2.75%
1989	49,800	1,300	2.68%
1990	51,177	1,377	2.77%
1991	53,300	2,123	4.15%
1992	55,300	2,000	3.75%

Annual % Change	
1980-1992	2.93%
1987-1992	3.22%
1990-1992	3.95%



Source: DBEDT Data Book, 1992

Visitation

Visitor arrivals on Kauai increased from 781,409 visitors in 1980 to a high of 1,291,210 visitors in 1989. There were slight declines in the visitor arrival counts in 1990 and 1991, and a significant drop in 1992, as a consequence of Hurricane Iniki. Preliminary data for 1993 indicates that visitor arrivals in 1993 declined to 572,410 visitors.

Average annual daily visitor census counts followed a similar pattern. In 1980 there was an average daily count of 7,259 visitors. The count reached a peak of 19,140 visitors per day in 1989, followed by slight declines in 1990 and 1991 a significant drop in 1992, the last year for which data is available, to 13,460 visitors per day.

Table III-3 present the data on visitor arrivals for the 1980 to 1993 period for visitor arrivals. Table III-4 present the data for the 1980 to 1992 for average annual daily visitor census counts.

Employment

Civilian jobs during the 1980 to 1990 period generally followed a pattern of growth. In the 1987 to 1990 period the total number of civilian jobs increased by over 25 percent. The pattern of job growth was interrupted in late 1992 by Hurricane Iniki. The hurricane and its after effects caused a drop in the total number of jobs, and a temporary shift from hotel employment to construction and non-hotel services employment. As the reconstruction activity winds up, and as hotels are re-opened, the allocation of jobs among employment sectors will move back to more customary patterns.

Under normal circumstances, services, trades and government employment are the major employment categories, with self-employed, agriculture, construction and financial services as the second tier of employment.

Table III-5 presents the employment and job counts for the County of Kauai for the years 1987, 1990 and 1993. The figures for 1987 and 1990 are average annual counts. The figures for 1993 are for the December 1993 period.

Per Capita Income

Real and nominal per capita income levels for the County of Kauai showed a general pattern of growth in the 1980 to 1991 period. There were some slight declines during the 1982 to 1983 and 1991 to 1993 recessionary periods, but the general pattern has been one of slight real growth. Nominal per capita income increased from $9,499 in 1980 to $17,682 in 1991. Real per capita

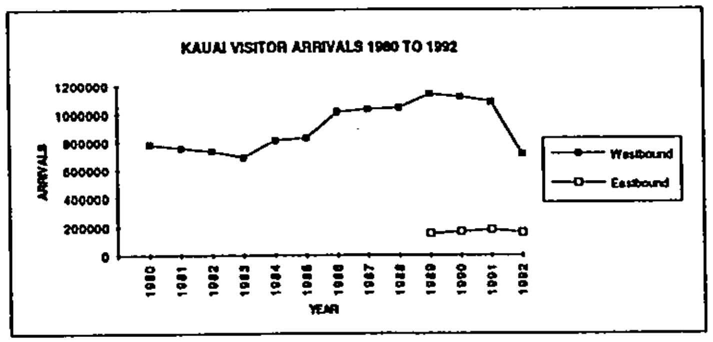
income based on 1982 dollars increased from $11,403 in 1980 to $11,947 in 1991. Per capita income for Kauai residents during the 1980 to 1991 period ranged between 81 percent to 89 percent of per capita income for the State of Hawaii.

Table III-6 presents real and nominal per capita income levels for the County of Kauai for the 1980 to 1991 period. Real per capita income levels are in constant 1982-1984 dollars calculated by dividing nominal per capita income by the consumer price index (CPI) adjustment factor. The adjustment factor is the CPI for Honolulu.

Table III-3.

Visitor Arrivals
Island of Kauai
1980 to 1992

Year	Kauai Visitors Westbound	Kauai Visitor Eastbound	Total Kauai Visitors	Total State Visitors	Kauai Westbound Visitors As % of Total	Kauai Eastbound Visitors As % of Total
1980	781,409		781,409	3,934,504	19.86%	
1981	757,811		757,811	3,934,623	19.26%	
1982	733,295		733,295	4,242,925	17.28%	
1983	691,940		691,940	4,368,105	15.84%	
1984	814,590		814,590	4,855,580	16.78%	
1985	832,580		832,580	4,884,110	17.05%	
1986	1,014,650		1,014,650	5,606,980	18.10%	
1987	1,032,840		1,032,840	5,799,830	17.81%	
1988	1,043,710		1,043,710	6,142,420	16.99%	
1989	1,138,230	152,980	1,291,210	6,641,820	17.14%	2.30%
1990	1,118,930	167,430	1,286,360	6,971,180	16.05%	2.40%
1991	1,085,290	182,330	1,267,620	6,873,890	15.79%	2.65%
1992	714,860	162,180	877,060	6,513,860	10.97%	2.49%
1993	444,840	127,570	572,410	6,115,300	7.27%	2.09%
Average Rate Of Growth 1980 To 1992:	-0.74%		0.97%	4.29%		
1987 To 1992:	-7.09%		-3.22%	2.35%		
1990 To 1992:	-20.07%	-1.58%	-17.43%	-3.34%		

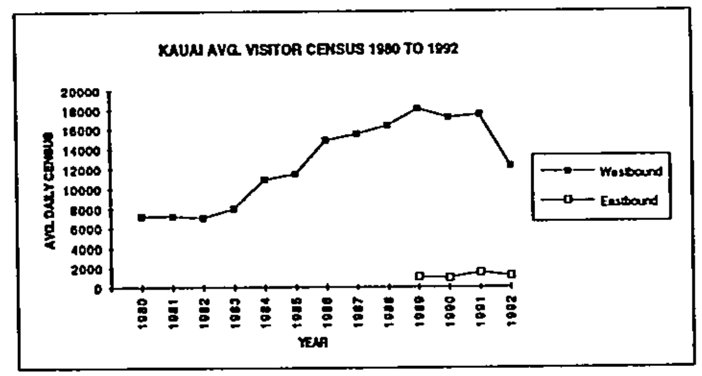


Source: DBEDT, Data Book 1992, Table 194 and earlier reports

Table III-4.

Average Daily Visitor Census
Island of Kauai - 1980 to 1992

Year	Kauai Visitors Westbound	Kauai Visitors Eastbound	Total Kauai Visitors	Kauai Westbound Visitors As % of Total	Kauai Eastbound Visitors As % of Total
1980	7,259		7,259		
1981	7,225		7,225		
1982	7,050		7,050		
1983	7,990		7,990		
1984	10,930		10,930		
1985	11,470		11,470		
1986	14,840		14,840		
1987	15,510		15,510		
1988	16,400		16,400		
1989	18,090	1,050	19,140	94.51%	5.49%
1990	17,200	1,000	18,200	94.51%	5.49%
1991	17,470	1,550	19,020	91.85%	8.15%
1992	12,270	1,190	13,460	91.16%	8.84%
Average Rate Of Growth 1980 To 1992:			5.28%		
1987 To 1992:			-2.80%		
1990 To 1992:	-15.54%	9.09%	-14.00%		



Source: DBEDT, Data Book 1992, Table 193 and earlier reports

Table III-5.

Employment and Jobs
County of Kauai
1987, 1990, 1993

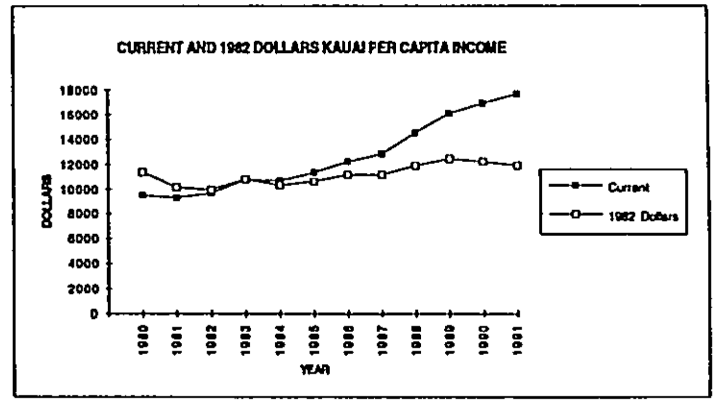
	1987	1990	1993
Civilian Jobs	22,750	28,000	25,900
Wage and Salary	20,750	25,450	23,600
Agriculture	1,300	1,150	1,400
Manufacturing	1,300	900	800
Construction	750	1,450	1,400
Transp., Com., Util.	2,050	2,400	1,500
Trade	5,450	7,050	5,800
Banking, Finance	1,150	1,550	1,500
Services	5,850	7,600	7,000
Hotels	3,200	4,000	2,400
Other Services	2,650	3,600	4,600
Government	2,900	3,350	4,200
State/Local	2,650	3,000	3,700
Federal	250	350	500
Self-employed	2,000	2,550	2,300
As % of Population:	48.20%	54.71%	N/A

Note: Self-employed figure for 1993 estimate based on 1991 annual average
Source: DBEDT, Data Book 1988 Table 365, 1991 Table 340; Dept. of Labor and Industrial Relations 1993

Table III-6.

Per Capita Personal Income
Current and Constant Dollars
County of Kauai
1980 to 1991

Year	Current	CPI Adj.	1982 Dollars
1980	$9,499	0.83	$11,403
1981	$9,308	0.92	$10,150
1982	$9,703	0.97	$9,983
1983	$10,764	0.99	$10,840
1984	$10,691	1.04	$10,329
1985	$11,365	1.07	$10,641
1986	$12,245	1.09	$11,193
1987	$12,861	1.15	$11,193
1988	$14,530	1.22	$11,939
1989	$16,067	1.29	$12,484
1990	$16,913	1.38	$12,247
1991	$17,682	1.48	$11,947
Average Rate Of Growth			
1980 To 1990:	5.94%		0.72%
1980 To 1991:	5.81%		0.42%



Source: County of Kauai, Statistical Abstract of the Kauai Economy, Table 3.1, from Bank of Hawaii

The Effects Of Hurricane Iniki

Hurricane Iniki passed directly over the Island of Kauai on September 11, 1992. The hurricane caused an estimated $1.6 billion worth of damage to property on the Islands of Kauai and Niihau, and left in its wake an economy which: 1) had a substantial portion of its workforce without adequate housing; 2) required extensive repairs to its electrical and telephone infrastructure; 3) had extensive agricultural crop damage; and 4) had a substantial portion of its visitor accommodation facilities put out of action. Table III-7 lists the estimates of damage by major property classification.

Much of the economic activity on the Island of Kauai during the first year after the hurricane has been related to the repair and the rebuilding of utilities and structures which were damaged by the hurricane. This reconstruction activity, which has been substantially funded by off-island sources of funds such as insurance and government, has partially made up for the greatly reduced level of visitor industry activity, and has made it possible for most of the island's workforce to remain on the island. While the level of reconstruction activity has begun to decline, visitors are returning to the island and are re-establishing the visitor industry as the island's leading economic sector.

It is critical for the near-term economic health of the County of Kauai that the level of visitor activities return to pre-Iniki levels as soon as possible in order to counteract declines in employment as reconstruction activities are completed. Further hampering recovery are delays in the repair and reconstruction of several major hotels including the Marriott (previously Westin) Kauai, the Coco Palms, the Waiohai, the Poipu Beach Hotel, and the Sheraton Poipu. Until these hotels are once again open to guests, it is unlikely that average daily visitor counts and visitor expenditures will be able to reach pre-Iniki levels. Published reports and discussions with knowledgeable professionals regarding the time required for complete recovery indicate that it may not be until the late 1990s before the visitor industry and the overall economy fully recover.

Table III-7.

Estimates of Damage from Hurricane Iniki
County of Kauai
1992

	Hotels	Condos	B&B		
Damages to Private and Public Property ($ millions)					
Private Property					$674.30
Residential					
Structures				$464.00	
Personal Property				$210.30	
Commercial					$668.30
Visitor Facilities/Infrastructure				$378.00	
Non-Visitor Facilities				$151.00	
Public Utilities				$139.30	
Private Non-Profit Orgs.				$14.20	
Agriculture				$78.00	
Public Property					$118.70
State/County				$115.10	
Federal				$3.60	
Total:					$1,461.30
Estimates of Private Housing Damage (Units)					
Single-Family					
Destroyed					1,420
Major Damage					5,149
Minor Damage					7,171
Subtotal:					13,740
Multiple-Family					
Destroyed					18
Major Damage					209
Minor Damage					369
Subtotal:					596
Mobile Homes					
Destroyed					1
Major Damage					2
Minor Damage					1
Subtotal:					4
Damage to Visitor Accommodations	Hotels	Condos	B&B		
Units Damaged					
Destroyed	241	401	10		652
Major Damage	427	654	24		1,105
Minor Damage	1,077	1,022	23		2,122
Unclassified Damage	245	0	0		245
Total:					4,124

Source: Governor's Economic Recovery Committee, "Imua: Kauai Beyond Hurricane Iniki," Tables IV-1, 2, and 3

Projections For The 1995 To 2020 Period

This section presents projections for the 1995 to 2020 period based on the Department of Business and Economic Development and Tourism's Series M-K projections for the County of Kauai. The Series M-K projections are adjusted to reflect recent statistics from the 1990 census and other sources, and the possible effects of Hurricane Iniki on key demographic variables. District population projections are based on projections used by the Office of State Planning in its 1992 Kauai boundary review, also adjusted for actual statistics and the effects of Hurricane Iniki.

The projection series includes projections regarding population, visitation to Kauai by non-Hawaii residents, jobs by employment sectors, and per capita income.

Population

This section presents population projections for the County of Kauai.

Table III-8 presents the DBEDT Series M-K population projections for the period 1990 to 2010 for the County of Kauai. Table III-9 presents adjustments to the projections to reflect 1) the difference of 2,393 persons between the 1990 projection and the lower 1990 census count, and 2) a reduction in the projected increase in the number of persons for the 1990 to 1995 period from 7,000 to 5,000 and for the 1995 to 2000 period from 7,100 to 6,000 to reflect the impact of Hurricane Iniki. An additional projection period of 2010 to 2020 has been added with two five year periods of 8,500 person increases per five year period.

Under the adjusted projections the County's population is projected to reach 78,577 persons in 2010, and 95,577 persons in 2020. The projection represents an increase of 27,400 persons for 2010 and 44,400 persons for 2020 from the 1990 level of 51,177 persons, and a composite growth rate from 1990 to 2010 to 2.17 percent and from 1990 to 2020 of 2.10 percent.

Table III-8.

Series M-K Projected Population Growth
County of Kauai
1990 to 2010

Year	Population	Change	Annual % Change
1990	54,100		
1995	61,100	7,000	2.46%
2000	68,200	7,100	2.22%
2005	75,500	7,300	2.05%
2010	84,600	9,100	2.30%

Source: DBEDT Series M-K Projections, Table 7; Arthur Andersen RESG

Table III-9.

Adjustments to Series M-K Projected Population Growth
County of Kauai
1990 to 2020

Year	Series M-K Population	Change	Annual % Change	Adjusted Population	Change	Annual % Change
1990	54,100			51,177		
1995	61,100	7,000	2.46%	56,177	5,000	1.88%
2000	68,200	7,100	2.22%	62,177	6,000	2.05%
2005	75,500	7,300	2.05%	69,477	7,300	2.25%
2010	84,600	9,100	2.30%	78,577	9,100	2.49%
2015				87,077	8,500	2.08%
2020				95,577	8,500	1.88%
Annual % Change						
1990-2010				2.17%		
1990-2020				2.10%		

Source: U.S. Census 1990, DBEDT Series M-K Projections, Table 7; Arthur Andersen RESG (including 2010 to 2020 projections)

Visitation

This section presents projections for visitation to the County of Kauai. The Series M-K projections presented in Table III-10 have been adjusted in Table III-11 to reflect actual visitation levels recorded by the Hawaii Visitors Bureau for 1990, 1991 and 1992, and for the recovery period related to the effects of Hurricane Iniki. Because of the relatively slow progress in reopening Kauai's main hotels, and the time it will take to build up occupancy, average daily visitor census levels may not reach previous peak levels of more than 19,000 before the late 1990s. As portrayed, the projections suggest that the rate of increase will be the same for the 1995 to 2000 period as in the Series M-K projections, and reach nearly 19,000 average daily visitors in 2000.

Employment

Projections of employment for the County of Kauai are based on the Series M-K projections presented in Table III-12, though they have been adjusted in Tables III-13 and III-14 to reflect the dynamic pattern of changes caused by the effects of Hurricane Iniki. In particular there likely will be a shift away from the increase in contract construction related to post-hurricane repair efforts and back to a more normal level hotel and other service employment starting in 1995.

By the year 2010 total civilian employment should reach 42,500 jobs, a net increase of 16,600 over the 1993 estimate of 25,900 jobs. This represents an average annual growth of approximately 975 new jobs for the period.

Trade, services and government are projected to continue as the leading employment sectors, followed by significant numbers of self-employed persons and contract construction workers.

Per Capita Income

In 1991 per capita income for Kauai residents as measured in current dollars stood at $17,682. This represented an increase of $8,183 or 5.81 percent over 1980 per capita income levels. After adjustment for inflation, however, the real growth as measured in 1982 constant dollars was only $544 for the period reflective of an annual percentage growth rate for the 1980 to 1991 period of 0.42 percent.

Series M-K projections for the County of Kauai average per capita projections are presented in Table III-15. In the projections, presented in constant 1982 dollars, there average annual increases range from 2.15 percent for the 1990 to 1995 period to 0.81 percent for the 2005 to 2010 period.

Nominal per capita income levels for 1980 and 1990 are adjusted in Table III-16 for inflation factors in order to relate them to the constant 1982 dollars used in the adjusted Series M-K projections. The Series M-K projections are further adjusted in Table III-17 to reflect estimates for 1990 and 1991. The same annual rates of change as in the original projections are used, and lower annual rates of change are used in the 2010 to 2020 period to reflect the declining rate used in the Series M-K projections. The adjusted 1982 dollars for per capita income are then recalculated into constant 1990 dollars for later use in the retail demand analysis. After these adjustments, real 1990 per capita income for Kauai residents is projected to increase from $16,913 in 1990 to $23,673 in 2020.

Table III-10.

Series M-K Projected Average Daily Visitor Census
County of Kauai
1990 to 2010

Year	Census	Change	Annual % Change
1990	18,700		
1995	21,400	4,700	5.08%
2000	26,800	5,400	4.60%
2005	30,300	3,500	2.49%
2010	36,900	6,600	4.02%

Source: DBEDT Series M-K Projections, Table 7; Arthur Andersen RESG

Table III-11.

Adjustments to Series M-K Projected Average Daily Visitor Census
County of Kauai
1990 to 2020

Year	Series M-K Census	Change	Annual % Change	Adjusted Census	Change	Annual % Change
1990	18,700			18,200		
1995	21,400	4,700	5.08%	15,000	(3,200)	-3.79%
2000	26,800	5,400	4.60%	18,785	3,785	4.60%
2005	30,300	3,500	2.49%	21,238	2,453	2.49%
2010	36,900	6,600	4.02%	25,864	4,626	4.02%
2015				29,364	3,500	2.57%
2020				32,864	3,500	2.28%
Annual % Change						
1990-2010				1.77%		
1990-2020				1.99%		

Source: Hawaii Visitors Bureau; DBEDT Series M-K Projections, Table 9; Arthur Andersen RESG (including 2010 to 2020 projections)

Table III-12.

Series M-K Employment Projections
County of Kauai
1985 to 2010

	1990	1995	2000	2005	2010
Civilian Jobs	25,300	29,800	34,200	38,100	42,500
Wage and Salary	23,100	27,400	31,600	35,400	39,600
Agriculture	1,500	1,700	1,800	2,000	2,200
Manufacturing	1,300	1,300	1,300	1,300	1,300
Construction	800	900	1,100	1,200	1,400
Transp., Com., Util.	2,400	2,800	3,100	3,400	3,600
Trade	3,600	4,500	5,400	6,200	7,100
Eating & Drinking	2,400	2,900	3,400	4,000	4,600
Banking, Finance	1,100	1,300	1,500	1,600	1,800
Services	6,700	8,000	9,400	10,700	12,200
Hotels	3,400	4,000	4,500	5,000	5,600
Other Services	3,200	4,000	4,900	5,700	6,600
Government	3,500	4,000	4,500	5,000	5,400
State/Local	3,300	3,800	4,300	4,800	5,200
Federal	200	200	200	200	200
Self-employed	2,200	2,400	2,600	2,700	2,900

Source: DBEDT, Series M-K, Table 7

Table III-13.

Adjustments To Series M-K
Kauai Employment Projections
1990 to 2010

	Series M-K Projected 1990	Actual 1990	Adjustments to 1990	Actual Dec. 1993	Adjustments to M-K 1990
Civilian Jobs	25,300	26,500	1,200	25,900	600
Wage and Salary	23,100	23,950	850	23,600	500
Agriculture	1,500	1,150	(350)	1,400	(100)
Manufacturing	1,300	900	(400)	800	(500)
Construction	800	1,450	650	1,400	600
Transp., Com., Util.	2,400	2,350	(50)	1,500	(900)
Trade	3,600	7,050	1,050	5,800	2,200
Eating & Drinking	2,400	0	0		
Banking, Finance	1,100	1,400	300	1,500	400
Services	6,700	7,500	800	7,000	300
Hotels	3,400	3,800	400	2,400	(1,000)
Other Services	3,200	3,700	500	4,600	1,400
Government	3,500	3,350	(150)	4,200	700
State/Local	3,300	3,000	(300)	3,700	400
Federal	200	350	150	500	300
Self-employed	2,200	2,550	350	2,300	100

Source: County of Kauai, Statistical Abstract of the Kauai Economy, 1993; DLIR, Labor Area News, Dec. 1993; Arthur Andersen RESG

Table III-14.

Adjusted M-K Series Employment Projections
County of Kauai
1990 - 2010

	Actual 1990	Actual 1993	1995	2000	2005	2010	2015	2020
Civilian Jobs	28,000	25,900	29,800	34,200	38,100	42,500	46,900	51,300
Wage and Salary	25,450	23,600	27,400	31,600	35,400	39,600	43,800	48,000
Agriculture	1,150	1,400	1,200	1,300	1,500	1,700	1,900	2,100
Manufacturing	900	800	800	800	800	800	800	800
Construction	1,450	1,400	1,000	1,100	1,200	1,400	1,600	1,800
Transp., Com., Util.	2,400	1,500	2,200	3,100	3,400	3,600	3,800	4,000
Trade	7,050	5,800	6,150	7,050	7,850	8,750	9,650	10,550
Eating & Drinking	0	0	0	0	0	0	0	0
Banking, Finance	1,550	1,500	1,300	1,500	1,600	1,800	2,000	2,200
Services	7,600	7,000	8,000	9,400	10,700	12,200	13,700	15,200
Hotels	4,000	2,400	4,000	4,500	5,000	5,600	6,200	6,800
Other Services	3,600	4,600	4,000	4,900	5,700	6,600	7,500	8,400
Government	3,500	4,200	4,100	4,600	5,100	5,500	5,900	6,300
State/Local	3,000	3,700	3,700	4,200	4,700	5,100	5,500	5,900
Federal	350	500	400	400	400	400	400	400
Self-employed	2,550	2,300	2,400	2,600	2,700	2,900	3,100	3,300
Employment As % of Population	54.71%	N/A	53.05%	55.00%	54.84%	54.09%	53.86%	53.67%

Notes: Construction for 1995 based on M-K plus 100 residual Iniki work
Transp., Com., Util. based on 1995 M-K
Eating and Drinking consolidated into Trade
Hotel assumed to reach 1990 levels by 1995
Other Services assumed to retain one-half of 1993 increase by 1995
All other Wage and Salary categories adjusted to reflect changes in 1993 actual

Source: Arthur Andersen RESG

Table III-15.

Per Capita Income
In 1982 Dollars
County of Kauai

Year	Nominal Per Capita Income	Inflation Adjustment Factor	Real Income 1982 Dollars
1980	$9,499	0.83	$11,403
1990	$16,913	1.38	$12,247
Real Increase:			$844
Average Annual Rate Of Growth 1980 To 1990			0.72%

Table III-16.

Series M-K Projected Per Capita Income
County of Kauai
1990 to 2010

Year	1982 Dollars	Change	Annual % Change
1990	$11,600		
		$1,300	2.15%
1995	$12,900		
		$1,000	1.50%
2000	$13,900		
		$600	0.85%
2005	$14,500		
		$600	0.81%
2010	$15,100		

Source: DBEDT Series M-K Projections, Table 7; Arthur Andersen RESG

Sources: DBED Data Book, 1991, Table 398; Arthur Andersen RESG

Table III-17.

Adjustments to Series M-K Projected Per Capita Income
County of Kauai
1990 to 2020
(1982 Dollars)

Year	Series M-K Income	Change	Annual % Change	Adjusted Income	Change	Annual % Change
1990	11,600			12,247		
		1,300	2.15%		1,372	2.15%
1995	12,900			13,619		
		1,000	1.50%		1,056	1.50%
2000	13,900			14,675		
		600	0.85%		633	0.85%
2005	14,500			15,309		
		600	0.81%		633	0.81%
2010	15,100			15,942		
					600	0.74%
2015				16,542		
					600	0.72%
2020				17,142		
Annual % Change						
1990-2010				1.33%		
1990-2020				1.13%		

Year	Adjusted 1982 Dollars	Inflation Adjustment Factor	Adjusted 1990 Dollars
1990	12,247	1.38	$16,913
1995	13,619	1.38	$18,806
2000	14,675	1.38	$20,268
2005	15,309	1.38	$21,141
2010	15,942	1.38	$22,018
2015	16,542	1.38	$22,845
2020	17,142	1.38	$23,673

Source: U.S. Census 1990, DBEDT Series M-K Projections, Table 9; Arthur Andersen RESG (including 2010 to 2020 projections)

SECTION IV: ANALYSIS OF RESIDENTIAL MARKET POTENTIALS

The following section evaluates the market potential for residential development in the Project Area. Demand is determined from a review of regional market forces on the Island of Kauai as well as local trends within the immediate Lihue area surrounding the property. Existing and future supply is evaluated through an assessment of large-scale competing residential development programs as well as the small lot filling in process occurring on small parcels in established, residential neighborhoods.

Methodology

The demand for housing at a specific location characteristically is determined by the following major factors:

1. An area's population base and rate of growth;

2. Household formation rates as a result of local population trends;

3. The socioeconomic characteristics of permanent residents;

4. The size, composition and quality of the area's existing housing stock;

5. The access and amenity attributes of the property and its immediate surroundings; and

6. The presence or absence of favorable neighborhood attributes such as schools, major employers, shopping opportunities, recreation opportunities, or other activity generators.

The analysis first examines the major components of housing demand as they have developed on the Island of Kauai generally, then reviews the Project Area and its unique potentials within both the larger regional and local market contexts.

Market Area Definitions

This section defines the regional and local markets for housing in relation to the Project Area.

Regional Market Definition

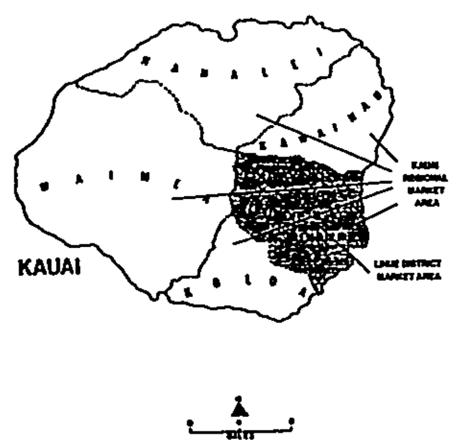
For this analysis the regional housing market area for the Project Area has been defined as encompassing the entire Island of Kauai (County of Kauai).

Lihue District Definition

The local housing market area for the Project Area encompasses a geographic locale which may be referred to as the Lihue District. Geographically and statistically the Lihue District housing market is coterminous with census tracts 404 and 405, and the Lihue judicial district. This area is illustrated in Figure IV-1.

Figure IV-1.

Project Area Regional And Local Housing Market Areas By Judicial District



Household Size

Household size is a measure of the average number of persons living in an occupied dwelling unit within a given market area. Household size, a key determinant of housing requirements for a given population, has been declining in the County of Kauai since 1980. Table IV-1 shows the trends in average household size for the period 1970 to 1990. In 1990 the ratio of population residing in households to total occupied dwelling units was 3.10 persons to one occupied housing unit, a reduction of 3.9 percent below the household size figure of 3.22 persons per occupied unit recorded in 1980, and 12.9 percent below the household size figure of 3.50 persons per occupied unit recorded in 1970. This trend is expected to continue through the 1990s and early 2000s. This anticipated decline in household size is consistent with state and national patterns, and reflects socioeconomic trends toward fewer and smaller families, an older population, fewer families as a percent of total households, and delays in family formation and childbearing.

One major result of this trend toward smaller households has been an increased demand for housing per unit of population. In effect, even if significant population growth does not occur in a housing market area, high household formation rates may result from the continuing decline in household size and generate a steady demand for new housing. As an example, in a given market with a fixed population of 1,000 persons, if the household size changes from 3.5 persons per unit to 3.0 persons per unit the effective demand for housing increases from 286 units to 333 units, an increase of 47 units, or more than 16 percent, even though total population has remained unchanged. This computation is shown below.

Housing Demand for 1,000 Residents with Household Size @ 3.5 persons per unit:	1,000 / 3.5 =	286 units
Housing Demand for 1,000 Residents with Household Size @ 3.0 persons per unit:	1,000 / 3.0 =	333 units
Net change in Housing Demand, with Constant Population of 1,000 Residents and Change in Household Size from 3.5 to 3.0 persons per unit:		47 units

Regional Housing Trends

Table IV-2 presents the change in resident dwelling unit inventory for the County of Kauai from 1970 to 1990 based on the 1970, 1980 and 1990 censuses. In 1970 the total housing unit inventory stood at 9,021 units, distributed between 8,234 single-family homes, or 91.3 percent of the inventory, and 739 multiple-family units, or 8.7 percent of the inventory. In 1990 the housing unit inventory totaled 17,613 units. Of this total, 15,092 units, or 85.7 percent, were single-family homes and 2,521, or 14.3 percent were multiple-family homes. Over the 20 year period a net increase of 8,592 units had been recorded for the market area, representing an annual net growth in housing stock of 430 units.

Housing Absorption Rates

Housing absorption rates measure the rate of change in occupied housing units per 1,000 change in resident population. Table IV-3 shows the housing absorption rate for the County of Kauai from 1970 to 1990. The total resident population residing in households increased from 29,337 persons in 1970 to 50,523 persons in 1990. During the same period the number of resident-occupied dwelling units increased from 8,282 units to 16,295 units. The comparison of these two rates of change indicate that 378 dwelling units were absorbed per each 1,000 resident population change over the last 20 years for the County of Kauai. In effect, one new dwelling unit was required for every 2.64 new full-time residents.

Based upon the 1970 to 1990 absorption rate the resident demand for new housing for the County of Kauai is projected to measure 14,716 units between the years 1995 to 2020 as shown in Table IV-4. This projection represents a net increase in demand of units over the 1990 census' resident-occupied inventory of 16,295 units. After allowance is made for (1) the replacement of obsolete units at a rate of 15 units per year and (2) a five percent vacancy rate, the new net housing requirement for the period 1995 to 2020 is projected to be a total of 15,826 units for an average of 633 units per year. Housing units destroyed by Hurricane Iniki are assumed to be replaced on a one-to-one basis.

Table IV-1.

Trends in Average Household Size
As Measured by Average Persons Per Occupied Unit
County of Kauai
1970, 1980 and 1990

Year	Number of Households	Persons per Household	Number	Annual Percent
1970	8,282	3.50		
1980	12,020	3.22	0.28	-0.83%
1990	16,295	3.10	0.12	-0.38%

Table IV-2.

Changes in Dwelling Unit Inventory
County of Kauai
1970, 1980 and 1990

		1970	1980	1990
Total Housing Units		9,021	14,828	17,613
Occupied Dwelling Units		8,282	12,020	16,295
Vacant		739	2,524	1,318
Vacancy Rate		8.19%	17.02%	7.48%
Unit Type	Single Family	8,234	10,848	15,092
	Multiple Family	739	3,980	2,521
Persons Per Occupied Dwelling Unit		3.50	3.22	3.10

Source: U.S. Census 1970, 1980 and 1990; Arthur Andersen RESG

Table IV-3.

Housing Absorption Rate
County of Kauai
1970, 1980 and 1990

	1970	1980	1990
Persons in Occupied Dwelling Units	29,337	38,607	50,523
Occupied Dwelling Units	8,262	12,020	16,295
Change in Dwelling Units Per 1,000 Population Change			
1970 - 1980			399
1980 - 1990			361
1970 - 1990			378

Source: U.S. Census 1970, 1980 and 1990; Arthur Andersen RESG

Table IV-4.

Demand for Resident Housing
County of Kauai
1990 to 2020

Year		1990	1995	2000	2005	2010	2015	2020
Total Population		51,177	56,177	62,177	69,477	78,577	87,077	95,577
% In Households		98.72%	98.75%	98.75%	98.75%	98.75%	98.75%	98.75%
Total Household Pop.		50,523	55,475	61,400	68,609	77,595	85,989	94,382
Potential Occupied Dwelling Units		16,295	18,168	20,409	23,135	26,534	29,709	32,884
			1990-1995	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020
Incremental Demand for New Housing (1)			1,873	2,241	2,727	3,399	3,175	3,175
Add: Vacancy Allowance @	5%		94	112	136	170	159	159
Add: Replacement of Obsolete Units Per Year @ (2)	15		75	75	75	75	75	75
Total Increase in Resident-Oriented Housing Per Period			2,042	2,428	2,938	3,644	3,408	3,408
Per Year			408	486	588	729	682	682
Cumulative Increase			2,042	4,470	7,407	11,051	14,460	17,868

(1) -- Based upon 1970 - 1990 absorption rate
(2) -- 1980 - 1990 average annual non-hurricane demolition of 17 units

Source: U.S. Census 1990; DBEDT, Data Book 1988 Table 618, 1992 Table 604; Arthur Andersen RESG

Lihue District Socioeconomic Trends

This section describes the basic socioeconomic trends for the Lihue District which comprise the primary housing market area for the Project Area. This includes brief summaries of the general characteristics of the district, and an analysis of major economic sectors.

General Characteristics

Sugar has long been the dominant land use and economic activity in the Lihue District, and the towns of Lihue, Hanamaulu and Puhi were established to support sugar operations. The location of sugar operations, together with the designation of Lihue as the seat of county government, the growth of Nawiliwili as the island's main harbor, and the development of the Lihue Airport, have contributed to the establishment of Lihue as the island's primary place for government, commercial and professional activity. Moreover, in recent years the construction of the Kauai Lagoons/Kauai Marriott (previously Westin), the Kauai Resort, the Outrigger Kauai Beach and Aston Kauai Villas have added a significant visitor destination element to this area.

Economic Sector Analysis

Visitor Industry

Visitor industry activities in the Lihue District are centered around the transportation functions related to the recently-expanded Lihue Airport and to the Kauai Lagoons resort. Although the golf courses and clubhouse at Kauai Lagoons reopened shortly after Hurricane Iniki, a combination of hurricane damage and debt-related problems has left the 850-room Marriott (previously Westin) Kauai hotel closed for over a year and is not expected to reopen until 1995.

The other major visitor accommodation facilities in the Lihue District are the Outrigger Kauai Beach hotel, the Aston Kauai Beach villas, and the Kauai Resort hotel located north of Hanamaulu and south of the Wailua River.

Sugar

For many years Grove Farm and the Lihue Plantation conducted the sugar cultivation in the Lihue District. Lihue Plantation also had its mill in Lihue. In the 1970s Grove Farm withdrew from sugar cultivation, and has leased portions of its Lihue District sugar lands south and west of the town of Lihue

to Lihue Plantation. Other Grove Farm lands are currently being leased to McBryde Sugar.

Lihue Plantation, like many other plantations in the State of Hawaii has had economic difficulties, but is working to remain profitable and has recently announced a decision to cultivate 500 additional acres in the Kawaihau district for seed cane.

Shipping

Nawiliwili Harbor is the main harbor for Kauai, and is the center of container, break bulk and passenger ship operations for the island. The State Department of Transportation is currently expanding the pier area of the harbor and building a new warehouse at Pier 3.

Government/Civic Center

The town of Lihue serves as the seat of county government and is also the site of Kauai district offices for state and federal agencies. Puhi is the site of the Kauai Community College, the island's only post-secondary educational facility.

Lihue District Population Growth Projections

Between 1980 and 1990 the Lihue District's population grew from 8,590 persons to 10,663 persons. This growth represented an annual increase of 2.19 percent or 207 persons.

Table IV-5 presents comparative population growth data for all five of the County's districts for the 1900 to 1990 period. The Lihue District has had a moderate rate of growth of over 2 percent for both the 1970 to 1980 and 1980 to 1990 periods.

Given the central location of the Lihue District, its continued role as Kauai's civic and commercial center, and the ready access to other employment areas, the Lihue District's share of the County's overall population should increase in the future. Reflecting this likelihood, the Office of State Planning's (OSP) 1992 State Land Use District Boundary Review for Kauai has projected population changes for each of Kauai's five districts for the 1988 to 2010 period. Table IV-6 presents the data from the OSP report, Table IV-7 adjusts that data to reflect actual 1990 census figures and the projected impacts on population growth related to Hurricane Iniki. Table IV-7 also provides population projections for the 2010 to 2020 period under these assumptions.

The district's share of Kauai's overall population is projected to increase from 21.5 percent in 1990 to 25.2 percent in 2000, and 28.8 percent in 2010. In the adjusted projections the Lihue District's population is expected to rise as follows:

Year	Projected Population	Annual Average Increase
1990	11,020	
1995	13,120	420
2000	15,685	513
2005	18,759	615
2010	22,648	778
2015	25,098	490
2020	27,548	490

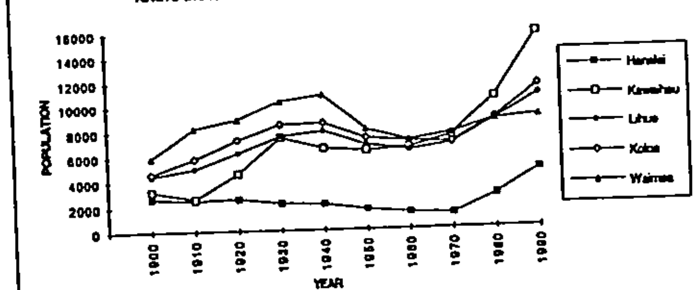
Table IV-5.

Historic Population Change
County of Kauai and Districts
1900 to 1990

Year	County	Hanalei	Kawaihau	Lihue	Koloa	Waimea
1900	20,734	2,630	3,220	4,434	4,564	5,886
1910	23,952	2,457	2,580	4,951	5,769	8,195
1920	29,438	2,549	4,533	6,223	7,270	8,863
1930	35,942	2,186	7,441	7,515	8,452	10,348
1940	35,818	2,065	6,512	7,898	8,493	10,852
1950	29,905	1,619	6,291	6,760	7,286	7,949
1960	28,176	1,312	6,498	6,297	7,012	7,057
1970	29,761	1,182	7,393	6,766	6,851	7,569
1980	39,082	2,668	10,497	8,590	8,734	8,593
1990	51,177	4,631	15,627	10,663	11,368	8,888

Annual % Change	County	Hanalei	Kawaihau	Lihue	Koloa	Waimea
1900-1990	1.01%	0.63%	1.77%	0.98%	1.02%	0.46%
1960-1990	2.01%	4.29%	2.97%	1.77%	1.62%	0.77%
1970-1990	2.75%	7.07%	3.81%	2.30%	2.56%	0.81%
1980-1990	2.73%	5.67%	4.06%	2.19%	2.67%	0.34%

KAUAI DISTRICT POPULATION CHANGE 1900 TO 1990



Source: Schmitt, Robert C., Historical Statistics of Hawaii; DBEDT Data Book, 1992

Table IV-6.

Population Projections - 5 Year Boundary Review
County of Kauai and Kauai Districts
1990 to 2010

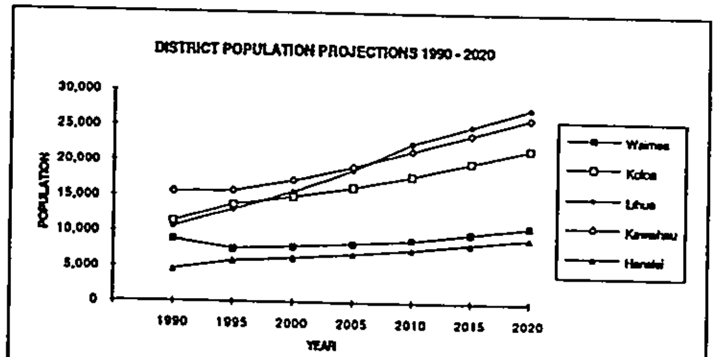
Year	1990	1995	2000	2005	2010
Total Population	54,100	61,100	68,200	75,500	84,600
Waimea	7,720	8,265	8,719	9,092	9,559
% of Total	14.27%	13.53%	12.78%	12.04%	11.30%
Annual % Change		1.37%	1.08%	0.84%	1.01%
Koloa	13,690	15,081	16,409	17,695	19,300
% of Total	25.30%	24.68%	24.06%	23.44%	22.81%
Annual % Change		1.95%	1.70%	1.52%	1.75%
Lihue	11,649	14,270	17,171	20,385	24,384
% of Total	21.53%	23.36%	25.18%	27.00%	28.82%
Annual % Change		4.14%	3.77%	3.49%	3.65%
Kawaihau	15,253	17,109	18,965	20,848	23,198
% of Total	28.19%	28.00%	27.81%	27.61%	27.42%
Annual % Change		2.32%	2.08%	1.91%	2.18%
Hanalei	5,787	6,375	6,936	7,480	8,158
% of Total	10.70%	10.43%	10.17%	9.91%	9.64%
Annual % Change		1.95%	1.70%	1.52%	1.75%

Source: State Land Use District Boundary Review - Kauai, Table 1-A
Arthur Andersen RESG

Table IV-7.

Adjusted Population Projections
County of Kauai and Kauai Districts
1990 to 2010

Year	1990	1995	2000	2005	2010	2015	2020
Total Population	51,177	56,177	62,177	69,477	78,577	87,077	95,577
Waimea	8,888	7,599	7,949	8,367	8,878	9,839	10,799
% of Total	17.37%	13.53%	12.78%	12.04%	11.30%	11.30%	11.30%
Annual % Change		-3.08%	0.90%	1.03%	1.19%	2.08%	1.88%
Koloa	11,368	13,866	14,960	16,283	17,926	19,865	21,804
% of Total	22.21%	24.68%	24.06%	23.44%	22.81%	22.81%	22.81%
Annual % Change		4.05%	1.53%	1.71%	1.94%	2.08%	1.88%
Lihue	10,663	13,120	15,655	18,759	22,648	25,098	27,548
% of Total	20.84%	23.36%	25.18%	27.00%	28.82%	28.82%	28.82%
Annual % Change		4.23%	3.60%	3.68%	3.84%	2.08%	1.88%
Kawaihau	15,627	15,730	17,290	19,185	21,548	23,877	26,208
% of Total	30.54%	28.00%	27.81%	27.61%	27.42%	27.42%	27.42%
Annual % Change		0.13%	1.91%	2.10%	2.35%	2.08%	1.88%
Hanalei	4,631	5,861	6,323	6,883	7,577	8,397	9,217
% of Total	9.05%	10.43%	10.17%	9.91%	9.64%	9.64%	9.64%
Annual % Change		4.82%	1.53%	1.71%	1.94%	2.08%	1.88%

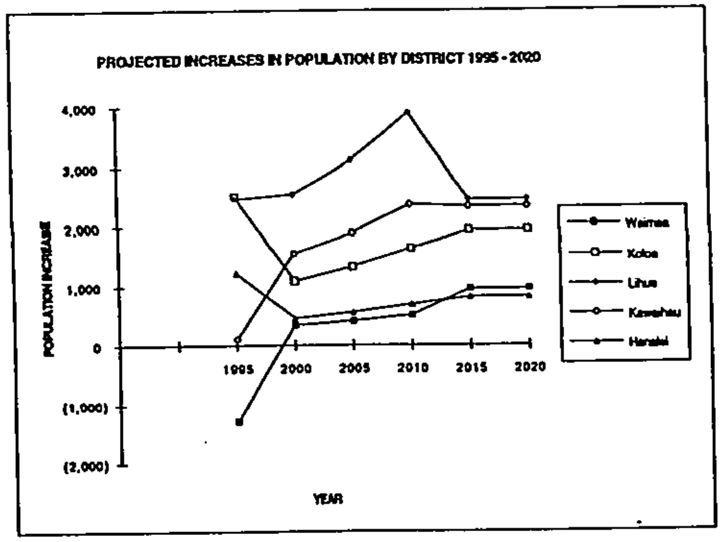


Note: Adjustments based on 1990 census and district % of County total in OSP report. 2015 and 2020 use % from 2010.
Source: U.S. Census 1990; Arthur Andersen RESG

Table IV-8.

Projected District Population Increases By Period
Demand For Permanent Resident Housing
1990 to 2020

Year	1990-1995	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020
Total Population	5,000	6,000	7,300	9,100	8,500	8,500
Waimea	(1,289)	350	418	512	960	960
Koloa	2,498	1,094	1,324	1,643	1,939	1,939
Lihue	2,457	2,534	3,104	3,889	2,450	2,450
Kawaihau	103	1,560	1,895	2,362	2,331	2,331
Hanalei	1,230	462	560	694	820	820



Source: Arthur Andersen RESG

Housing Market Trends - Lihue District

There is limited information currently available regarding the existing housing stock in the Lihue District market area which is occupied by the resident market population. Given this lack of information it is necessary to portray the current market from inferences derived from 1980 and 1990 census data and building permit data derived from the entire County of Kauai housing market area.

Between 1980 and 1990 the Lihue District's dwelling unit inventory increased from a total of 2,902 units to 3,526 units for an average annual rate of growth of 1.97 percent or a net addition of 60 units on an annual basis. As of 1990 the Lihue District contained 20.8 percent of the County of Kauai's total population and 20.0 percent of its total housing inventory.

County of Kauai building permit data for the 1980 to 1992 period as presented in Table IV-9 indicates that on average about three-quarters of the housing units built during that period were single-family units, with the remaining one-quarter being multi-family units. This trend was also reflected in the census data for the Lihue District which indicated that housing unit composition changed from a two-thirds/one-third split between single-family and multi-family unit types in 1980 to a three-quarters/one-quarter split in 1990.

Demand For Permanent Resident Housing - Lihue District

The number of new resident-oriented dwelling units required to support the anticipated population growth in the Lihue District market area between 1995 and 2020 is projected to be 5,733 units reflecting a need for an average of 229 units per year. This requirement is based upon the adjusted OSP population forecasts for the Lihue District and application of the 1970 to 1990 unit absorption rate in the local area, with allowance for: 1) replacement of obsolete structures at a rate of 3 units per year; and (2) a five percent vacancy rate in new units. The replacement of obsolete structures is based on a one-fifth share of the County average for the 1980 to 1990 period. Table IV-10 presents these projections. The results are summarized below.

Year	Single Family Units	Multiple Family Units	Total Units	Annual Average Increase
1990	2,621	905	3,526	
1995	3,250	1,062	4,312	
2000	4,057	1,264	5,321	201
2005	5,043	1,510	6,553	246
2010	6,275	1,818	8,093	308
2015	7,056	2,013	9,069	195
2020	7,837	2,208	10,045	195

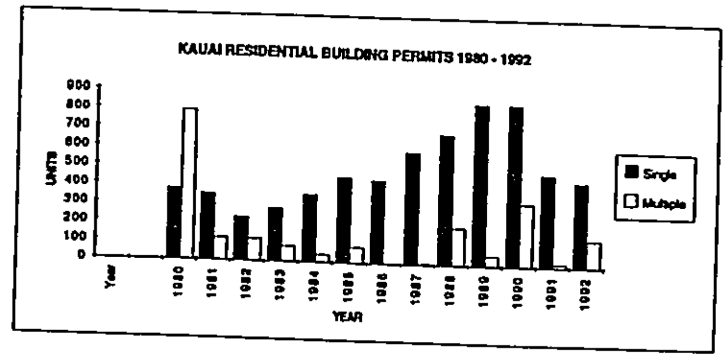
Table IV-8.

Analysis of County of Kauai
Building Permit Data
1980 to 1992

Year	Total Authorized	Single Family	Multiple Family	SF as % of Total	MF as % of Total
1980	1,170	377	793	32.22%	67.78%
1981	473	353	120	74.63%	25.37%
1982	348	230	118	66.09%	33.91%
1983	361	282	79	78.12%	21.88%
1984	396	357	39	90.15%	9.85%
1985	534	453	81	84.83%	15.17%
1986	442	440	2	99.55%	0.45%
1987	599	594	5	99.17%	0.83%
1988	890	692	198	77.75%	22.25%
1989	911	857	54	94.07%	5.93%
1990	1,190	858	332	72.10%	27.90%
1991	509	491	18	96.46%	3.54%
1992	598	453	145	75.75%	24.25%
Total	8,421	6,437	1,984	76.44%	23.56%

Lihue District - Unit Types

	Total Units	Single Family	Multiple Family	SF as % of Total	MF as % of Total
1980	2,902	1,998	904	68.85%	31.15%
1990	3,526	2,621	905	74.33%	25.67%



Source: Bank of Hawaii, Construction in Hawaii, 1993

Table IV-10.

Demand for Resident Housing
Lihue District
1990 to 2020

Year		1990	1995	2000	2005	2010	2015	2020
Total Population		10,663	13,120	15,655	18,759	22,648	25,098	27,548
% In Households		98.72%	98.75%	98.75%	98.75%	98.75%	98.75%	98.75%
Total Household Pop.		10,527	12,958	15,459	18,524	22,365	24,784	27,204
Cumulative Increase In Occupied Dwelling Units (1)			919	1,866	3,025	4,478	5,393	6,308
				1995-2000	2000-2005	2005-2010	2010-2015	2015-2020
Incremental Demand for New Housing (1)				947	1,159	1,453	915	915
Add: Vacancy Allowance @	5%			47	58	73	46	46
Add: Replacement of Obsolete Units Per Year @ (2)	3			15	15	15	15	15
Total Increase In Resident-Oriented Housing								
Per Period				1,009	1,232	1,540	976	976
Per Year				202	246	308	195	195
Cumulative Demand				1,009	2,241	3,781	4,757	5,733
Avg Res/Household				2.48	2.49	2.49	2.48	2.48
Demand By Unit Type								
Per Period								
Resident SF	80%			807	986	1,232	781	781
Resident MF	20%			202	246	308	195	195
Per Year								
Resident SF	80%			161	197	246	156	156
Resident MF	20%			40	49	62	39	39
Cumulative Demand								
Resident SF				807	1,793	3,025	3,806	4,586
Resident MF				202	448	756	951	1,147

Note: (1) Based upon 1970 - 1990 absorption rate of 378 housing units/1,000 increase in population
(2) One-fifth of projected average annual demolition of 15 units

Source: U.S. Census 1990; DBEDT, Data Book 1988 Table 618, 1992 Table 604; Arthur Andersen RESG

Planned Competitive Development

The number of planned competitive residential developments for the County of Kauai is somewhat limited due to the market uncertainty created by Hurricane Iniki and its after effects. A total of five major planned development programs are expected to compete with the Project Area program. Princeville is continuing with its implementation of the Princeville master plan. Grove Farm is in the process of selling its affordable housing and is beginning to develop an increment of market-priced housing and golf course-related housing. A&B Hawaii is completing its most recent phase of housing in the Eleele area, and is evaluating directions for the development of its lands in the Kukuiula area of Poipu. A&B Hawaii anticipates that a substantial portion of its housing units will be sold to non-Kauai residents. The Department of Hawaiian Home Lands is planning to develop several medium-sized subdivisions in Anahola, and has conceptual plans for a larger project in the indefinite future.

Federal and other funds may also become available for rental and low-cost housing at sites as yet unspecified.

Table IV-11 shows that the total number of units included in these programs is 838 single family units and 780 multi-family units in the Lihue District, and 2,531 single family units and 1,127 multiple-family units for all other areas of Kauai.

Potential Capture Of Residential Demand - Project Area

As previously discussed there is a potential demand in the Lihue District of 162 to 308 housing units annually for the 1995 to 2020 period. Of the major planned developments, three are located in the Lihue District – the Grove Farm project, the Okada Molokoa project, and zoned but undeveloped residential areas in Hanamaulu. The Project Area will be the primary alternative to housing products offered by these projects.

In terms of the attributes of the Project Area, the property has good access to existing shopping facilities, employment centers, existing schools, recreational facilities. In addition the property is located near existing residential and commercial areas, and has excellent access to other parts of the island via Ahukini Road, Kapule Highway, and Kuhio Highway.

Given these limitations on the development of housing units by other parties due to control of large portions of the Lihue District by Amfac and Grove Farm , and the attractive qualities of the Project Area, the property should have the potential to capture a significant portion of the demand for residential units in the Lihue District.

Table IV-12 presents a projection of the potential capture of Lihue District housing by the Project Area from 1997 to 2016, for both single-family and multi-family units under lower and higher assumptions regarding the average portion of the market capture.

Of the Lihue District's total projected demand for housing units, the Project Area should be able to achieve a 30 to 40 percent capture rate for resident-oriented single-family units. This capture rate assumes that for roughly every three units constructed in the Lihue District, the Project Area should be able to capture one unit. This assumption is based on the limited number of major landowners in the Lihue District, the presence of the single-family unit program by Grove Farm, the relatively small size of the Okada project, the possibility of small lot developments in the Lihue and Nawiliwili areas, and the attractiveness of the Project Area in terms of close proximity to schools, employment centers and the amenities of the Lihue town area.

Of the Lihue District's total projected demand for multi-family housing units, the Project Area should be able to achieve a 35 to 45 percent capture rate for resident-oriented multi-family units. This capture rate assumes that for every two to three units constructed in the Lihue District, the Project Area should be able to construct one unit.

Given the Project Area's location and amenities discussed above, and taking into consideration the growth in population projected for the Lihue District, these capture rates appear to be reasonable, particularly if projects in the Amfac Project property area are competitive in price and value.

Table IV-11.

Planned Residential Developments
County of Kauai

Development/Developer	Total	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020
LIHUE DISTRICT						
Puhi						
Grove Farm						
Single Family	528	528				
Multi-Family	780	130	260	390		
Molokoa						
Okada						
Single Family	130	100	30			
Hanamaulu Urban Zoned Area						
Single Family	180	90	30			
Kalepa Village	0	180				
Subtotal - Lihue District						
Single Family	838	718	60	0	0	0
Multi-Family	780	310	260	390	0	0
OTHER KAUAI						
Kukuiula, Poipu						
A & B - Hawaii						
Single Family	2,031	450	530	550	501	0
Multi-Family	1,047	132	245	275	277	118
Anahola						
DHHL						
Single Family	348	348				
Poipulani (status unknown)						
Knudsen Trust						
Single Family	54	54				
Port Allen (status unknown)						
A & B - Hawaii						
Single Family	100	100				
Multi-Family	80	80				
Princeville						
Single Family	land development planned but counts not disclosed					
Multi-Family	land development planned but counts not disclosed					
Subtotal - Other Kauai						
Single Family	2,531	950	530	550	501	0
Multi-Family	1,127	212	245	275	277	118
Total:	3,658	1,162	775	825	778	118

Notes: Kukuiula, Poipulani and Princeville units are intended to be marketed to both residents and visitors
Source: Interviews with brokers, developers, and DHHL

Table IV-12.

Projected Capture of Lihue District Housing Demand
By Project Area
1995 - 2020

Year		1997-2000	2000-2005	2005-2010	2010-2015	2015-2017
LOWER CAPTURE RATES						
Single Family						
Units Per Period ⊙	30% Capture	145	296	370	234	94
Units Per Year ⊙		29	59	74	47	19
Cumulative ⊙		145	441	811	1,045	1,139
Multi-Family						
Units Per Period ⊙	35% Capture	42	86	108	68	27
Units Per Year ⊙		8	17	22	14	5
Cumulative ⊙		42	129	236	305	332
HIGHER CAPTURE RATES						
Single Family						
Units Per Period ⊙	40% Capture	194	394	493	312	125
Units Per Year ⊙		39	79	99	62	25
Cumulative ⊙		39	433	926	1,238	1,363
Multi-Family						
Units Per Period ⊙	45% Capture	54	111	139	88	35
Units Per Year		11	22	28	18	7
Units Cumulative		11	122	260	348	383

Source: Arthur Andersen RESG

SECTION V: ANALYSIS OF RETAIL MARKET POTENTIALS

The following section examines the potential for development of commercial retail and services land uses in the Project Area. Commercial retail land uses examined include:

1. Community-oriented convenience and shopper goods retail uses; and
2. Tourist-oriented specialty retail uses.

Methodology

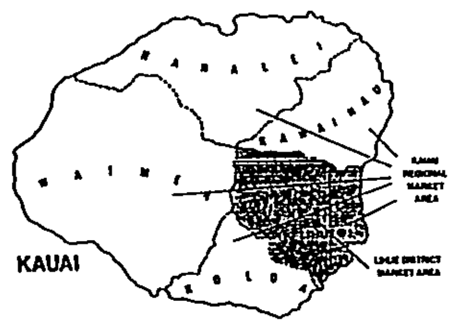
A variety of research techniques and data sources were utilized in the formulation of the body of information in this section. These included field surveys of existing and potential retail sites which would potentially be competitive with retail uses developed in the Project Area; and a review of published information concerning the socioeconomic base in the Lihue District market area which supports existing retail activities.

In order to understand the Lihue District's present and future retail requirements, a computer-based projection model was developed which can forecast retail demand within the market area. A comparison of the forecasted retail sales requirements with estimated average retail sales performances for existing establishments reveals supportable retail space which can then be translated into commercial land use requirements for the Amfac properties.

Market Area Or Trade Area

The market area or trade area is defined as the geographic area which contains people who are likely to purchase a given class of goods or services from a particular firm or group of firms such as a collection of stores within a shopping center. Two distinct market areas have been delineated for the purposes of this analysis. The market areas are defined below and depicted in Figure V-1.

Figure V-1.
Primary and Secondary Market Areas
By Census Tract[2]



Primary Market Area (PMA)

The PMA has been defined as being contiguous with the boundaries of the Lihue judicial district. This area consists of census tracts 404 and 405. The major population centers in the PMA are Lihue, Puhi, and Hanamaulu. This definition of the PMA is based on the relatively close proximity of the population centers in the district to the Project Area, convenient highway access and traditional patterns of shopping for convenience goods such as groceries and household products, and for shopper goods such as apparel and appliances. Given the presence of adequate neighborhood and regional shopping facilities, it is believed that residents of this area will likely purchase the majority of their required goods and services within this district and that sales leakage to other areas will be minimal. The major population centers in the PMA are:

[2]Note: Census tract 410 includes the islands of Niihau, Lehua and Kaula

- Lihue
- Hanamaulu
- Puhi

Secondary Market Area (SMA)

The SMA has been defined as being contiguous with the boundaries of the judicial districts of Hanalei, Kawaihau, Koloa, and Waimea. This market area consists of census tracts 401, 402.01, 402.02, 403, 406, 407, 408 and 409. The SMA contributes to the sales of the PMA because of the presence in the PMA of the island's only regional shopping center, its role as a center for the sale hard goods, and its role as a major employment center with workers from all areas of the island. The major population centers in the SMA are:

- Hanalei
- Kilauea
- Anahola
- Kapaa
- Wailua
- Koloa
- Kalaheo
- Eleele
- Hanapepe
- Waimea
- Kekaha

Retail Demand

The market potential for retail goods and supportable retail space is primarily a function of market area population, personal income, and that proportion of income which is spent for various categories of retail goods. For the purposes of this analysis primary focus is placed upon the projected number of residents expected to reside within the Primary and Secondary Market areas between 1995 and 2020. Notwithstanding, consideration was also given to demand generated by tourists for certain types of convenience and shopper goods which would commonly be found in local market oriented shopping facilities.

Demand Sectors

The following paragraphs examine the demand generated by residents and visitors. Each sector is examined with respect to population projections, income characteristics, and retail expenditure potentials. Capture potentials for the Project Area are evaluated to determine the size and type of center(s) which can logically be developed on the site.

Resident Population

Resident population projections for the market areas are, along with per capita income projections, the primary determinants of resident retail expenditure potentials. The Lihue District has shown steady growth which is projected to continue. Table V-1 presents a summary of the resident population projections for the primary and secondary market areas.

<u>Primary Market Area (PMA)</u>

The PMA's 1990 population was 10,663 persons, accounting for 20.8 percent of the County of Kauai's population. It is projected that the PMA's population will increase to 18,759 persons by 2005 and to 27,548 persons by 2020. By 2020 the PMA will account for 28.8 percent of Kauai's total population. The 2020 figure represents an increase of 16,885 persons over the 1990 count, an annual growth rate of 3.2 percent.

<u>Secondary Market Area (SMA)</u>

The SMA's 1990 population was 40,157 persons, or 78.5 percent of the County of Kauai's population. It is projected that by 2005 the population will increase to 50,718 persons; and to 68,028 persons by 2020. The 2020 figure represents an increase of 27,871 persons over the 1990 count for an annual growth rate of 1.7 percent. The SMA's share of the County of Kauai's population will fall to 71.2 percent.

Visitor Population

Visitor days projections are, along with average daily visitor expenditures on retail goods and services, the primary determinants of visitor retail expenditure projections. Total visitor days for the County of Kauai peaked in 1989 at 6,986,100 visitor days, fell in 1990 to 6,643,000 visitor days in 1990, recovered to 6,942,300 visitor days in 1991, and then dropped in 1992 to

4,912,900 visitor days in 1992 due to Hurricane Iniki. Annual visitor day levels are projected to increase from the 1992 level and return to close to the 1991 level in 2000.

Annual visitor days for the County of Kauai are projected to increase to 7,751,986 visitor days by 2005 and to 11,995,537 visitor days by 2020. Table V-1 presents a summary of visitor day projections. The projections include a disaggregation of visitor days by country of origin. U.S. visitors, which accounted for 77.6 percent of the County of Kauai's visitor days in 1992 are projected to decline slightly over time as a percentage of total visitor days, with Japanese and visitors from other foreign countries increasing over time as a percentage of total visitor days.

Table V-1.

Resident and Visitor Population Projections
County of Kauai
1995 - 2020

	1990	1995	2000	2005	2010	2015	2020
Residents							
Primary Market Area							
Lihue	10,663	13,120	15,655	18,750	22,848	25,098	27,548
Secondary Market Area							
Waimea	8,688	7,599	7,949	8,367	8,878	9,839	10,799
Koloa	11,368	13,866	14,960	16,283	17,926	19,865	21,804
Kawaihau	15,627	15,730	17,290	19,185	21,548	23,877	26,208
Hanalei	4,631	5,861	6,323	6,883	7,577	8,397	9,217
Subtotal:	40,514	43,057	46,522	50,718	55,928	61,978	68,028
Visitors							
Avg. Daily Vis. Census	18,200	15,000	18,785	21,238	25,864	29,364	32,864
Annual Visitor Days	6,643,000	5,475,000	6,856,542	7,751,986	9,440,537	10,718,037	11,995,537
U.S. Visitors %	N/A	78%	77%	76%	75%	74%	74%
Japan Visitors %	N/A	4%	5%	6%	7%	8%	8%
Other Foreign %	N/A	18%	18%	18%	18%	18%	18%
U.S. Visitors Days	N/A	4,249,834	5,280,772	5,892,905	7,082,103	7,933,277	8,878,857
Japan Visitors Days	N/A	240,651	342,827	465,119	660,838	857,443	959,643
Other Foreign Days	N/A	984,514	1,232,943	1,393,962	1,697,597	1,927,317	2,157,037

Source: DBEDT Series M-K, Table 7; Hawaii Visitors Bureau 1992; Arthur Andersen RESG

Personal Income

The other primary determinant of resident retail expenditure potential is personal income. Table V-2 presents a summary of the County of Kauai's per capita income projections, total market area income projections, and resident retail expenditure potentials for both the Primary Market and Secondary Market Areas for the period 1995 to 2020.

As previously discussed the per capita income for the County of Kauai in 1990 was $16,913. The per capita income figure is projected to increase to $23,673 by 2020 expressed in 1990 dollars.

Retail Expenditure Potentials

The potential buying power, or capacity to purchase retail goods and services, represented by County of Kauai residents is a function of total population, their level of income, and their relative propensities to spend income for various retail goods and services. Comparison of actual retail sales with total personal income for the State's population indicates that retail purchases by local resident households represent roughly 36 percent of total resident personal income after allowance for purchases made by tourists, local businesses, government, and other institutions.

The potential buying power in the County of Kauai in 1995 for residents is projected to total $380.4 million. This figure is projected to increase to $528.8 million by 2005 and $814.5 million by 2020. These figures are expressed in constant 1990 dollars. The 2020 figure represents an increase of 114.1 percent over the 1995 figure, or an annual growth rate of 3.1 percent.

Primary Market Area (PMA)

Based on calculations of projected resident population multiplied by projected per capita income, the product of which is multiplied by the estimated propensity to spend 36 percent of income for various retail goods and services, PMA residents are projected to total $88.8 million in 1995, and to increase to $234.8 million in 2020, reflecting an annual growth rate of 4.0 percent.

Secondary Market Area (SMA)

Based on calculations of projected resident population multiplied by projected per capita income, the product of which is multiplied by the estimated propensity to spend 36 percent of income for various retail goods and services, SMA residents are projected to total $291.5 million in 1995, and to increase to $579.8 million in 2020, reflecting an annual growth rate of 2.8 percent.

Table V-2.

Resident and Visitor Potential Retail Demand Projections
County of Kauai
1995 - 2020

	1995	2000	2005	2010	2015	2020
Residents						
Primary Market Area						
Population	13,120	15,655	18,759	22,648	25,098	27,548
Per Capita Income	$18,808	$20,266	$21,141	$22,016	$22,845	$23,673
Total Personal Income ($000s)	$246,771	$317,262	$396,584	$498,620	$573,354	$652,148
Total Retail Sales ($000s)	$88,837	$114,214	$142,770	$179,503	$206,407	$234,773
Secondary Market Area						
Population	43,057	46,522	50,718	55,926	61,978	68,026
Per Capita Income	$18,808	$20,266	$21,141	$22,016	$22,845	$23,673
Total Personal Income ($000s)	$809,830	$942,844	$1,072,246	$1,231,316	$1,415,867	$1,610,445
Total Retail Sales ($000s)	$291,539	$339,424	$386,009	$443,274	$509,712	$579,760
Combined PMA and SMA						
Total Personal Income ($000s)	$1,056,601	$1,260,106	$1,468,831	$1,729,936	$1,989,221	$2,262,592
Total Retail Sales ($000s)	$380,376	$453,638	$528,779	$622,777	$716,120	$814,533

Source: Arthur Andersen RESG

Distribution of Resident Retail Demand By Retail Category

Projected retail demand can be disaggregated into various retail categories based upon historic retail expenditure patterns. After removal of tourist expenditures, historic patterns suggest the distribution of sales to residents by retail category as noted in Table V-3. As delineated in the table, an estimated 25 percent of retail demand is allocable for shopper goods purchases which include the retail categories of apparel, general merchandise, specialty and furniture/appliances. In comparison, the demand for convenience goods, including food and drug/proprietary stores, is estimated at 38 percent of total resident retail demand; demand for eating and drinking facilities, 12 percent of resident retail demand; and the balance of automotive and "heavy commercial" retail activities represents 25 percent of resident retail demand.

Projected Demand For Retail Goods

Given the anticipated population growth, real income growth, and distribution of retail sales by major retail category, existing and projected demand for retail goods generated by residents is portrayed in Table V-4. The projected increases in resident demand for retail goods and services by category is projected to follow the overall pattern of projected increases in per capita income and population.

Retail Demand Generated By Visitors

A second major demand source for retail goods in the County of Kauai market area is the visitor population, which includes day visitors and overnight visitors who spend their vacation in resort areas in the Lihue, Hanalei, Wailua-Waipouli, and Poipu areas. Demand is calculated by multiplying visitor days by average daily expenditures. Because there are different patterns of average daily expenditures for different nationalities of visitors, visitors are grouped into three groups: U.S. visitors, Japanese visitors, and visitors from other foreign countries (Other Foreign).

Table V-5 presents data on Kauai visitor days by country of origin for 1992. Visitors from the U.S. constituted the largest group of visitors in 1992 with 77.2 percent of the total. Visitors from Canada made up 4.8 percent, and Japan 4.4 percent. Other Foreign visitors made up the remaining 13.1 percent.

Tables V-6 to V-8 presents data on U.S., Japanese and Other Foreign visitor expenditure patterns for retail categories in 1992. While U.S. and Other Foreign visitor expenditure patterns are similar in total amount and distribution by retail category, with average expenditures of $44.36 and $56.86

per day respectively, Japanese visitor expenditures are significantly higher in total magnitude at $102.61 per day, and are proportionately higher in terms of expenditures on apparel/fashion and miscellaneous retail.

Tables V-9 to V-11 present projections of visitor retail expenditures by category, derived from projected visitor day counts presented in Table III-5 and 1992 average daily visitor expenditures by category adjusted to 1990 dollar levels. Potential U.S. visitor retail expenditures are projected to increase from $188.5 million in 1995 to $393.9 million in 2020. Potential Japanese visitor expenditures are projected to increase from $24.7 million in 1995 to $98.5 million in 2020. Potential Other Foreign visitor expenditures are projected to increase from $56.0 million in 1995 to $122.6 million in 2020. In the aggregate all visitor retail expenditures should approach $269.2 million in 1995; and are projected to increase to $615.0 million in 2020.

Table V-3.

Projected Distribution of Resident Retail Demand
By Major Category

Retail Category	Percent of Retail Demand		Percent of Total Income
Shopper Goods		25.00%	
Apparel	4.00%		1.44%
General Merchandise	10.00%		3.60%
Specialty (1)	8.00%		2.88%
Furniture/Appliances	3.00%		1.08%
Convenience Goods		38.00%	
Food/Liquor	31.00%		11.16%
Drug/Proprietary	7.00%		2.52%
Eating and Drinking		12.00%	4.32%
Heavy Commercial (2)		25.00%	9.00%
Total:		100.00%	
Total as Percentage of Total Income			36.00%

Note (1) Includes gifts, jewelry, sporting goods, books, florists, and other shopping goods stores.

Note (2) Includes automotive dealers and supplies, service stations, and building materials and hardware stores.

Source: U.S. Census of Retail Expenditures, 1987; Arthur Andersen RESG

Table V-4.

Projected Resident Demand for Retail Goods
1995 - 2020
(In $000s of 1990 Constant Dollars)

	1995	2000	2005	2010	2015	2020
Primary Market Area						
Shopper Goods						
Apparel	$3,553	$4,569	$5,711	$7,180	$8,256	$9,391
General Merchandise	$8,884	$11,421	$14,277	$17,950	$20,641	$23,477
Specialty	$7,107	$9,137	$11,422	$14,360	$16,513	$18,782
Furniture/Appliances	$2,665	$3,426	$4,283	$5,385	$6,192	$7,043
Convenience Goods						
Food/Liquor	$27,540	$35,406	$44,259	$55,646	$63,986	$72,780
Drug/Proprietary	$6,219	$7,995	$9,994	$12,565	$14,449	$16,434
Eating and Drinking	$10,660	$13,706	$17,132	$21,540	$24,769	$28,173
Heavy Commercial	$22,209	$28,554	$35,693	$44,878	$51,602	$58,693
Total:	$88,837	$114,214	$142,770	$179,503	$206,407	$234,773
Secondary Market Area						
Shopper Goods						
Apparel	$11,662	$13,577	$15,440	$17,731	$20,308	$23,190
General Merchandise	$29,154	$33,942	$38,601	$44,327	$50,971	$57,976
Specialty	$23,323	$27,154	$30,881	$35,462	$40,777	$46,381
Furniture/Appliances	$8,746	$10,183	$11,580	$13,298	$15,291	$17,393
Convenience Goods						
Food/Liquor	$90,377	$105,221	$119,663	$137,415	$158,011	$179,726
Drug/Proprietary	$20,406	$23,760	$27,021	$31,029	$35,680	$40,583
Eating and Drinking	$34,985	$40,731	$46,321	$53,193	$61,165	$69,571
Heavy Commercial	$72,865	$84,856	$96,502	$110,818	$127,428	$144,940
Total:	$291,539	$339,424	$386,009	$443,274	$509,712	$579,760
Grand Total:	$380,378	$453,638	$528,779	$622,777	$716,120	$814,533

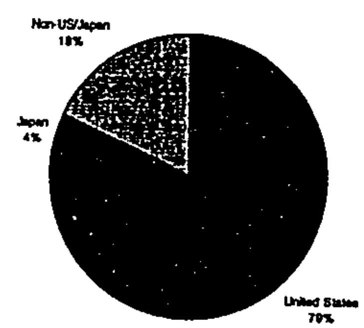
Source: Arthur Andersen RESG

Table V-5.

Kauai Visitor Days By Country of Origin
1992

Country	1992 WB Visitor Days	1992 EB Visitor Days	1992 Total Visitor Days	Percent of Total
United States	3,865,560	134,190	3,999,750	77.62%
Japan	26,630	199,860	226,490	4.40%
Non-US/Japan	624,380	302,200	926,580	17.98%
Canada	237,390	10,270	247,660	4.81%
Australia	27,820	30,610	58,430	1.13%
New Zealand	26,830	7,200	34,030	0.66%
United Kingdom	68,340	5,370	73,710	1.43%
Germany	94,120	13,800	107,920	2.09%
Other Europe	93,280	4,350	97,630	1.89%
Other Foreign	76,600	230,600	307,200	5.96%
Totals:	4,516,570	636,250	5,152,820	

1992 KAUAI VISITOR DAYS BY COUNTRY OF ORIGIN



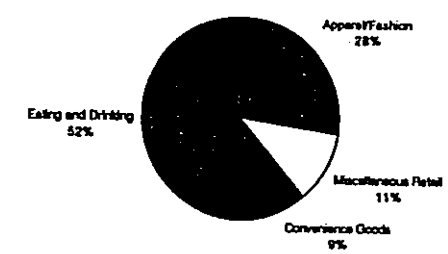
Source: Hawaii Visitors Bureau, Research Report, 1992

Table V-6.

U.S. Visitor Expenditures On Retail Categories
1992

Retail Expenditure Category	U.S. Visitor N.I. Daily Expenditures		U.S. Visitor Days Kauai		Total U.S. Visitor Expenditures ($000s)
			3,999,750		
Apparel/Fashion		$12.27		$49,077	
Clothing-Casual	$6.34				$25,358
Clothing-Designer	$2.15				$8,599
Jewelry/Watches	$2.65				$10,599
Cosmetics/Perfumes	$0.14				$560
Leather Goods	$0.21				$840
Other Fashion	$0.78				$3,120
Miscellaneous Retail		$5.06		$20,239	
Souvenirs	$3.55				$14,199
Agriculture	$1.51				$6,040
Convenience Goods		$4.11		$16,439	
Groceries	$4.11				$16,439
Eating and Drinking		$22.92		$91,674	
Restaurants	$21.20				$84,795
Night Clubs/Bars	$1.72				$6,880
Total Retail:	$44.36			$177,429	

1992 KAUAI U.S. VISITOR EXPENDITURES



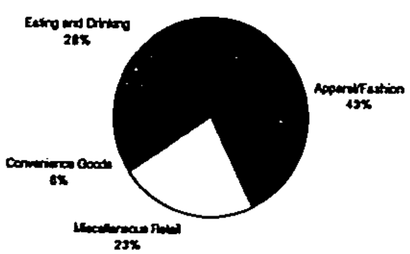
Source: Hawaii Visitors Bureau, Research Report, 1992

Table V-7.

Japan Visitor Expenditures On Retail Categories
1992

Retail Expenditure Category	Japan Visitor N.I. Daily Expenditures		Japan Visitor Days Kauai		Total Japan Visitor Expenditures ($000s)
			226,490		
Apparel/Fashion		$44.11		$9,990	
Clothing-Casual	$20.56				$4,657
Clothing-Designer	$2.86				$648
Jewelry/Watches	$3.30				$747
Cosmetics/Perfumes	$5.34				$1,209
Leather Goods	$11.39				$2,580
Other Fashion	$0.66				$149
Miscellaneous Retail		$23.41		$5,302	
Souvenirs	$20.78				$4,706
Agriculture	$2.63				$596
Convenience Goods		$6.65		$1,506	
Groceries	$6.65				$1,506
Eating and Drinking		$28.44		$6,441	
Restaurants	$27.70				$6,274
Night Clubs/Bars	$0.74				$168
Total Retail:	$102.61			$23,240	

1992 KAUAI JAPANESE VISITOR EXPENDITURES



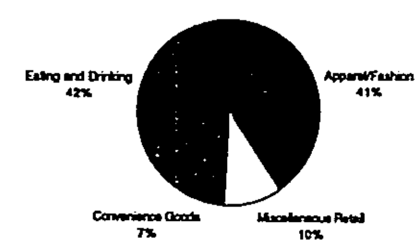
Source: Hawaii Visitors Bureau, Research Report, 1992

Table V-8.

Other Foreign Visitor Expenditures On Retail Categories
1992

Retail Expenditure Category	Other Foreign Daily Expenditures		Other Foreign Days Kauai		Total Other Foreign Expenditures ($000s)
			926,580		
Apparel/Fashion		$23.08		$21,385	
Clothing-Casual	$8.67				$8,033
Clothing-Designer	$4.77				$4,420
Jewelry/Watches	$4.46				$4,133
Cosmetics/Perfumes	$1.00				$927
Leather Goods	$1.57				$1,455
Other Fashion	$2.61				$2,418
Miscellaneous Retail		$5.94		$5,504	
Souvenirs	$4.41				$4,086
Agriculture	$1.53				$1,418
Convenience Goods		$4.22		$3,910	
Groceries	$4.22				$3,910
Eating and Drinking		$23.62		$21,886	
Restaurants	$19.40				$17,976
Night Clubs/Bars	$4.22				$3,910
Total Retail:	$56.86			$52,685	

1992 KAUAI OTHER FOREIGN VISITOR EXPENDITURES



Source: Hawaii Visitors Bureau, Research Report, 1992

Table V-9.

Projected U.S. Visitor Demand for Retail Goods
1995 - 2020
(In $000s of 1990 Constant Dollars)

Primary Market Area	Daily Per Capita Expe	1995	2000	2005	2010	2015	2020
Shopper Goods							
Apparel	$9.48	$40,288	$50,062	$55,865	$67,138	$75,207	$84,172
General Merchandise	$5.06	$21,504	$26,721	$29,818	$35,835	$40,142	$44,927
Specialty	$2.79	$11,857	$14,733	$16,441	$19,759	$22,134	$24,772
Furniture/Appliances		$0	$0	$0	$0	$0	$0
Convenience Goods							
Food/Liquor	$4.11	$17,467	$21,704	$24,220	$29,107	$32,606	$36,492
Drug/Proprietary	$0.00	$0	$0	$0	$0	$0	$0
Eating and Drinking	$22.92	$97,406	$121,035	$135,065	$162,322	$181,831	$203,503
Heavy Commercial	$0.00	$0	$0	$0	$0	$0	$0
Total:		$188,523	$234,255	$261,409	$314,162	$351,920	$393,866

Source: Arthur Andersen RESG

Table V-10.

Projected Japanese Visitor Demand for Retail Goods
1995 - 2020
(In $000s of 1990 Constant Dollars)

	Daily Per Capita Expe	1995	2000	2005	2010	2015	2020
Shopper Goods							
Apparel	$35.47	$8,536	$12,160	$16,498	$23,440	$30,414	$34,009
General Merchandise	$23.41	$5,634	$8,026	$10,888	$15,470	$20,073	$22,465
Specialty	$8.64	$2,079	$2,962	$4,019	$5,710	$7,408	$8,291
Furniture/Appliances	$0.00	$0	$0	$0	$0	$0	$0
Convenience Goods							
Food/Liquor	$6.65	$1,600	$2,280	$3,093	$4,395	$5,702	$6,382
Drug/Proprietary	$0.00	$0	$0	$0	$0	$0	$0
Eating and Drinking	$28.44	$6,844	$9,750	$13,228	$18,794	$24,386	$27,292
Heavy Commercial	$0.00	$0	$0	$0	$0	$0	$0
Total:		$24,693	$35,177	$47,726	$67,809	$87,982	$98,469

Source: Arthur Andersen RESG

Table V-11.

Projected Other Foreign Visitor Demand for Retail Goods
1995 - 2020
(In $000s of 1990 Constant Dollars)

	Daily Per Capita Exps	1995	2000	2005	2010	2015	2020
Shopper Goods							
Apparel	$17.62	$17,347	$21,724	$24,582	$29,912	$33,959	$38,007
General Merchandise	$5.94	$5,848	$7,324	$8,280	$10,084	$11,448	$12,813
Specialty	$5.46	$5,375	$6,732	$7,611	$9,269	$10,523	$11,777
Furniture/Appliances	$0.00	$0	$0	$0	$0	$0	$0
Convenience Goods							
Food/Liquor	$4.22	$4,155	$5,203	$5,883	$7,164	$8,133	$9,103
Drug/Proprietary	$0.00	$0	$0	$0	$0	$0	$0
Eating and Drinking	$23.62	$23,254	$29,122	$32,925	$40,097	$45,523	$50,949
Heavy Commercial	$0.00	$0	$0	$0	$0	$0	$0
Total:		$55,979	$70,105	$79,261	$96,525	$109,587	$122,649

Source: Arthur Andersen RESG

Projected Sales Demand Capture

Table V-13 presents capture rates considered achievable by Lihue District retail facilities within the Primary and Secondary Market Areas. Capture rate assumptions are judgments based upon consideration of several factors including: proximity to resident and visitor population centers, access, proximity to major employment centers, and the general nature of activities in the district. It also considers the competitive position of the district in relation to existing and planned supply of retail space in the County of Kauai.

Proximity to Resident Population Centers	The Lihue District is the central district of the three districts that account for roughly three-quarters of Kauai's existing and projected resident population.
Proximity to Visitor Population Centers	The Lihue Airport and Nawiliwili Harbor are the primary entry and exit points for visitors to Kauai. Also, visitor accommodations in the Lihue District account for approximately 22 percent of the total count for the County of Kauai. The major visitor accommodation areas of Wailua-Waipouli and Poipu are located within 12 miles of the town of Lihue.
Access	The Lihue District is the central point for the County of Kauai's three main highways: Kaumualii, Kuhio and Kapule. It is also the location of the County's primary airport and commercial harbor.

Proximity to Major Employment Centers	The Lihue District is the major employment center for the County of Kauai for professional/technical, transportation, utilities, and government employment, and is convenient to the major resort employment areas of Wailua-Waipouli and Poipu.
Other Activities in the Lihue District	The Lihue District serves as the seat of county government, and generally serves as the location of state and federal district offices. The district also generally serves as the primary or central location for businesses and other organizations that have established a presence in the County of Kauai.
Other Activities in the Lihue District (cont.)	The Lihue District also often serves as the center of the County's educational and cultural activities. Located within the district are Kauai Community College, Vidinha Stadium, and the Kauai War Memorial Convention Hall.

Existing Competitive Retail Space	The Lihue District is home to the County's only regional shopping center, the Kukui Grove Center, and is the primary location for the County's automotive and heavy commercial activities. The district also has two major grocery stores and two major drug stores. There are also visitor-oriented specialty stores in the district to serve visitors staying in the Lihue area. Other districts have neighborhood shopping centers with grocery stores, and have visitor-oriented stores and centers. Heavy commercial stores are very limited outside of the Lihue District.
Planned Competitive Retail Space	Most of the planned competitive retail space for the County of Kauai is located in the Lihue District. KMart and Wal-Mart will open new stores within the next two years. No major facilities outside of the Lihue District have been announced.

Shopper Goods/Heavy Commercial

In the apparel, general merchandise, specialty and furniture/appliances categories, Lihue District retail facilities should be able to capture a substantial portion of the potential resident expenditures due their strategic location with respect to population distribution and the nature of Lihue town and the Kukui Grove Center areas as Kauai's primary area for shopper goods and heavy commercial retail activities. With the addition new KMart and Wal-Mart stores, the capture of general merchandise should be very high.

Convenience Goods

The Lihue District's potential capture of convenience goods represent a smaller portion of resident expenditures due to the presence of neighborhood shopping facilities in most of the major towns on the island. Capture rates for visitor expenditures are based upon the relative share of island hotel rooms in the Lihue District, and then adjusted to reflect the importance of the Lihue District as a market center, and as the entry and exit point for visitors to the island.

Eating and Drinking

The Lihue District's potential capture of eating and drinking is the same as for convenience goods. As with convenience goods, capture rates for the Lihue District are based upon the district's relative share of resident and visitor populations adjusted to reflect the importance of the Lihue District as a market center, and as the entry and exit point for visitors to the island.

Based on the capture rates presented in Table V-14 in 1995, the potential combined capturable retail sales by residents and visitors in the Lihue District by market area stores could approach $301.3 million; this sales potential is projected to reach $654.4 million annually by 2020.

Existing And Planned Supply Of Retail Space

Table V-15 presents a listing of the major existing and planned retail centers for the County of Kauai. In addition to the major centers there are retail facilities in many of the hotels and in small individual buildings.

Resident-Oriented Facilities

The Lihue town area serves as the regional center for County of Kauai residents and is the home of Kauai's only regional shopping center, Kukui Grove Center. It is also the location of the county's main outlets for furniture, appliances, and heavy commercial goods and services.

Convenience goods are generally sold at neighborhood centers and convenience stores found in major towns throughout the island. Neighborhood centers generally include supermarkets, drug stores,

restaurants, and a variety of service facilities such as beauty parlors and laundries.

Visitor-Oriented Retail Facilities

In addition to retail shops found within hotel properties there are four major visitor-oriented specialty retail facilities on Kauai: a retail area adjacent to the Kauai Lagoons resort along Nawiliwili Road; the Coconut Grove shopping center in Waipouli; the Kiahuna Village in Poipu; and the Princeville center in Princeville. In addition, there are visitor-oriented shops in older buildings in Hanalei, Kapaa, and Koloa.

Planned Facilities

Planned facilities are limited to the expansion of the Kukui Grove center to include a KMart store and additional mall stores, and a new Wal-Mart store in Lihue. Some additional neighborhood commercial space is planned for Alexander & Baldwin's Kukuiula project to serve residents in that new community.

Table V-12.

Projected Total Resident and Visitor Demand for Retail Goods
1995 - 2020
(In $000s of 1990 Constant Dollars)

	1995	2000	2005	2010	2015	2020
Shopper Goods						
Apparel	$81,387	$102,092	$118,075	$145,401	$168,225	$188,796
General Merchandise	$71,023	$87,434	$101,865	$123,667	$143,275	$161,656
Specialty	$49,742	$60,718	$70,373	$84,560	$97,355	$110,003
Furniture/Appliances	$11,411	$13,609	$15,863	$18,683	$21,484	$24,436
Convenience Goods						
Food/Liquor	$141,136	$169,815	$197,117	$233,727	$268,438	$304,482
Drug/Proprietary	$26,626	$31,755	$37,015	$43,594	$50,128	$57,017
Eating and Drinking	$173,150	$214,344	$244,672	$295,946	$337,674	$379,489
Heavy Commercial	$95,094	$113,410	$132,195	$155,694	$179,030	$203,633
Total:	$649,572	$793,176	$917,175	$1,101,273	$1,265,609	$1,429,517

Source: Arthur Andersen RESG

Table V-13.

Potential Capture Rates of Resident and Visitor
Retail Demand by Lihue District Retail Facilities
1995 - 2020 (Projected to Remain Constant)

	1995	2020
Apparel		
Resident Primary Market Area	80%	80%
Resident Secondary Market Area	70%	70%
U.S. Visitors	25%	25%
Japan Visitors	25%	25%
Other Foreign Visitors	25%	25%
General Merchandise		
Resident Primary Market Area	90%	90%
Resident Secondary Market Area	80%	80%
U.S. Visitors	25%	25%
Japan Visitors	25%	25%
Other Foreign Visitors	25%	25%
Specialty (Gifts, etc.)		
Resident Primary Market Area	80%	80%
Resident Secondary Market Area	70%	70%
U.S. Visitors	25%	25%
Japan Visitors	25%	25%
Other Foreign Visitors	25%	25%
Furniture/Appliances		
Resident Primary Market Area	90%	90%
Resident Secondary Market Area	80%	80%
Food/Liquor		
Resident Primary Market Area	90%	90%
Resident Secondary Market Area	35%	35%
U.S. Visitors	25%	25%
Japan Visitors	25%	25%
Other Foreign Visitors	25%	25%
Drug/Proprietary		
Resident Primary Market Area	90%	90%
Resident Secondary Market Area	35%	35%
U.S. Visitors	25%	25%
Japan Visitors	25%	25%
Other Foreign Visitors	25%	25%
Eating and Drinking		
Resident Primary Market Area	90%	90%
Resident Secondary Market Area	30%	30%
U.S. Visitors	25%	25%
Japan Visitors	25%	25%
Other Foreign Visitors	25%	25%
Heavy Commercial Goods		
Resident Primary Market Area	90%	90%
Resident Secondary Market Area	70%	70%

Source: Arthur Andersen RESG

Table V-14.

Projected Lihue District Resident and Visitor Demand for Retail Goods
1995 - 2020
(In $000s of 1990 Constant Dollars)

	1995	2000	2005	2010	2015	2020
Shopper Goods						
Apparel	$27,549	$34,145	$39,608	$48,278	$55,772	$62,800
General Merchandise	$39,565	$47,951	$55,977	$66,965	$77,269	$87,562
Specialty (1)	$26,840	$32,424	$37,772	$44,996	$51,770	$58,702
Furniture/Appliances	$9,396	$11,230	$13,119	$15,485	$17,806	$20,253
Convenience Goods						
Food/Liquor	$62,223	$75,990	$90,014	$108,343	$124,502	$141,400
Drug/Proprietary	$12,739	$15,511	$18,452	$22,169	$25,492	$28,995
Eating and Drinking	$51,968	$64,531	$74,620	$90,648	$103,577	$118,633
Heavy Commercial	$71,008	$85,097	$99,675	$117,961	$135,641	$154,282
Total:	$301,285	$366,880	$479,236	$514,844	$591,829	$670,657

Source: Arthur Andersen RESG

Table V-15.

Existing and Planned Retail Space in Lihue District

Property Name	Location	Total GLA	Comments
Existing			
Anchor Cove	Nawiliwili	20,750	
Kauai Lagoons Shopping Village	Nawiliwili	12,000	Closed for hotel repairs
Kukui Grove Center	Puhi	314,000	Regional center
Lihue Shopping Center	Lihue	80,000	County has taken over small shop space; Gem has vacated Reduction in GLA from 142,250 sf
Rice Shopping Center	Lihue	44,000	
Pacific Ocean Plaza	Lihue	30,000	Retail/Office
Lihue Town Center	Lihue	17,314	Retail/Office
Aina Hou	Nawiliwili	12,000	
Kuhio Business Center	Lihue	17,280	
Haleko Center	Lihue	15,500	Under renovation
		562,844	
Planned			
Kukui Grove Center	Puhi	170,000	KMart and inline stores
Wal-Mart	Lihue	120,000	1995 est. opening
		290,000	

Market Potentials At The Project Area

Table V-16 presents the projected supportable retail space for the Lihue District based upon the district's potential capture of retail sales divided by assumed average sales per square foot of gross leasable area for different categories of retail goods and services. The assumptions of average sales per square foot of gross leasable area for different categories are based on judgments related to sales levels and operating expenses at existing Hawaii retail facilities.

The projected supportable space for 1995 for the Lihue District is 839,338 square feet of gross leasable area. The supportable retail space is projected to increase to 1,865,114 square feet of gross leasable area by 2020. The construction of a KMart and additional retail space at Kukui Grove Center in 1994 and 1995, and the planned construction of a Wal-Mart store in 1995, creates a deficit of supportable space in 1995 in the projections, which may be felt in terms of reduced average sales per square foot gross leasable area, or withdrawals of space.

The potential for retail space development at the Project Area is based on several factors. Opportunities for resident-oriented facilities relate to the proximity of the property to existing and planned residential and commercial areas in Lihue and Hanamaulu, and to the role of Lihue town as the island's center for hard good purchases such as furniture, autos, and major household appliances. Opportunities for visitor-oriented facilities relate to the proximity of the property to the Lihue Airport and the roads from the airport to the island's various visitor destination areas.

The 30 to 40 percent rates for the capture of projected increased demand for retail space in the Lihue District used for the Project Area are based upon consideration of the types of existing and planned commercial retail space, the advantageous location of the Project Area in relation to major highways and arterial roads, and close proximity to existing commercial and residential areas.

At a capture rate of 30 to 40 percent 246,431 to 328,574 square feet of leasable area can be absorbed over the 1997 to 2017 period.

Neighborhood Center Potential

With the projected growth in population of the Lihue District there is the potential for an additional neighborhood center to serve residents and workers in Lihue and residents of the Hanamaulu area. The Project Area should provide for a neighborhood center ranging in size from 60,000 to

90,000 square feet of GLA. The center should include a major drugstore and supermarket as anchor tenants, and should have a location along a major roadway at a site with excellent access and high visibility to the local resident population.

Convenience Center Potential

In addition to the development of a neighborhood center there is the potential to develop a convenience-oriented center in the Hanamaulu area to serve residents in that area. The center should include a convenience store and other stores and services to serve the immediate neighborhood.

Heavy Commercial/Automobile Related Commercial Potential

These types of retail facilities typically have unique site and specialized facility requirements that would dictate a location along a major arterial road allowing separate identity and direct ingress and egress. Typical users would include the following: auto dealers; auto supplies; service stations; building materials; and hardware stores.

Visitor Related Potential

The potential for visitor-related retail facilities in the Project Area is related primarily to the opportunity to serve visitors traveling to and from the Lihue Airport. Visitor-oriented facilities should thus be placed on sites near the airport on major arterial streets. Appropriate retail activities include specialty retail, local crafts, other unique Kauai products and services, service stations, and other visitor-oriented convenience stores.

Table V-18.

Supportable Retail Space in Lihue District
1995 - 2020
(In Square Feet of Gross Leasable Area or GLA)

Retail Category	Sales Per SF GLA		Sales Per SF GLA
Shopper Goods		Convenience Goods	
Apparel	$330	Food/Liquor	$468
General Merchandise	$330	Drug/Proprietary	$365
Specialty	$358	Eating and Drinking	$358
Furniture/Appliance	$275	Heavy Commercial Goods	$330

	Sales Per SF GLA	1995	2000	2005	2010	2015	2020
Shopper Goods							
Apparel	$330	83,481	103,471	120,024	148,296	169,006	190,304
General Merchandise	$330	119,894	145,305	169,826	202,923	234,150	265,336
Specialty (1)	$358	75,076	90,697	105,655	125,863	144,812	164,202
Furniture/Appliances	$275	34,168	40,836	47,705	56,310	64,749	73,648
Convenience Goods							
Food/Liquor	$468	133,097	162,545	192,543	231,750	266,314	302,459
Drug/Proprietary	$365	33,090	40,269	47,927	57,582	66,212	75,311
Eating and Drinking	$358	145,359	180,507	208,726	253,559	289,725	326,330
Heavy Commercial	$330	215,175	257,871	302,045	357,458	411,034	467,521
Subtotal:		839,338	1,021,522	1,194,253	1,431,742	1,646,002	1,865,114
Less: Existing Retail Space		687,844	977,844	977,844	977,844	977,844	977,844
Retail Space Planned or Under Construction		290,000	0	0	0	0	0
Subtotal:		977,844	977,844	977,844	977,844	977,844	977,844
Net Potential Supportable Space		(138,506)	43,678	216,409	453,898	668,158	887,270
Net Increase			182,184	172,730	237,489	214,261	219,112
Project Area							
Capture @	30%		54,655	51,819	71,247	64,278	65,734
Cumulative:			54,655	106,474	177,721	241,999	307,733
Capture @	40%		72,874	69,092	94,996	85,704	87,645
Cumulative:			72,874	141,966	236,962	322,666	410,311

Source: Arthur Andersen RESG

SECTION VI: ANALYSIS OF OFFICE MARKET POTENTIALS

The following section examines the market potentials for office space in the Project Area through an examination of current and future market forces as well as a review of the current supply of office space in the Lihue District. Potential demand for office space should come from the following major sources:

- Governmental activities which locate in response to the needs of their constituents;
- Services related to population, as provided by medical practitioners, attorneys, and real estate agents;
- Services related to an employment base, such as accounting, legal, and consulting activities;
- Services related to both employment activities and households, such as major financial institutions and insurance companies;
- Firms which are seeking a special environment and lower costs than traditional office centers; and
- Firms which are seeking a location near transportation centers such as the Lihue Airport and Nawiliwili Harbor.

Employment - County Of Kauai

Table VI-1 presents estimates of office-using employment by major employment sector for the years 1987, 1990 and 1992. The estimates are based on the actual number of employees in each major sector multiplied by the percentage of employment which actually use office space. In 1987 there were approximately 3,100 office-using employees in the County of Kauai. In 1992 that figure had increased by over 1,000 persons to 4,031 office-using employees. The change represents an additional 200 office-using employees per year.

Table VI-1 also presents the total job count for the County excluding agricultural employees. In 1987 that figure totaled 23,850 employees; by 1992 it had increased to 28,900 employees. The total job count as a percentage of total population increased from 50.1 percent in 1987 to 52.6 percent in 1992. The office-using employees per 1,000 population also increased from 65.2 in 1987 to 74.7 per 1,000 population in 1992.

Table VI-1.

Estimates of Office Employment By Major Employment Sector

Sector	% Using Office	1987	1990	1992
Contract Construction	10.00%	75	145	100
Manufacturing	5.00%	58	45	40
Trans., Comm., Utilities	30.00%	615	720	690
Fin., Ins., R.E.	100.00%	1,150	1,550	1,500
Services/Other	35.00%	928	1,260	1,470
Government	5.00%	145	168	185
Agriculture	2.50%	33	29	25
Self-Employed	5.00%	100	115	120
Subtotal:		3,103	4,031	4,130
Total Employed Labor Force		23,850	27,350	28,900
Population		47,600	51,600	55,300
Labor Force as % of Population		50.11%	53.00%	52.26%
Office Employees/ 1,000 Population		65.18	78.13	74.68

Note: 1992 Figure for employed labor force based on June 1992 monthly figure

Source: Dept. of Labor and Industrial Relations, Labor Area News; Arthur Andersen RESG

Existing Supply Of Office Space

Field surveys were conducted to determine the current supply of office space in the Lihue District which would be potentially competitive with new facilities developed in the Project Area. Field research was conducted of free-standing office space in Lihue and Puhi of buildings 3,500 square feet or larger in size. A total of 16 buildings were identified which were primarily used as office space. In total they represented nearly 210,000 square feet of existing office space. These buildings are presented in Table VI-2. Current rents average $1.39 to $1.75 per square foot triple net. Common Area Maintenance (CAM) charges range from $0.27 to $0.40 per square foot.

Employment Projections - County Of Kauai

Table VI-3 presents projections of office-using employment for the County from 1995 to 2020. The 1995 figure of 4,213 office-using employees is projected to reach 5,211 by 2005 and will reach 7,168 by 2020.

Office Space Development Potential - County Of Kauai

Based on the projected growth of population and the resultant growth in office-using employees, there exists a strong market for office space for the County of Kauai. Table VI-4 presents the projected demand for office space for the County. Office space required per employee is anticipated to average 220 square feet per employee for the 1995 to 2020 period. Based on these requirements the projected increase in demand for office space should reach 650,100 square feet for the 1995 to 2020 period.

Office Space Development Potential - Lihue District

Given the recent and anticipated growth of the Lihue District, and the role of the Lihue District as Kauai's civic and commercial center, it is expected that there will be a strong demand for office space in the Lihue area. The recent growth of office space in the Kukui Grove West complex, the conversion of residential buildings along Ekahi and Elua Streets, and the recent development of several small complexes in the Lihue area are indicators of the recent demand for additional office space at nearby locations.

The anticipated growth for the Lihue District and other areas of Kauai may require that additional governmental facilities be offered in the area. Governmental facilities, constitute a major source of demand for office space.

In addition to the governmental facilities other private sector office users such as law offices and banking may demand additional space at adjacent or nearby locations.

Assuming a 60 percent capture rate of the County demand, it is projected that the Lihue District will capture 390,060 square feet of office space over the 1995 to 2020 period. The 60 percent capture rate is based on the role that the Lihue District plays as the primary center for professional, service and commercial activities in the County of Kauai.

Office Space Potential - Project Area

The site has excellent potential for office space. The site is located near employee generating areas such as the Lihue Airport, the Lihue Industrial center, and the Lihue Central Business District. In addition, there is an opportunity to work with the County to provide new civic center facilities. Based on these factors, it is believed that the Project Area can capture 50 to 60 percent of the Lihue District demand, or a cumulative total of 157,905 to 189,486 square feet of space between 1997 and 2016. Table VI-4 presents the distribution of demand by time period and acreage for the Project Area.

Table VI-2.

Existing Lihue District Office Space

Building	Area	GLA	
Ahana Building	Lihue	6,622	
Ahukini Annex	Lihue	4,126	
Dynasty Court	Kukui Grove	23,000	
4357 Rice Street	Lihue	4,100	
Garden Island Publ. Bldg.	Lihue	3,650	
Kokua Prof. Bldg.	Lihue	5,800	
Kukui Medical Off. Bldg.	Kukui Grove	15,500	
Kukui Executive Center	Kukui Grove	20,000	
Kukui Prof. Center	Kukui Grove	9,000	
Kuuleialoha Bldg.	Lihue	14,607	
Lihue Town Annex	Lihue	19,280	
Lihue Town Center	Lihue	24,658	Retail/Office
Lihue Town Plaza	Lihue	8,235	
Pacific Ocean Plaza	Lihue	30,500	Retail/Office
Park Plaza I & II	Lihue	6,000	
Watamull Plaza	Lihue	15,500	
Total:		210,578	

Source: Hawaii Business Statewide Office Guide, 1992

Table VI-3.

Projections of Office Using Employment
County of Kauai
1995 - 2020

	1995	2000	2005	2010	2015	2020
Population	56,177	62,177	69,477	78,577	87,077	95,577
Total Employment	32,200	36,800	40,800	45,400	50,000	54,600
Employees as % of Population	57.32%	59.19%	58.72%	57.78%	57.42%	57.13%
Office Employees/ 1,000 Population	75.00	75.00	75.00	75.00	75.00	75.00
Office Using Employment	4,213	4,663	5,211	5,893	6,531	7,168

Source: DBED Data Book, 1988 Table 365, 1991 Table 340; Dept. of Labor and Industrial Relations (DLIR); Arthur Andersen RESG

Table VI-4.

Projected Demand for Office Space
County of Kauai and Project Area
1995 - 2020

	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020
Change in Office Using Employment	450	548	682	638	638
Cumulative Increase in Office Using Employment	450	998	1,680	2,318	2,955
Office Space Required Per New Employee (In Square Feet)	220	220	220	220	220
Office Space Required Per Period	99,000	120,450	150,150	140,250	140,250
Cumulative Office Space Required	99,000	219,450	369,600	509,850	650,100
Lihue District Market Potential					
Capture Rate	60%	60%	60%	60%	60%
Office Space Required Per Period	59,400	72,270	90,090	84,150	84,150
Cumulative Office Space Required	59,400	131,670	221,760	305,910	390,060
Project Area Market Potential					
Lower Capture Rate @	50%	50%	50%	50%	50%
Office Space Required Per Period	29,700	36,135	45,045	42,075	42,075
Cumulative Office Space Required (GLA)	29,700	65,835	110,880	152,955	195,030
GLA Per Acre	23%	23%	23%	23%	23%
Acres Required Per Period	2.96	3.61	4.50	4.20	4.20
Cumulative Acres Required	2.96	6.57	11.07	15.27	19.47
Higher Capture Rate @	60%	60%	60%	60%	60%
Office Space Required Per Period	35,640	43,362	54,054	50,490	50,490
Cumulative Office Space Required (GLA)	35,640	79,002	133,056	183,546	234,036
GLA Per Acre	23%	23%	23%	23%	23%
Acres Required Per Period	3.56	4.33	5.40	5.04	5.04
Cumulative Acres Required	3.56	7.89	13.28	18.32	23.36

SECTION VII: ANALYSIS OF INDUSTRIAL MARKET POTENTIALS

This section presents an analysis of the potential market for industrial land at the Project Area. The analysis covers the existing and planned light industrial activity in the Lihue District, projected changes in the employment categories which characteristically use industrial space, and the potential capture of demand for industrial space by the Project Area.

Existing And Planned Light Industrial Activity - County Of Kauai

Industrial space in the Lihue District was initially centered around the sugar mills, sugar plantation staging areas, and harbor areas at Nawiliwili and Ahukini. After World War II the Ahukini landing area was closed, and harbor operations were consolidated at Nawiliwili. With the closure of sugar operations at Grove Farm, the Puhi staging area was converted to a heavy equipment storage area.

Modern light industrial space was first developed in the Lihue Industrial subdivision. Recently, Grove Farm has developed a new light industrial area in Puhi near the old sugar plantation staging area with a combination of fee simple lots and leasehold lots.

Employment - County Of Kauai

Demand for industrial land is a function of the growth in uses which would use industrially zoned property. The analysis of demand is based on an examination of projected increases in the number of positions in employment categories which tend to use buildings on industrially-zoned property. This provides an estimated level of demand for building space on industrial property, which can then be related to demand for land.

Industrial Space Potential - County Of Kauai

Projected growth in employment sectors which utilize industrial space for the 1995 to 2020 period suggest that an average of roughly 300 new jobs per year for industrial space-using employment sectors. These figures are presented in Table VII-1. The manufacturing sector is not anticipated to be a major contributor to this increase.

Development of the relationship between the average annual addition of 330 employment positions during the 1995 to 2020 period and the consequent potential demand for industrial-type space in the Lihue District during the same period involves three steps:

1. Identify the number of square feet of potential demand for light industrial-type space that each additional position will create in a given employment category;

2. Estimate the percentage of the positions in a given employment category that is likely to contribute to the potential demand for light industrial-type space; and

3. Estimate the potential capture rate by employment category for the Study Area of the projected new positions that are likely to contribute to the potential demand for industrial-type space.

Through these steps a projection of potential demand for light industrial-type space in the Study Area is established.

For the categories of Contract Construction; Transportation, Communication and Utilities; Wholesale Trade; and Other Services, it is believed that there will be an average demand of 400 square feet per position.

For the categories of Other Self-Employed, it is believed that there will be an average demand of 300 square feet per position. This lower figure is due to the lower space requirement per employee typical of that employment sector.

Employment Projections - County Of Kauai

Contract Construction businesses use industrial space primarily for baseyard operations and storage. Much of the work is carried out at the construction site, and for purposes of projecting demand for industrial-type space only 25 percent of the additional positions are considered as requiring space.

Transportation, Communication and Utilities; Other Services; and Other Self-Employed businesses may have a substantial portion of their work out in the field, and may also use commercial office space for a portion of their operations. For the purposes of projecting demand for industrial-type space 50 percent of the additional positions are counted in the projection.

Table VII-1.

Growth Trends In Employment Sectors Which Utilize Industrial Space County of Kauai 1990 - 2020

Employment Sector	1990-1995	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020
Contract Construction	(450)	100	100	200	200	200
Manufacturing	(100)	0	0	0	0	0
Trans., Com., Util.	(200)	900	300	200	200	200
Wholesale Trade	(69)	69	62	69	69	69
Other Services	400	900	800	900	900	900
Other Self-Employed	(150)	200	100	200	200	200
Totals:	(569)	2,169	1,362	1,569	1,569	1,569

Table VII-2.

Space Utilization By Employment Sector Industrial Space County of Kauai

Sector	Industrial Space Per Worker	Portion Requiring Space
Contract Construction	400	25%
Manufacturing	400	50%
Trans., Com., Util.	400	50%
Wholesale Trade	400	50%
Other Services	400	50%
Other Self-Employed	300	50%

Source: Arthur Andersen RESG

Industrial Space Potential - Lihue District

In projecting a capture rate for the Lihue District, the assumption is that the capture rate will reflect the role of the Lihue District as the County's transportation and commercial center. It also considers the presence of the existing industrial areas around Nawiliwili Harbor, the Lihue Industrial Subdivision and the Puhi industrial area. Given these competitive conditions and the relative advantages of Lihue as an industrial location, it is projected that the Lihue District will capture 40 percent of the new industrial space required during the 1995 to 2020 period.

Tables VII-3 and VII-4 below provide an estimate for average annual growth in the potential demand for industrial-type space in the Lihue District for the 1995 to 2020 period. The projections based upon employment growth suggests that about 3,045,520 square feet can be absorbed over the twenty-five year period.

With a building site coverage of 23 percent per acre, the development of approximately 121,821 sf per year would absorb approximately 12 acres per year on average. For the 1995 to 2020 period the cumulative total would lead to the potential development of about 316 acres.

Industrial Space Potential - Project Area

The potential capture rate of the industrial space captured by the Amfac property in the Lihue District is estimated to be 30 to 40 percent. This is based on consideration of the property's proximity to the Lihue Airport, its excellent access to Kapule Highway and other major roadways, and its proximity to other industrial centers in the Lihue Industrial Subdivision and around Nawiliwili Harbor.

At a capture rate of 30 to 40 percent 712,012 to 949,520 square feet of leasable area can be absorbed over the 1997 to 2016 period.

Table VII-3.

Industrial Space Utilization By Employment Sector
Based On Employment Projections
County of Kauai
1990 - 2020

Employment Sector		1990 to 1995	1995 to 2000	2000 to 2005	2005 to 2010	2010 to 2015	2015 to 2020
Contract Construction		(45,000)	10,000	10,000	20,000	20,000	20,000
Manufacturing		(20,000)	0	0	0	0	0
Trans., Com., Util.		(40,000)	180,000	60,000	40,000	40,000	40,000
Wholesale Trade		(13,860)	13,860	12,320	13,860	13,860	13,860
Other Services		80,000	180,000	160,000	180,000	180,000	180,000
Other Self-Employed		(22,500)	30,000	15,000	30,000	30,000	30,000
Totals:		(61,360)	413,860	257,320	283,860	283,860	283,860
SF Area Coverage @	20%	(306,800)	2,069,300	1,286,600	1,419,300	1,419,300	1,419,300
Acre Area Coverage @	43,560	-7.04	47.50	29.54	32.58	32.58	32.58
Lihue District Market Potential							
Capture Rate			40%	40%	40%	40%	40%
Industrial Space Required Per Period			827,720	514,640	567,720	567,720	567,720
Cumulative Industrial Space Required			827,720	1,342,360	1,910,080	2,477,800	3,045,520
Project Area Market Potential							
Capture Rate			30%	30%	30%	30%	30%
Industrial Space Required Per Period			248,316	154,392	170,316	170,316	170,316
Cumulative Industrial Space Required (GLA)			248,316	402,708	573,024	743,340	913,656
GLA Per Acre			23%	23%	23%	23%	23%
Acres Required Per Period			24.79	15.41	17.00	17.00	17.00
Cumulative Acres Required			24.79	40.20	57.19	74.19	91.19

Source: Arthur Andersen RESG

Table VII-4.

Industrial Space Utilization By Employment Sector
Based On Employment Projections
County of Kauai
1990 - 2020

Employment Sector		1990 to 1995	1995 to 2000	2000 to 2005	2005 to 2010	2010 to 2015	2015 to 2020
Contract Construction		(45,000)	10,000	10,000	20,000	20,000	20,000
Manufacturing		(20,000)	0	0	0	0	0
Trans., Com., Util.		(40,000)	180,000	60,000	40,000	40,000	40,000
Wholesale Trade		(13,860)	13,860	12,320	13,860	13,860	13,860
Other Services		60,000	180,000	160,000	180,000	180,000	180,000
Other Self-Employed 0		(22,500)	30,000	15,000	30,000	30,000	30,000
Totals:		(61,360)	413,860	257,320	283,860	283,860	283,860
SF Area Coverage @	0.20	(306,800)	2,069,300	1,286,600	1,419,300	1,419,300	1,419,300
Acre Area Coverage @	43,560	(7.04)	47.50	29.54	32.58	32.58	32.58
Lihue District Market Potential							
Capture Rate			40%	40%	40%	40%	40%
Industrial Space Required Per Period			827,720	514,640	567,720	567,720	567,720
Cumulative Industrial Space Required			827,720	1,342,360	1,910,080	2,477,800	3,045,520
Project Area Market Potential							
Capture Rate			40%	40%	40%	40%	40%
Industrial Space Required Per Period			331,088	205,856	227,088	227,088	227,088
Cumulative Industrial Space Required (GLA)			248,316	402,708	573,024	743,340	913,658
GLA Per Acre			23%	23%	23%	23%	23%
Acres Required Per Period			33.05	20.55	22.67	22.67	22.67
Cumulative Acres Required			33.05	53.59	78.26	98.93	121.59

Source: Arthur Andersen RESG

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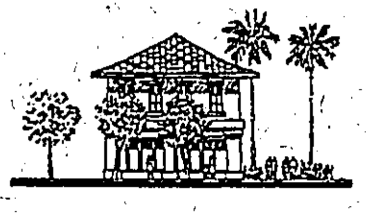
Agricultural Assessment of the Lands in the Proposed Lihue-Hanamaulu Master Plan



AGRICULTURAL ASSESSMENT OF THE LANDS IN THE PROPOSED LIHUE-HANAMAULU MASTER PLAN

The Lihue Plantation Company, Limited
Amfac/JMB Hawaii, Inc.

August 24, 1994

prepared by

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Agricultural Assessment of the Lands in the Proposed Lihue-Hanamaulu Master Plan

This report contains three parts: The first focuses on the significance of the subject lands to the Lihue Plantation Company, Limited (LPCo), a subsidiary of Amfac/JMB Hawaii Inc., who currently uses these lands to produce sugarcane. The second briefly analyses the potential impact on LPCo of using sugarcane lands to dispose of waste water from the proposed development. The third part focuses on the agricultural significance of the subject lands to the County of Kauai and the State of Hawaii.

Location, Description, and Current Use

The proposed project involves approximately 552 acres, comprised of four parcels, three of which are located at the intersection of Ahukini Road and the Hanamaulu-Ahukini Cutoff Road (the fourth "corner" of this intersection is occupied by Lihue Airport) and the fourth parcel is located on the Lihue side of the intersection of the Hanamaulu-Ahukini Cutoff Road and Kuhio Highway. All of the lands being used for agriculture (540 acres) are currently used for the production of sugarcane. The remaining 12 acres are either gullies or other waste areas. These fields can be expected to produce about 11.5 tons of sugar and 3.4 tons of molasses per acre.

Briefly, the subject parcels consist of fairly flat to gently sloping terrain (slopes of less than 10%). The prevailing winds are brisk to gentle; there tends to be more frequent cloud cover here than in other major sugar areas of the State; and rainfall typically is between 40 to 60 inches per year. Supplemental irrigation and windbreaks are required for most crops.

Soils found in the parcel are in the Lihue Series. All the soils except about 20 acres in the parcel closest to Lihue (TMK 3-6-02) are classified as Lihue Silty Clay. The 20 acres are classified as Lihue Gravelly Silty Clay. The Lihue series consists of well-drained soils on the uplands of Kauai. These soils were developed in material weathered from basic igneous rock. They are nearly level to steep. The surface layer is a dusky red silty clay about 12 inches thick. The subsoil is also a dark red to reddish-brown compact silty clay more than 48 inches thick, and is deposited over soft, weathered igneous rock. These soils are deep, fine textured, well drained, and well suited for machine tilling.

The agricultural potential of the subject lands can be examined in terms of several different indices of productivity compiled by State and Federal agencies. The portion of the subject lands currently used for sugar production, except for a small area in an old reservoir site (now planted to cane), are designated "Prime Agricultural Lands" by the State of Hawaii Department of Agriculture. The "Prime" designation indicates that the property has all the physical and climatic conditions which permit sustained high yields under economically advantageous operating conditions. Such lands are characterized by high yields with relatively low production costs and little risk of damage to the physical environment.

The lands in sugar production were given productivity ratings of "B" by the University of Hawaii Land Study Bureau (LSB) if irrigated. Land Study Bureau ratings range from "A" to "E" with "A" being the highest or most productive. The Soil Conservation Service of the United States Department of Agriculture assigned a crop capability classification of IIe to these lands. Soils with a classification of I have few, if any, limitations, II implies some limitations due to slope, shallowness, unfavorable texture, stoniness, or low water-holding capacity, III implies severe limitations, and IV very severe limitations. For the subject parcel, the limitation in productivity is due to slope and the potential for erosion. All of the above productivity measures are based on irrigated production and assume that good water is available.

Significance of Subject Lands to LPCo

LPCo is the largest sugar plantation on Kauai and the second largest in the State that has not announced plans to close. It currently farms about 11,200 acres and is putting an additional 500 acres in Kealia into the production of seed cane. As well as utilizing lands it owns, LPCo leases 4,155 acres from the State of Hawaii and 1,990 acres from Grove Farm. The leases from the State will expire in 1999 and those from Grove Farm in 1995.

LPCo currently produces approximately 50,000 tons of raw sugar and 15,000 tons of molasses (85°Brix) annually. LPCo also produces electricity. The electricity is both sold to Kauai Electric and used internally. LPCo currently employs 361 persons, including 250 field workers, 97 mill workers, and 14 individuals in administration. The sugarcane in the subject fields is furrow irrigated. The water comes from the South Fork of the Wailua River.

The proposed takedown or removal of lands from sugar production will have some impact on LPCo, primarily due to the loss of fields close to the mill. However, LPCo has been aware of the likelihood of urban expansion in the Lihue area for a long time and has incorporated the potential loss of lands in its long-range plans. Thus the proposed takedown is not unexpected and will not significantly disrupt operations. In addition, the

proposed loss in acreage is almost entirely offset by the additional 500 acres being put into the production of seed cane at Kealia. Moreover, even though the subject lands are close to the mill, they incur costs that other fields do not due to the proximity and adjacent locations of the airport, hospital, schools, and residential housing. Restrictions that increase cultivation and harvest costs are incurred. Primarily, burning and cultivation days are limited to those when weather and soil conditions will minimize the impact of the resultant smoke and dust. The ultimate use of these lands in the proposed project, however, will not be a determining factor in the future of LPCo.

Currently, LPCo is, at best, operating in a break-even mode and may even be operating at a loss. The future of the company will depend on several factors, including: U.S. sugar policy (which determines the price of sugar), the ability of LPCo to renegotiate satisfactory leases with the State and Grove Farm, changes in the costs of doing business (such as workers' compensation insurance), the success of management in reducing unit costs of producing and processing sugar, as well as the ability of the management of LPCo to adapt to the planned development. However, the takedown will not occur at once, but will be phased over a number of years, at an estimated average rate of 25 acres per year, giving LPCo sufficient time to adapt.

As the acreage farmed declines, LPCo will not require as many employees in the field and the mill will operate fewer days. The actual impact on employment depends on how LPCo handles the immediate increase of 500 acres in Kealia. If the increased workload is handled with the existing workforce, e.g., by using overtime, it is quite possible that the proposed future reductions in acreage will not require releasing any employees. Currently, LPCo is using about one full-time-equivalent field employee for every 50 acres of sugarcane.

The mill can operate fewer days without significantly increasing per unit costs of processing cane, as long as any excess labor can be profitably used. Mill labor is employed on a full-time basis. However, as the current mill labor force is more than fully utilized (the mill is currently paying overtime), a longer off season would mean less overtime, not a reduction in the number of employees.

Furthermore, future economic conditions, independent of the proposed development, may force LPCo to consider alternatives such as consolidating their operations with other mills, particularly with A&B's McBryde Sugar Company, or reducing operations from the current two lines in the mill to a single line. The mill has to grind enough sugarcane: 1) to produce enough sugar to support mill overhead costs; and 2) to produce enough bagasse to generate enough power for internal operations and to meet LPCo's contractual obligations to supply power to Kauai Electric.

Impact of Waste Water Disposal on LPCo

It has been suggested that effluent from the proposed development be reused to irrigate sugarcane fields. The planned volume of effluent is 1.46 million gallons per day (mgd). This will impact LPCo operations and yields in many ways, depending primarily on two factors: 1) how the effluent is applied; and 2) how much land is used. Studies by the Water Resource Center of the University of Hawaii near Mililani on Oahu have shown that it is possible to use effluent to irrigate sugarcane with no loss in sugar production provided the effluent is mixed with ditch water (not more than 25 percent effluent) and effluent is not used for irrigation during the second crop year.

The availability of nutrients in the effluent has the potential of reducing the amount of fertilizer LPCo must apply during the first year of production. However, the use of effluent for irrigation will also require different handling techniques and field workers must be trained in simple precautionary measures (sanitation and personnel hygiene) to minimize the risk of contracting infections.

One problem with using effluent for irrigation is that while effluent is constantly produced irrigation water is not constantly applied. Good farm management practices require that water and nutrient availability be limited during the second year of sugarcane production to control ripening. There must be sufficient lands available to utilize all the effluent. If insufficient lands are available, the spreading of "excess" effluent on sugarcane fields will reduce yields. If a mixture of 75 percent ditch water and 25 percent effluent were to be used during the first year and no effluent were to be used in the second year, it would require about 1,600 acres of sugarcane to completely utilize 1.46 mgd of effluent without impacting production. The acreage required could be reduced to about 1,000 acres if the effluent ditch water mixture was used for eight months during the second year.

A related problem is that irrigation may not be required after heavy rains. Therefore, unless there are adequate storage or alternative methods of disposal available, the effluent will have to be spread when there already is ample moisture available to the sugarcane. Depending on the specifics, this may reduce yields.

The use of effluent by LPCo will also require some additional capital and operating costs. First the effluent has to be pumped to the fields and then mixed. This not only

requires building a system to move the effluent but maintaining the system as well. Also, operations will have to modified to handle more than one source and type of irrigation water.

The use of effluent for irrigation should not have a major impact on the profitability of LPCo as long as establishment and maintenance expenses are not incurred by LPCo, the system is designed to mix effluent with ditch water, the mixed water can be delivered to a sufficient number of fields, and appropriate measures are taken to handle short-term over-supplies of effluent.

Assessment of the Agricultural Importance of the Subject Lands

The significance of the subject lands as part of the agricultural resources of the State of Hawaii can be evaluated by examining the potential uses of the land. These uses are determined by three sets of factors: (1) the physical, agronomic and environmental characteristics of the land; (2) economic variables such as the existence and location of markets for goods that can be feasibly produced on the land, the cost of inputs required to grow the goods, and the supply of similar products from other sources; and (3) the current and future demand of agricultural producers for land having the physical, environmental, agronomic, and economic characteristics of the subject lands.

The agricultural significance of the subject lands can be examined in terms of the total amount of existing lands of similar quality on Kauai and in the State. The subject lands constitute a very small percentage of such lands. The subject lands with a rating of "Prime" constitute less than 1 percent of the "Prime" lands on Kauai (see Table 1). Further, there are over 40,000 acres on Kauai with a Land Study Bureau rating of "A" or "B." The subject lands (which have a productivity rating of "B") represent slightly more than 1.3 percent of lands on Kauai with a rating of "B or better. The acreage in question that has productive potential is also insignificant when viewed as a percentage of the lands currently being used for crop production. Currently 35,000 acres are being used for crop production on Kauai (Table 2) and thus the subject parcel represents about 1.5 percent of the lands currently cropped on Kauai. In terms of its current use, the subject lands account for about 1.6 percent of the sugarcane lands on Kauai.

Agricultural lands similar to or of better quality are not scarce, and may be found throughout the State. As of 1992, 212,000 acres in Hawaii were used for crop production (including sugarcane and pineapple). This is 113,000 acres less than were used for crop production in 1968. See Table 2. The reduction is the result of a steady decline in sugarcane acreage and pineapple acreage; about 100,000 and 37,000 acres respectively since 1968. This decline has been offset somewhat by an increased land use by other crops of approximately 20,000 acres. Since 1968, the total acreage used for crop production in Kauai County has decreased by 19,000 acres to the current level of 35,200 acres (as of 1992). The majority of the reduction in acreage in Kauai County is due to loss of sugarcane acreage, including the conversion of some lands to coffee and macadamia nut production and the setting aside of some high cost fields by LPCo.

Table 1. Inventory of Agricultural Lands: Subject Property, Kauai and State, By ALISH Classification

ALISH Classification	Subject Property	Kauai	State
		(Acres)	
Prime	540	54,916	304,310
Unique	0	388	31,320
Other	0	36,673	642,544

It is almost certain that more land will be released from plantation agriculture in the near future. The sugar industry in Hawaii is struggling and many mills are operating at less than or at barely break-even levels, remaining in operation only because long term energy contracts and land leases make it less costly to operate than to shut down. On Oahu, Oahu Sugar Company, Limited, has announced that it is closing and on the Island of Hawaii, all the plantations have either shut down or have announced that they plan to close. An idea of the impact these closings will have on land use is given in Figure 1 which incorporates the announced closings.

Even though some of the land that went out of agricultural production has been converted to urban uses, particularly on Oahu, the amount of land no longer in production exceeds the amount converted by tens of thousands of acres.

Based on the physical, agronomic, and environmental characteristics of the subject parcel previously discussed in combination with the history of crop production in Hawaii, the best agricultural use of the subject lands is for the production of sugarcane. If the land were to be released from sugarcane production, it would be capable of producing the same crops currently produced on Molokai and Oahu, at lower elevations on the Big Island and Maui, and elsewhere on Kauai. The crops produced on Oahu and Molokai are listed in Table 3 along with the current sources of supply of these products to the Honolulu market.

Table 2. Crop Production Acreage in Hawaii and on Kauai, 1961 - 1990

Year	State of Hawaii: Sugar	Pine-apple	Other Crops	All Crops	County of Kauai: Sugar	Other Crops*	All Crops
				(Thousands of Acres)			
1968	242.5	63.4	19.5	325.4	51.6	2.7	54.3
1969	242.2	62.4	19.4	324.0	52.0	2.9	54.9
1970	237.9	60.9	19.4	318.2	49.6	2.8	52.4
1971	232.1	60.9	22.9	315.9	47.2	2.3	49.5
1972	229.6	58.1	22.0	309.7	46.9	1.4	48.3
1973	226.1	57.5	25.0	308.6	46.3	0.9	47.2
1974	224.2	55.0	24.4	303.6	45.7	1.5	47.2
1975	221.4	50.0	26.7	298.1	45.7	1.6	47.3
1976	221.6	48.0	26.4	296.0	46.0	0.9	46.9
1977	220.7	45.0	27.4	293.1	45.9	1.0	46.9
1978	220.7	43.0	27.7	291.4	46.1	1.1	47.2
1979	218.8	44.0	28.0	290.8	45.8	1.4	47.2
1980	217.7	43.0	30.7	291.4	46.0	1.4	47.4
1981	216.1	41.0	33.2	290.3	45.8	1.5	46.3
1982	204.8	36.0	38.0	278.8	44.9	1.5	46.4
1983	194.3	36.0	41.2	271.5	44.1	1.5	45.6
1984	188.4	35.0	42.7	266.1	43.9	1.7	45.6
1985	187.9	34.5	42.6	265.0	43.7	1.6	45.3
1986	184.3	36.0	40.9	261.2	43.2	1.5	44.7
1987	181.1	36.1	42.5	259.7	43.0	1.6	44.6
1988	176.5	34.6	44.4	255.5	41.9	1.6	43.3
1989	170.8	32.7	41.9	245.4	40.9	1.4	42.2
1990	162.0	30.9	44.8	237.7	38.1	1.5	39.6
1991	155.6	28.4	41.4	225.4	34.0	1.6	35.6
1992	145.7	26.2	40.3	212.2	33.7	1.5	35.2
1992	145.7	26.2	40.3	212.2	33.7	1.5	35.2

*Includes pineapple production before 1973.

Source: *Statistics of Hawaiian Agriculture*, various issues.

Table 3. Honolulu Market - Size and Sources of Supply

Crop Name	Total From State	From Oahu	From Rest of State	Total Oahu Market
		(1,000 lbs)		
Avocado	636	5	631	1,137
Bananas, Apple	1025	936	89	1,025
Bananas, Cavendish	4318	153	4,165	16,685
Beans, Green	430	35	395	761
Bittermelon	86	86	0	105
Cabbage, Kai Choi	654	197	457	672
Cabbage, Pak Choy	216	214	2	552
Corn, Sweet	1520	0	1520	1,792
Cucumbers	1618	602	1016	3,596
Daikon	2381	730	1651	2,403
Dasheen	43	7	36	158
Eggplant, Long	428	272	156	475
Eggplant, Round	183	37	146	496
Ginger Root	759	2	757	891
Limes	99	7	92	630
Lotus Root	16	16	0	48
Luau Leaf	157	157	0	157
Lychee	5	1	4	5
Mango	24	24	0	44
Onions, Dry	628	0	628	15,525
Onions, Green	657	653	4	799
Oranges	1446	1	1,445	11,594
Papaya	9764	2	9,762	9,764
Peas, Chinese	0	0	0	271
Parsley	98	51	47	200
Peppers, Green	1335	5	1,330	3,381
Pomelos	3	1	2	3
Pumpkins	56	0	56	1,094
Squash, Hechima	12	12	0	12
Squash, Italian	523	2	521	1,905
Squash, Hyotan	176	153	23	193
Squash, Togan	35	28	7	73
Sweetpotatoes	1201	0	1,201	2,145
Tomatoes	3020	0	3,020	15,440
Tomatoes, others	27	3	24	1,033
Watercress	441	441	0	441
Watermelon	11114	0	11,114	15,632

Crops for local markets currently produced in Hawaii. The subject lands have one economic advantage in the production of fruits and vegetables for local markets relative to other areas on Kauai. They are proximate to the two principal shipping points on Kauai, Lihue Airport and Nawiliwili Harbor. However, this is not a major advantage given the relatively short distances from other producing regions on Kauai to the shipping points. If this area were to produce any of the crops listed in Table 3 it would be in direct competition with producers on Oahu and Molokai. Oahu producers are closer to the market and Molokai producers have more favorable water rates.

Also, the forthcoming shutdown of Oahu Sugar Company, Limited, will free up 10,500 acres of some of the best agricultural lands in the State on Oahu. Because of the location and quality of the land, this will be the logical place to produce most crops for the Honolulu market. Del Monte is already commencing crops trials on some of these lands and other farmers have announced plans to begin to use these lands.

Evaluation of Potential Export Crops. Crops produced in Hawaii can readily be separated into two groups -- those that are produced for export and those that are produced for local consumption. In terms of crops that have export potential, papaya, guavas, passion fruit, pineapple, coffee, and macadamia nuts can all be produced on lands similar to the subject lands. Of these crops, papaya may have the most potential for expansion on Kauai.

However, the potential for increased production of papaya is limited. First, existing problems with pests must be overcome. Restrictions on the use of pesticides are forcing papaya processors to use other methods to control fruitfly infestations. These methods have decreased the marketability of the fruit. The construction of the new hot air processing plant next to Lihue Airport should increase the feasibility of papaya production. The potential for increased production of papaya, however, not only depends on improvements in technology, but on the ability of Kauai to compete with other parts of the State in overseas markets and with production elsewhere in the world, primarily Mexico and the Caribbean.

There are currently over 20,000 acres of macadamia nuts planted in Hawaii. Prior to 1990, there was a period when both prices to growers and production were increasing (prices increased 30 percent and Hawaii production increased 20 percent). However production is now flat and prices are down almost 25 percent to 68 cents, a nine year low.

The feasibility of further planting of macadamia nuts is limited. Approximately 15 percent of current Hawaii acreage is non-bearing (young trees) so production can be expected to increase by another 18 percent even if there are no further new plantings. Imports of macadamia nuts into the U.S. are also increasing rapidly; 730 percent since 1983. In 1992 imports of 1,852 metric tons accounted for 20 percent of the U.S. supply. This increase in competition is the primary reason for the current price decline.

After being stagnant for a number of years, plantings of coffee in Hawaii have nearly doubled. Current prices are up due to a world-wide shortage of coffee, but this is likely to be a transient phenomena, and coffee prices can be expected to return to the $2.00 to $2.50 per pound (parchment) range. Current marketings are slightly more than 2 million pounds and this can be expected to nearly double in the next few years when the new plantings on Maui, Molokai, and Kauai reach full production.

Passion fruit is uneconomical to produce because of the high cost of installing trellises. The market for guavas is beginning to grow and plantings are increasing. However, it is premature to recommend increases in commercial plantings. Also, any increases in plantings are more likely to occur proximate to existing plantings in order to take advantage of existing processing facilities.

Lands such as the subject lands, however, are not only suitable for the production of fruits and vegetables. They could also be used for the production of floral and nursery products, the production of seed, the production of forage crops and for livestock uses.

Floral and Nursery Products. The floral and nursery industry in Hawaii has been expanding rapidly during recent years. This industry, however, produces a large volume of high-value products from a very small land area and does not require large acreages. The average size of all floral and nursery operations in the State is under three acres. For these crops, climate is typically more important in choosing a site than land quality. Current expansion of this industry is limited only by market availability and management capability, not by the availability of land. Also, some agricultural parks have made specific provisions for nurseries.

Seed Production. Lands such as the subject parcel are suitable for the production of seed for crops such as corn if adequate irrigation water is available. The demand for land for the production of seed corn and other seeds tends to fluctuate depending on climatic conditions elsewhere in the world. It is difficult to plan on a long-term demand for such a use and sufficient lands are available to meet current levels of demand.

Forage Crop Production. Large amounts of grains are imported into the State as livestock feeds. The production of feed grains has not proven to be economically viable in Hawaii. However, the production of forage crops for green chop has potential. (Green

chop refers to grass and grain crops harvested and chopped while green and moist for animal feed.) Corn for green chop has been produced on the North Shore of Oahu. The principal potential market for the green chop and other forage crops on Kauai is the dairy industry and to a lesser extent the beef industry.

The subject property is well-suited for the production of forage crops if sufficient amounts of low-cost water are available. However, for the production of forage for green chop to be an economically viable activity it must be located close to the potential users since green chop is a very bulky product and expensive to transport. Most commercial forage operations are on lands adjacent to the place where the forage will be used. The current and potential users of green chop are too distant to make forage production feasible. The small size of the beef and dairy industry on Kauai also limit the feasibility of this alternative.

Livestock. The subject lands could be used for the production of livestock. However, the production of swine and poultry would not be appropriate due to the property's proximity to urban areas. In any case, such production does not require large acreages and would not be limited if the subject lands were not available.

These lands could be used for grazing. However, grazing is a very extensive use of land and returns per acre are very low. The beef industry in Hawaii has been stagnant during the past decade and all the existing feedlots are either closing or closed. All the market calves are being shipped to the mainland and the only local beef on the market comes from cull cows and bulls.

Conclusion

It is not the availability of land that is limiting the expansion of diversified agriculture, but rather a combination of the small local market and the lack of suitable export crops. The de facto population of the entire State is only slightly more than 1.25 million persons and in the principal market area (Oahu), the de facto population is approximately 900,000 persons. This is a very small market and substantial acreage is not required to supply such a market, particularly when many popular foods either require temperate climatic conditions not found in Hawaii or can be produced more profitably elsewhere and imported for less than it costs to produce them locally.

The subject lands are productive agricultural lands. However, due to market parameters, the declining importance of the sugar industry, and the availability of similar lands elsewhere in the State, taking the subject lands out of agriculture will not have a significant impact on the agricultural sector of Kauai County or the State. Lands of equal or superior quality and economic potential are currently lying fallow and there are sufficient lands available to meet current and projected future agricultural needs.

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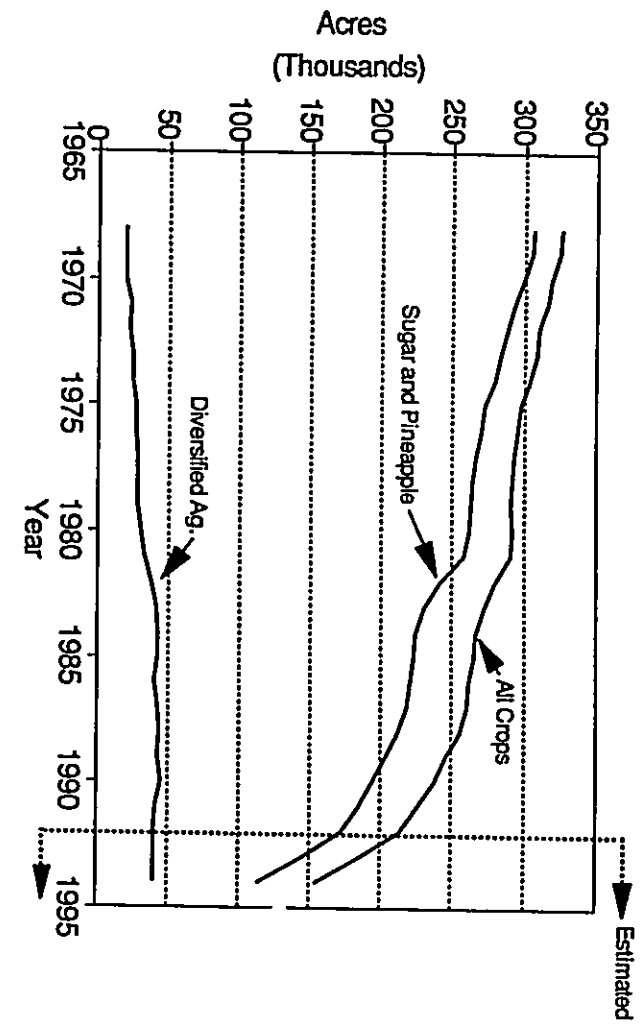
Figure 1. Agricultural Land in Hawaii
1968 to Present



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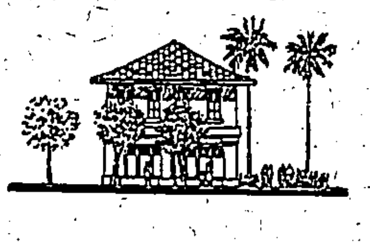
A Quantitative Assessment of the Marine Communities and Water Quality in Hanamaulu Bay, Kauai



A QUANTITATIVE ASSESSMENT OF THE MARINE COMMUNITIES AND WATER QUALITY IN HANAMAULU BAY, KAUAI

FINAL REPORT

Prepared For:

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EAC Report No. 94-09

EXECUTIVE SUMMARY

This study was undertaken to establish baseline conditions for the marine communities and water chemistry characteristics of Hanamaulu Bay, Lihue, Kauai. The Lihue-Hanamaulu Master Plan proposes to rezone 555 acres from primarily agricultural to a mix of urban, village mixed use, industrial, school, park and open space. Presently 97 percent of the 555 acres is in sugar production and has been so for many years. The gulch in which Hanamaulu Stream flows borders much of the proposed development and Hanamaulu Stream empties into Hanamaulu Bay. Identified environmental concerns include the potential impact of (1) runoff and sedimentation during construction and (2) changes in water quality due to the subsequent operation of the facilities on the marine communities of Hanamaulu Bay.

This study established preliminary baseline conditions in Hanamaulu Bay from shore to the 20m (60 foot) isobath. Hanamaulu Bay has an east-west orientation with Hanamaulu Stream entering at the head of the bay's sandy beach on the western side; the mouth of the bay faces due east and is exposed to the prevailing tradewinds and surf. Hanamaulu Bay once served as the primary shipping port for Kauai. Ahukini Landing and breakwater on the southern side of the bay, now a state park, is all that remains of this port which closed in 1950.

Water quality samples were collected at 20 locations; five samples were taken from Hanamaulu Stream and estuary to characterize these waters flowing into Hanamaulu Bay and 15 samples were taken in the bay from shore to a point approximately 500m seaward of it. The water quality data demonstrate the large influence of Hanamaulu Stream on the water quality of the bay; during normal dry weather (low stream flow conditions as measured in this June 1994 study), Hanamaulu Stream contributes more than one percent of the bay's total volume daily. As a result many parameters measured in many samples from the bay individually exceeded the state water quality "wet" standards for embayments. However, in terms of geometric means, only chlorophyll-a exceeded the state standards probably due to the washout of phytoplankton from the estuary as well as relatively poor circulation inside of the bay which allows *in situ* growth of phytoplankton to occur. The geometric mean for turbidity was very close to exceeding the state standards, indicating that much of Hanamaulu Bay is extremely turbid; again, this is probably related to sluggish circulation in the bay. Water quality outside of Hanamaulu Bay is typical of well-flushed, exposed Hawaiian coastlines.

In total, this study examined more than 52 ha (129 acres) in Hanamaulu Bay; two zones or biotopes were identified in this area. These zones are: 1) the biotope of sand which is found

from the beach on the west side and through the central part of bay as well as seaward of the project site, and, 2) the high energy biotope of rubble and hard substratum which is primarily confined to areas adjacent to the northern and southern shorelines of the bay as well as seaward of it. Ten stations were established to sample the benthic (primarily coral and algae) and fish communities in these zones.

In general the marine communities in Hanamaulu Bay are not well-developed. Coral cover is low and this is the result of the influence of Hanamaulu Stream in the inner portions of the bay as well as the occasional disturbance caused by high surf that impinges primarily on the outer portions of the bay. Corals, through their growth, may provide shelter for many invertebrate and fish species. Where this shelter is lacking or is poorly developed, these communities may not be well-developed. This appears to be the situation in much of Hanamaulu Bay.

The threatened green sea turtle is present in Hanamaulu Bay. Our short study noted at least five juvenile turtles in the bay. The rocky lower intertidal areas of the bay have well-developed algal communities which could serve as forage for these turtles. Recreational fishing is important in Hanamaulu Bay where a number of commercially and recreationally important fish species are taken. Of particular note during the summer months are the presence of schools of akule which are avidly sought by the public using both nets and hook and line methods.

An analysis of potential for impact to marine communities with the development of the Lihue-Hanamaulu Master Plan project site suggests that this would probably be greatest during the construction phase of the project when lands are uncovered. The project will be phased with development occurring over a 15 to 20 year period thus minimizing the amount of land to be exposed at any one time. Exposed soils coupled with a high rainfall event could trigger erosion and runoff to Hanamaulu Stream and on into the ocean. Once the project is completed, environmental concerns may focus on the potential impact that could occur with normal operations on the project site resulting in pollutants (inorganic nutrients, pesticides and herbicides) reaching the stream and eventually, the ocean.

Approximately 97 percent of the proposed project site has been in sugar cultivation for many years. As part of the cultivation cycle, these lands are uncovered during harvest thus subject to the same potential erosional problems. If prudent construction techniques are used (i.e., removing vegetation only as immediately needed, use of temporary settlement basins, etc.) the opportunity for negative impact to the marine communities due to sedimentation should be low during the construction phase.

Permanent retention basins are part of this proposed development and they will assist in retaining water from normal rainfall on the project site as well as regulate (throttle) the flow of stormwater from the site during heavy rainfall events.

Longterm water quality studies (e.g. for dissolved nutrients, pesticides and herbicides) carried out on the West Hawaii coast, around Lanai and other studies offshore of Kaanapali, Maui have found changes only in one location (in West Hawaii) to the groundwater chemistry related to coastal (golf course and urban) development. However, these groundwater chemistry changes only involve increases in the concentration of inorganic nutrients; pesticides and/or herbicides have not been detected in water, sediments or organisms at any of these sites. Furthermore, the changes in inorganic nutrients all fall within the range of concentrations encountered at other Hawaiian coastal localities that have no surrounding development (i.e., completely natural systems) and where increases in inorganic nutrients have been found, studies have been unable to detect any quantifiable change in the aquatic biota. Thus the data to date suggest that there is little opportunity for pollution to occur with modern coastal development such as proposed with this development.

INTRODUCTION

Purpose

The proposed development of approximately 555 acres of primarily agricultural land located at Hanamaulu, Kauai has served as the impetus for this study. Because much of this proposed project borders the gulch containing Hanamaulu Stream which drains into Hanamaulu Bay, the need for a baseline environmental assessment encompassing both the water quality and status of marine communities in the bay was identified. This baseline provides the preliminary information necessary for an understanding of the status of marine communities present in the area and addresses the possible impacts that may occur to those communities if the project is to proceed. Thus this document has been prepared to provide a quantitative description of the marine macrobiota and water quality conditions in the waters of Hanamaulu Bay as well as to assess the possible impacts that may occur with the proposed development.

Strategy

Marine environmental surveys are usually performed to evaluate feasibility of and ecosystem response to specific proposed activities. Appropriate survey methodologies reflect the nature of the proposed action(s). An acute potential impact (such as channel dredging that may be undertaken on other projects) demands a survey designed to determine the route of least harm and the projected rate and degree of ecosystem recovery. Impacts that are more chronic or progressive require different strategies for measurement. Management of chronic stress to a marine ecosystem demands identification of system perturbations which exceed boundaries of natural fluctuations. Thus a thorough understanding of normal ecosystem variability is required in order to separate the impact signal from background "noise".

The potential impacts confronting the marine ecosystem in Hanamaulu Bay are most probably those associated with chronic or progressive stresses. Impacts due to human activities (e.g., accelerated erosion and resultant sedimentation) have probably been ongoing for many years with Hanamaulu Stream discharge being the primary conduit for this input. Fully 539 of the 555 acres (or 97%) proposed for this development are presently in sugar cane and have been so for many years. The bay was important as Kauai's first major port for the island which operated from the early 1920's up until 1950 when Nauwiliwili Harbor became operational (Clark 1990). The construction of Ahukini Pier, a 100m long breakwater and the dredging of a turning basin at the mouth

of Hanamaulu Bay all continue to impede the exchange and flushing of the bay's waters with the open ocean (AECOS 1982). Additionally, an old landfill occupies much of the shoreline area just south of the bay. Thus human impacts have been ongoing in the area for some time.

Monitoring strategies for assessing chronic stresses rely on comparative spatial and temporal evaluations of ecosystem structure and function in relation to ambient conditions. Usually in order to reliably detect system perturbations, detailed quantitative descriptions of the pre-development environment are necessary as a "benchmark" against which later studies may be comparatively analyzed. The strategy is to establish a number of permanent stations from which quantitative "baseline" studies are made. These permanent stations can be resampled to allow quantitative delineation of change if necessary. If changes are noted, appropriate mitigative actions would be undertaken. This document reports on the first field effort, thus establishing the primary "benchmark" for the marine communities and water quality characteristics under "dry" or low rainfall conditions in Hanamaulu Bay.

In most Hawaiian nearshore marine communities, ambient water quality conditions are largely determined by inputs from land. In geologically young settings (such as the Kona coast) these inputs are primarily via groundwater seepage to the sea; on the older islands, streams are often the primary input. In the case of Hanamaulu Bay, the flow of freshwater from Hanamaulu Stream appears to be the largest source of freshwater to the bay (see below). Stream flow is heavily influenced by rainfall thus rainfall may have a large influence on the resulting water quality of the bay's receiving waters. Thus, the sampling strategy employed in this study is to sample during a relatively "dry" period and again following a period of relatively high rainfall. The data will thus represent the two extremes or envelope of water quality conditions in Hanamaulu Bay. The first sample period (June 1994) represents a relatively dry or low stream flow situation; since that time (through December 1994), a high rainfall event has not occurred. Following such an event, a second water quality sampling regime will be undertaken.

MATERIALS AND METHODS

A. BENTHIC STUDIES

The fieldwork which provided the database for this baseline study of the marine macrobiota of Hanamaulu Bay and environs was carried out on 13-14 June 1994. The area encompassed in this

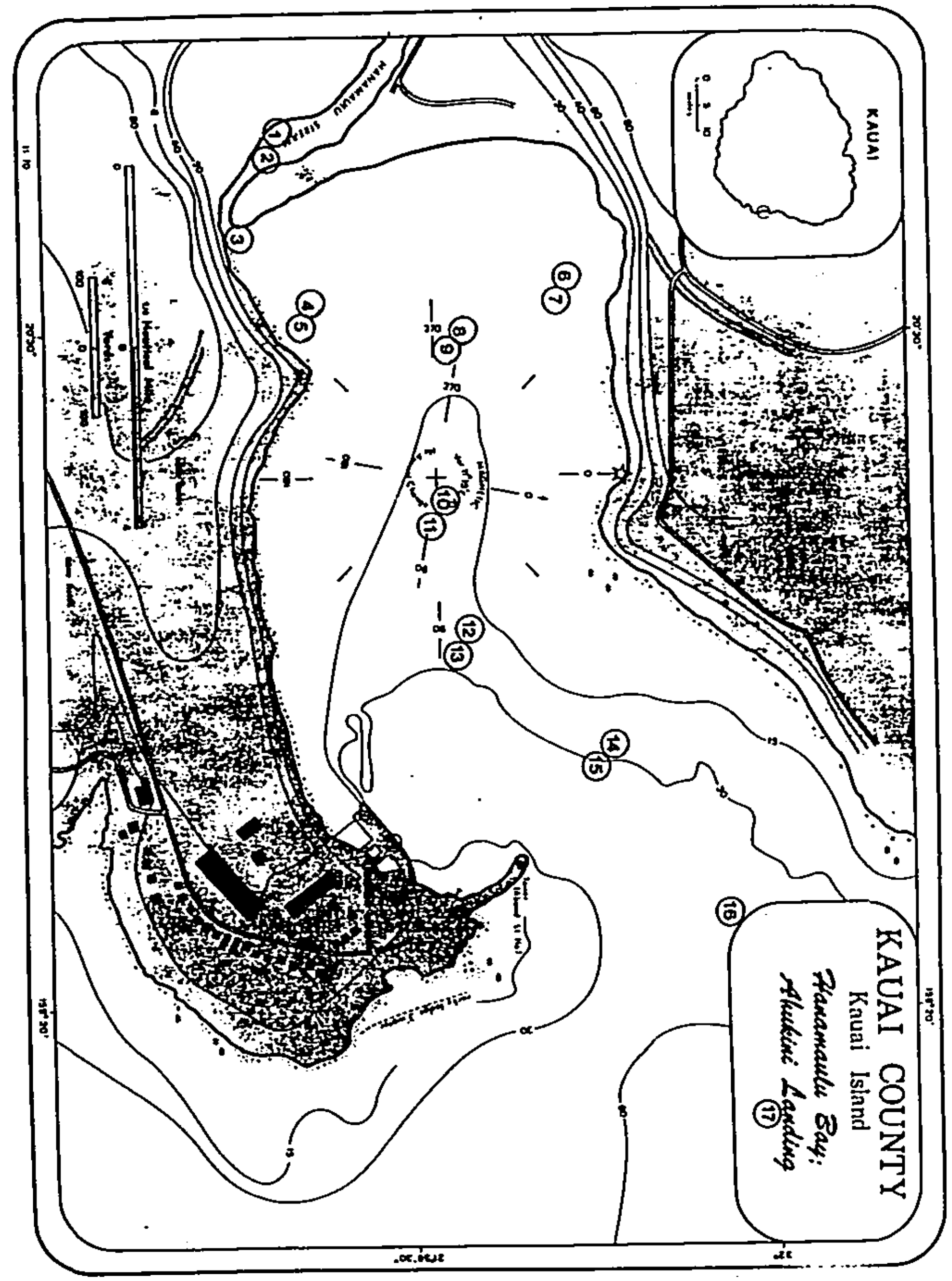

FIGURE 1. Hanamaulu Bay, Kauai and vicinity showing the approximate locations of the marine water quality sampling stations. Station numbers 1, 3, 4, 6, 8, 10, 12, 14, 16 and 17 all sample surface waters; stations 2, 5, 9, 11, 13 and 15 sample waters just above the bottom beneath the surface stations. Stations 18, 19 and 20 sampled the stream at approximately 480m, 1.2km and 3.2km inland of the stream mouth respectively (off the map).

survey is given in Figure 1; it includes the nearshore region from the shore, seaward to approximately the 20m (60 foot) isobath fronting the bay (about 1.4km seaward from the head of the bay).

The methods used in carrying out this study follow those prescribed the West Hawaii Coastal Monitoring Protocol (1992) and are described below.

The quantitative sampling of macrofauna of marine communities presents a number of problems; many of these are related to the scale on which one wishes to quantitatively enumerate organism abundance. Marine communities in Hanamaulu Bay may be spatially defined in a range on the order of a few hundred square centimeters (such as the community residing in a Pocillopora meandrina coral head) to major biotopes covering many hectares. Recognizing this ecological characteristic, we designed a sampling program that attempted to delineate major extant communities in the limits of the study area and to quantitatively describe these communities. Thus, a number of methods were used.

To obtain an overall perspective on the extent of the major communities or "zones" occurring in the study area, divers swam or conducted "bounce dives" through much of the bay from shore seaward to the 20m isobath (the outer limits for this study). Areas of high surf (particularly along the northern outer portions of the bay) were not examined. This exercise allowed the qualitative delineation of major biotopes based partially on the presence of large structural elements (e.g., amount of sand, hard substratum, fish abundance, coral coverage or dominant coral species). Sites for each station were selected and quantitative studies were conducted, including visual enumeration of fish, counts along benthic transect lines and cover estimates in benthic quadrats. Besides these quantitative measures, a qualitative reconnaissance was made in the vicinity of each station by swimming and noting the presence of species not encountered in the transects. All assessments were carried out using SCUBA.

The location of stations were subjectively chosen as being representative of a given biotope and in some cases coincided with water quality sampling points. Immediately following site selection, a visual fish census was undertaken to estimate the abundance of fishes. These censuses were conducted over a 25 x 4m corridor and all fishes within this area to the water's surface were counted. Data collected included species, numbers of individuals and an estimate of the length of each fish; the length data were later converted to standing crop estimates using linear regression techniques (Ricker 1975). Species specific regression coefficients have been developed over the last thirty years by the author and others at the University of Hawaii, Naval

Undersea Center (see Evans 1974) and the Hawaii State Division of Aquatic Resources through capturing, weighing and measuring fishes; for many species, sample sizes are in excess of a hundred individuals. A single diver equipped with SCUBA, transect line, slate and pencil would enter the water, count and note all fishes in the prescribed area (method modified from Brock 1954). The 25m transect line was paid out as the census progressed, thereby avoiding any previous underwater activity in the area which could frighten wary fishes.

Fish abundance and diversity is often related to small-scale topographical relief over short linear distances. A long transect may bisect a number of topographical features (e.g., cross coral mounds, sand flats, and algal beds), thus sampling more than one community and obscuring distinctive features of individual communities. To alleviate this problem, a short transect (25m in length) has proven adequate in sampling many Hawaiian benthic communities (Brock and Norris 1989).

Besides frightening wary fishes, other problems with the visual census technique include the underestimation of cryptic species such as moray eels (family Muraenidae) and nocturnal species, e.g., squirrelfishes (family Holocentridae), aweoweos or bigeyes (family Priacanthidae), etc. This problem is compounded in areas of high relief and coral coverage affording numerous shelter sites. Species lists and abundance estimates are more accurate for areas of low relief, although some fishes with cryptic habits or protective coloration (e.g., the nohus, family Scorpaenidae; the flatfishes, family Bothidae) might still be misssed. Obviously, the effectiveness of the visual census technique is reduced in turbid water and species of fishes which move quickly and/or are very numerous may be difficult to count and to estimate sizes. Additionally, bias related to the experience of the diver conducting counts should be considered in making any comparisons between surveys. In spite of these drawbacks, the visual census technique probably provides the most accurate non-destructive method available for the assessment of diurnally active fishes (Brock 1982).

After the assessment of fishes, an enumeration of epibenthic invertebrates (excluding corals) was undertaken using the same transect line as established for fishes. Exposed invertebrates usually greater than 2cm in some dimension (without disturbing the substratum) were censused in a 4 x 25m area. As with the fish census technique, this sampling methodology is quantitative for only a few invertebrate groups, e.g., some of the echinoderms and holothurians. Most coral reef invertebrates (other than corals) are cryptic or nocturnal in their habits making accurate assessment of them in areas of topographical complexity very difficult. This, coupled with the fact that the majority of these cryptic invertebrates are small, necessitates the use of methodologies that are beyond the scope of this survey (e.g., see Brock and Brock 1977). Recognizing constraints on time and the scope of this survey, the invertebrate censusing technique used here attempted only to assess those few macroinvertebrate species that are diurnally exposed.

Exposed sessile benthic forms such as corals and macrothalloid algae were quantitatively surveyed by use of quadrats and the point-intersect method. The point-intersect technique only notes the species of organism or substratum type directly under a point. Along the previously set fish transect line, 50 such points were assessed (once every 50cm). These data have been converted to percentages. Quadrat sampling consisted of recording benthic organisms, algae and substratum type present as a percent cover in six one-meter square frames placed at five-meter intervals along the transect line established for fish censusing (at 0, 5, 10, 15, 20 and 25m).

If macrothalloid algae were encountered in the 1 x 1m quadrats or under one of the 50 points, they were quantitatively recorded as percent cover. Emphasis was placed on those species that are visually dominant and no attempt was made to quantitatively assess the multitude of microalgal species that constitute the "algal turf" so characteristic of many coral reef habitats.

During the course of the fieldwork, notes were taken on the number, size and location of green sea turtles and other threatened or endangered species seen within or near to the study area. Additionally, casual observations were made on recreational use patterns as observed within the study area while carrying out other field studies. Further information on threatened or endangered species was obtained by questioning users familar with the area.

B. WATER CHEMISTRY STUDIES

Water quality parameters were measured at 20 locations (Station numbers 1 through 20). Sample numbers 1, 2, 18, 19 and 20 were taken from Hanamaulu Stream; the remainder were marine. Stations 1 and 2 were taken about 100m inland of the stream mouth (in the estuary) with station 1 being a surface sample and station 2 being a bottom sample (30cm above the bottom), station 18 a surface sample at a point about 480m inland from the stream mouth (at the old railroad bridge), station 19 a surface sample about 1,280m inland near the innermost reach of the estuary and station 20, again a surface sample at the bridge where Kuhio Highway crosses Hanamaulu Stream (about 3.2km inland of the stream mouth).

The remaining sample sites were marine. Sample numbers 3, 4, 6, 8, 10, 12, 14, 16 and 17 were taken at the surface (about 20cm below the air-water interface); the other samples were all collected at depth, approximately 1m above the bottom. The location of the marine stations is presented in Figure 1. Water quality parameters that were evaluated for all samples are specific criteria designated for "Class A waters for embayments" in Title 11, Chapter 54, Amended Administrative Rules for Water Quality Standards (1992). These criteria include ammonia nitrogen, nitrate + nitrite nitrogen, total nitrogen, orthophosphate phosphorus, total phosphorus, chlorophyll-a and nephelometric turbidity. Also collected were samples for the non-specific criteria including oxygen, temperature, pH and salinity as well as the nutrient, silica at each station.

Water samples were collected by opening one-liter polyethylene bottles at the desired depth. These bottles were all triple rinsed using the sample water prior to sample collection. Subsamples for nutrient analyses were filtered through glass fiber filters and immediately placed in 125ml acid-washed, triple rinsed polyethylene bottles and stored on ice until returned to Honolulu for later analysis. Analyses for ammonia nitrogen, orthophosphate and nitrate are performed using a Technicon autoanalyzer following standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). Total nitrogen and total phosphorus are similarly analyzed following digestion.

Turbidity samples are collected as unfiltered water and stored on ice in 125ml polyethylene bottles until measurements are made. Turbidity is measured on a Monitek Model 21 nephalometer following procedures as described in Standard Methods (1985). Chlorophyll-a samples are collected by filtering known volumes of sample water through glass microfiber filters; filters are stored frozen in dark containers until analyses. Pigments are extracted in 90 percent acetone in the dark for 12 to 24 hours and fluorscence before and after acidification is measured on a Turner Designs fluorometer. Salinity samples are collected in triple-rinsed 125ml polyethylene bottles and are analyzed on a AGE Model 2100 laboratory salinometer with precision of 0.0001%. In-situ field measurements of temperature, oxygen and pH are made using a YSI Model 58 oxygen meter and a Hanna Instruments pH/mV pH meter (model no. HI 9025).

All methods used in the water quality sampling program comply to and follow those as outlined by the West Hawaii Coastal Monitoring Task Force (1992) recommendations for water quality studies.

RESULTS

WATER CHEMISTRY

Water quality parameters as specified by the State Department of Health (DOH) Water Quality Standards were collected and measured at the surface (about 20cm below the water surface) and/or at depth (about 1m above the bottom) at 20 locations; four of the twenty samples were collected from Hanamaulu Stream and the remaining sixteen from marine sites in and just seaward of Hanamaulu Bay. Marine surface samples include numbers 3, 4, 6, 8, 10, 12, 14, 16 and 17; the station locations are given in Figure 1.

The waters of Hanamaulu Bay are classified as an embayment (Class A) by the state (Chapter 11-54) and the standards are given in Table 1 for comparative purposes.

Table 2 presents a synopsis of the water chemistry parameters measured in this study. There are several trends apparent in these data: (1) the concentrations of some dissolved nutrients (particularly nitrate nitrogen and silicate in surface samples) decrease with distance from shore, (2) salinity shows a strong inverse relationship, increasing with both distance from shore and is greater in bottom samples relative to surface samples from a particular location and (3) the geometric mean for chlorophyll-a exceeds the the state water quality standards for "wet" criteria. The high geometric mean for chlorophyll-a is related to the washout of phytoplankton from the estuary, the response of *in situ* phytoplankton to nutrient input all probably coupled with relatively poor circulation in the inner reaches of the bay.

"Wet" criteria apply when the average fresh water inflow from the land equals or exceeds one percent of the embayment volume per day. In the case of Hanamaulu Bay, we made a rough calculation utilizing just the freshwater flow from Hanamaulu Stream (neglecting the contribution from diffuse groundwater input which, in any case, we did not detect in our studies in the bay) to determine if wet or dry criteria applied. At the point of entry to the bay on 13 June 1994, Hanamaulu Stream had a crossectional area of about 3m in width, 30cm deep with an estimated flow rate of 0.25 m/sec which amounts to 19,440 m^3 of freshwater from the stream entering the bay daily. If we assume that Hanamaulu Bay has a mean depth of about 3m, the approximate volume of the bay is 1.8 million m^3. Utilizing just the stream, the freshwater delivery to the bay is about 1.07 percent of the bay's volume on a 24 hour basis, thus wet criteria apply.

Water quality data from 13-14 June 1994 represents data from

TABLE 1. Specific criteria specified by the Department of Health water quality standards for embayments with Class A waters as amended in 1992. Standards converted from ug/l to uM.

Parameter	Geometric mean not to exceed the given value	Not to exceed the given value more than 10% of the time	Not to exceed the given value
Total Nitrogen (uM)	14.29* 10.71**	25.00* 17.86**	35.71* 25.00**
Ammonia Nitrogen (uM)	0.43* 0.25**	0.93* 0.61**	1.43* 1.07**
Nitrate+Nitrite Nitrogen (uM)	0.57* 0.36**	1.43* 1.00**	2.50* 1.79**
Total Phosphorus (uM)	0.81* 0.65**	1.61* 1.29**	2.42* 1.94**
Chlorophyll-a (ug/L)	1.50* 0.50**	4.50* 1.50**	8.50* 3.00**
Turbidity (NTU)	1.50* 0.40**	3.00* 1.00**	5.00* 1.50**

1. * "Wet" criteria apply when the average fresh water inflow from the land equals or exceeds one percent of the embayment volume per day.
2. ** "Dry" criteria apply when the average fresh water inflow from the land is less than one percent of the embayment volume per day.
3. Applicable to both "wet" and "dry" conditions:
4. pH Units - shall not deviate more than 0.5 units from a value of 8.1, except at coastal locations where and when freshwater from stream, stormdrain or groundwater discharge may depress the pH to a minimum level of 7.0.
5. Dissolved Oxygen - Not less than 75% saturation, determined as a function of ambient water temperature and salinity.
6. Temperature - Shall not vary more than 10% from natural or seasonal changes considering hydrologic input and oceanographic factors.
7. Orthophosphate was eliminated from the list of requirements in the revised 1988 document but becasue of its biological importance, it was measured in this study.

TABLE 2. Summary of the water quality parameters as measured at 20 sites in the study. In the body of the table concentrations of dissolved nutrients given in uM. Stream samples are given separately from the marine samples. For the marine samples geometric means are given at the foot of the table for each parameter measured; single underlined values are at or exceed "wet" Department of Health water quality standards for embayments.

Station	Nitrate N	Ammonia N	Total N	Ortho P	Total P	Silicate	DON	DOP
STREAM SAMPLES								
1	28.62	0.59	33.80	0.28	0.61	273.56	5.18	0.33
2	28.62	0.59	33.51	0.25	0.64	275.72	4.89	0.39
18	140.63	1.32	167.19	7.65	8.64	517.31	26.56	0.99
19	45.84	0.29	58.18	0.50	0.83	271.40	12.34	0.33
20	15.50	0.22	19.01	0.08	0.38	256.30	3.51	0.30
MARINE SAMPLES								
3	25.50	0.88	31.19	0.25	0.38	254.15	5.69	0.13
4	12.55	0.74	18.28	0.08	0.11	132.96	5.73	0.03
5	0.57	0.43	6.82	0.10	0.19	26.08	6.25	0.09
6	9.59	0.44	15.09	0.05	0.08	135.90	5.50	0.03
7	0.41	0.48	5.66	0.05	0.11	23.14	5.25	0.06
8	3.77	0.15	10.59	0.07	0.12	100.60	6.82	0.05
9	0.08	0.17	4.93	0.05	0.15	16.08	4.85	0.10
10	1.15	0.14	8.85	0.03	0.11	83.93	7.70	0.08
11	0.16	0.29	4.93	0.03	0.19	11.96	4.77	0.16
12	0.04	0.31	6.09	0.03	0.11	49.03	6.05	0.08
13	0.03	0.29	4.21	0.05	0.15	6.86	4.18	0.10
14	0.03	0.13	4.64	0.03	0.11	14.90	4.61	0.08
15	0.06	0.14	4.35	0.08	0.19	2.94	4.29	0.11
16	0.04	0.29	4.79	0.10	0.18	3.14	4.75	0.08
17	0.04	0.12	4.64	0.05	0.19	2.35	4.60	0.14
GEOMETRIC MEAN	0.35	0.27	7.29	0.06	0.15	23.95	5.32	0.08

TABLE 2. Continued.

Station	Turbidity (NTU)	Chlorophyll a (ug/l)	Salinity (°/oo)	Temp (°C)	Oxygen (% Sat)	pH
STREAM SAMPLES						
1	4.43	0.144	0.105	24.5	103	7.02
2	4.22	0.272	0.106	24.4	103	7.08
18	4.02	0.256	0.123	24.1	101	6.98
19	12.22	0.256	0.098	23.8	100	7.26
20	2.64	0.143	0.097	23.8	101	7.23
MARINE SAMPLES						
3	4.14	1.177	3.823	24.5	102	7.43
4	4.52	6.134	17.838	25.0	104	8.11
5	4.11	5.033	31.684	25.7	105	8.11
6	5.33	9.413	17.029	25.8	104	8.14
7	1.73	3.069	32.010	25.8	106	8.13
8	3.04	10.436	20.775	26.7	106	8.24
9	1.54	3.223	33.052	26.1	105	8.13
10	2.83	8.287	22.787	26.6	106	8.36
11	1.60	1.823	33.562	25.8	103	8.18
12	2.12	7.060	27.430	26.8	104	8.31
13	0.41	1.248	34.272	25.9	103	8.19
14	0.73	2.084	32.838	26.0	104	8.22
15	0.14	0.216	35.058	25.2	103	8.05
16	0.25	0.304	34.756	26.0	102	8.18
17	0.16	0.160	34.984	25.6	104	8.19
GEOMETRIC MEAN	1.49	2.391	24.776	25.8	104	8.13

a relatively dry period. Rainfall records from Lihue Airport over the last five years show that rainfall for the May-June period has varied from 706mm in 1990 to 1,412mm in 1991. Recorded rainfall in the May-June 1994 period was 1,140mm.

Both silica and nitrate+nitrite nitrogen usually exist in higher concentration in groundwater and some stream waters owing to metabolism, organic material and mineral dissolution; these ions are in low concentration in open ocean waters and hence they (along with salinity) may serve as tracers of freshwater input into oceanic settings.

Hanamaulu Stream has an obvious influence on the water chemistry of the bay; besides the parameters noted above, turbidity is high and terrigeneous material carried in by the stream as well as resuspension by wave activity are probably responsible. During the June fieldwork, the bay appeared very turbid and inner bay stations that sampled biological communities had poor visibility, being often less than 1m. Water clarity improved towards the mouth of the bay and this is reflected in the turbidity measurements (Table 2). Outside of the bay at biological station 10, horizontal visibility below the upper 5m of the water column was in excess of 50m. The considerable wave activity impinging on the outer portions of the bay and the outer exposed coastline foster water exchange resulting in the water quality data of these stations being typical of well flushed, exposed Hawaiian coastlines.

BIOLOGICAL

The qualitative reconnaissance to define major biotopes in Hanamaulu Bay extended from the shoreline to approximately the 20m isobath more than 1.4km from the shoreline at the head of the bay. In total, about 52ha (129 acres) were surveyed in this area and two major biotopes or "zones" were recognized. The physical extent of each is shown in Figure 2. It should be noted that the boundaries of each zone are not sharp but rather grade from one to another; these are ecotones or zones of transition. Biotopes were delimited by physical characteristics including water depth, relative exposure to wave and current action, and the major structural components present in the benthic communities. The latter include the amount of sand, hard substratum, and vertical relief present as well as the biological attributes of relative coral coverage, fish abundance, and dominant species of the coral community. Biotopes were named for distinctive features of each as shown in Figure 2.

The biotope of sand (designated as "A" in Figure 2) dominates the inner portion of Hanamaulu Bay and continues offshore

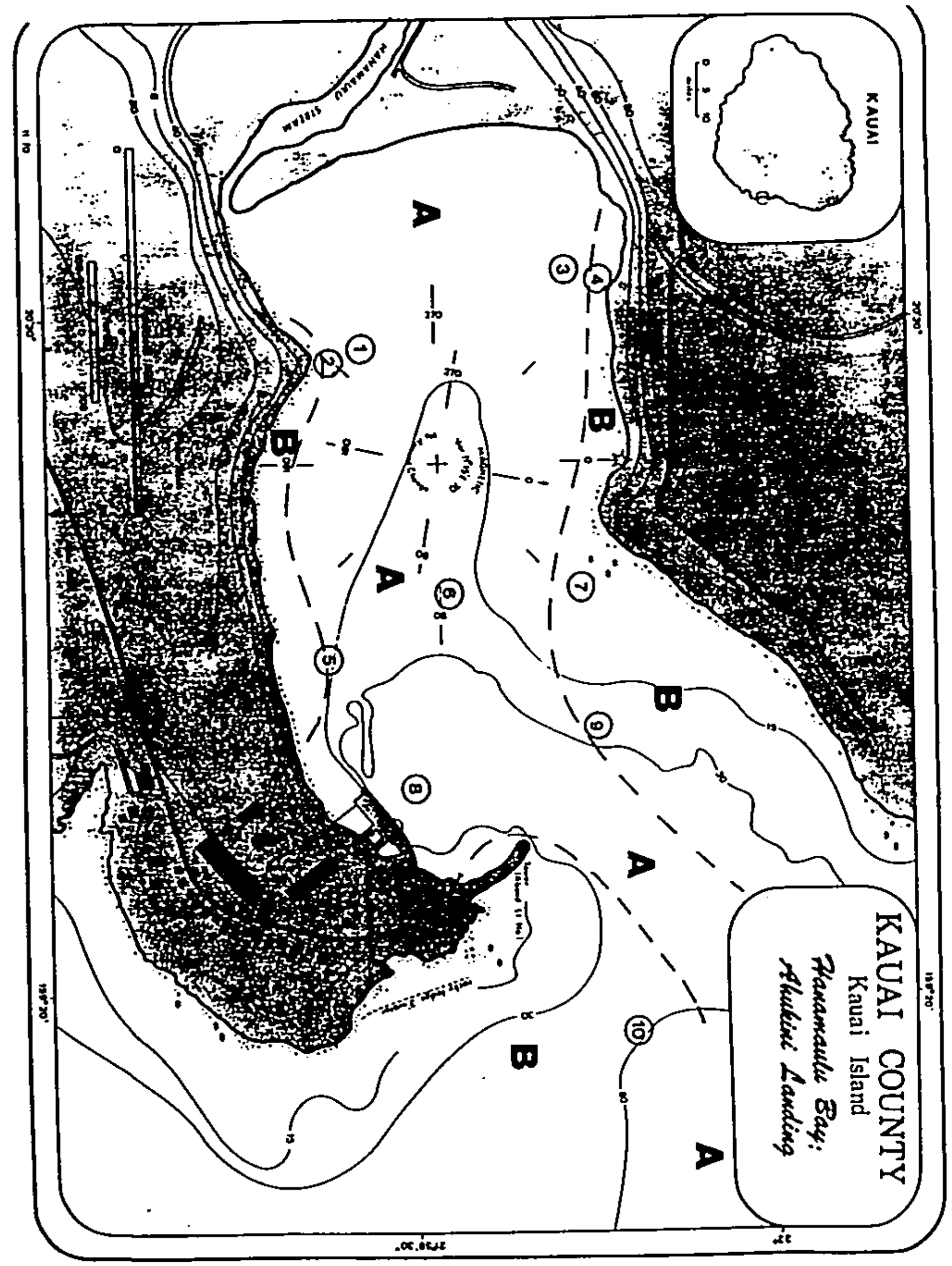

FIGURE 2. Map of Hanamaulu Bay, Kauai showing the approximate boundaries of the two biotopes recognized in this study (dashed lines) where A = the biotope of sand and B = the high energy biotope of hard and rubble substratum. Also shown are the approximate locations of the ten stations (numbered) established to sample the marine communities of the bay.

through the central part of the bay. The head of Hanamaulu Bay has a well developed beach where the biotope of sand reaches the shore; in the bay this biotope forms a pie-shaped wedge that continues through the central part of the bay in an offshore direction. Outside of the bay sand is again encountered as a dominant feature at depths below 20m (outside of the scope of this study). In general because of the lack of appropriate shelter and solid substratum, benthic and fish communities are poorly developed in this biotope; the influence of freshwater due to Hanamaulu Stream also curtails benthic community development on the sand substratum of the inner parts of the bay. Three stations (numbers 1, 3 and 8) were established to sample the sand biotope of Hanamaulu Bay. Station 6 was established to sample the ecotone between the biotope of sand and the biotope of high energy hard and rubble substratum (designated as "B" in Figure 2).

The Biotope of Sand

The biotope of sand (designated as "A" in Figure 2) is the dominant biotope in the inner part of Hanamaulu Bay. This biotope dominates the central part of Hanamaulu Bay and terminates in a broad sandy beach at the head of the bay. As the name implies, the substratum in the biotope of sand is dominated by sand. Because of its shifting nature, the benthic species found in sand habitats are generally adapted for life on an unstable and frequently abrading environment. Many species that are found in this habitat will bury into the sand to avoid predators and the abrasion that occurs with storm waves. Thus many species in the sand biotope are cryptic and difficult to see; among those are many molluscs and crustaceans such as the Kona crab (Rania serrata). Hence, without considerable time spent searching in the biotope of sand, many species in this habitat will not be seen. The biota of the biotope of sand is best developed at greater depths; where the biotope occurs in shallow water in the inner parts of the bay, many of the characteristic species become less abundant probably as a result of the considerable input of freshwater from Hanamaulu Stream.

Benthic communities on sand substrates usually have their greatest development at depths below which wave impact occurs (below 20m). Because of constraints with bottom time at these depths as well as the fact that these communities are seaward of the area encompassed by this study, only a short qualitative survey was done. Species commonly seen in the deeper regions of the biotope of sand include a number of molluscs: the helmet shell (Cassis cornuta), augers (Terebra crenulata, T. maculata and T. inconstans), the leopard cone (Conus leopardus) and flea cone (Conus pulicarius) as well as the sea hare (Brissus sp.), starfish (Mithrodia bradleyi), brown sea cucumber (Bohadschia vitiensis), the Kona crab (Rania serrata), opelu or mackeral scad (Decapterus macarellus), nabeta (Hemipteronotus umbrilatus), the goby-like fish (Parapercis schauslandi), uku or snapper (Aprion virescens), hihimanu or sting ray (Dasyatis hawaiiensis), goby (Gnathelepis anjerensis) and the weke or white goatfish (Mulloides flavolineatus). Undoubtedly with greater searching, many more species would be encountered in this biotope. Most of these species become less evident in the shallower portions of this biotope and this is reflected in the quantitative data collected at the three shallow water stations sampling this biotope in the bay.

Station 1 was established approximately 220m seaward of the sand beach and the stream mouth at a depth of 5m. Visibility at this station was about 30cm due to considerable terrigeneous material and phytoplankton in the water column. The substratum at this station is a muddy sand. The results of the quantitative survey carried out at station 1 are given in Table 3. The only macroinvertebrate encountered in the survey was a single auger shell (Terebra inconstans) and the fish census noted a single "nightmare weke" or goatfish (Upeneus arge) resulting in an estimated standing crop of 1 g/m^2. Also present at this station were a number of small burrows probably caused by small crustaceans or polychaetes having a mean density of 1 hole/$3m^2$ of sampled substratum.

Station 3 was established about 180m offshore of the sand beach on the north side of the bay (opposite station 1, see Figure 2). The water depth at this station was 2.4m and the substratum was again muddy sand. Water clarity was approximately 1.5m at this station. The results of the quantitative survey carried out at this station are given in Table 4. The only organisms encountered in the quantitative survey at station 3 was a single juvenile white or haole crab (Portunus sanguinolentus) and a single 'ulae or lizard fish (Saurida gracilis) which resulted in an estimated standing crop of 0.3 g/m^2.

The final station sampling the biotope of sand was established about 50m offshore of the old Ahukini Pier situated along the southern side of the bay. According to available maps, this area was dredged probably when the pier was constructed in the 1920's and the substratum is sand with a depth of 8.8m. The results of the quantitative survey are given in Table 5. The quadrat survey noted only sand present and the macroinvertebrate census found a single oak cone (Conus quercinus, three distantly lined cones (Conus distans), a single auger (Terebra inconstans) a juvenile haole crab (Portunus sanguinolentus) and a large mantis shrimp (Lysiosquilla maculata). Again, the fish census noted only a single small flatfish or paki'i (Bothus mancus)

TABLE 3. Summary of the benthic survey conducted at Station 1 approximately 220m from the shoreline at Hanamaulu Bay Beach Park in the biotope of sand on 13 June 1994. Results of the $6m^2$ quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 5m; mean coral coverage is zero (quadrat method).

A. Quadrat Survey

	Quadrat Number					
Species	0m	5m	10m	15m	20m	25m
Sand	100	100	100	100	100	100

B. 50-Point Analysis

Species	Percent of the Total
Sand	100

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Mollusca	
Terebra inconstans	1
Unidentified burrows (1cm diameter)	$1/3m^2$

D. Fish Census (4 x 25m)

1 Species
1 Individual
Estimated Biomass = 1 g/m^2

TABLE 4. Summary of the benthic survey conducted at Station 3 approximately 180m from the shoreline at Hanamaulu Bay Beach Park in the biotope of sand on 13 June 1994. Results of the $6m^2$ quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 2.4m; mean coral coverage is zero (quadrat method).

A. Quadrat Survey

	Quadrat Number					
Species	0m	5m	10m	15m	20m	25m
Sand	100	100	100	100	100	100

B. 50-Point Analysis

Species	Percent of the Total
Sand	100

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Arthropoda	
Portunus sanguinolentus	1

D. Fish Census (4 x 25m)

1 Species
1 Individual
Estimated Biomass = 0.3 g/m^2

TABLE 5. Summary of the benthic survey conducted at Station 8 approximately 50m offshore of the old Ahukini Pier in Hanamaulu Bay in the biotope of sand on 13 June 1994. Results of the $6m^2$ quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 8.8m; mean coral coverage is zero (quadrat method).

A. Quadrat Survey

Species	Quadrat Number 0m	5m	10m	15m	20m	25m
Sand	100	100	100	100	100	100

B. 50-Point Analysis

Species	Percent of the Total
Sand	100

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Mollusca	
Conus quercinus	1
C. distans	3
Terebra inconstans	1
Phylum Arthropoda	
Portunus sanguinolentus	1
Lysiosquilla maculata	1

D. Fish Census (4 x 25m)

1 Species
1 Individual
Estimated Biomass = 0.4 g/m^2

resulting in a biomass estimate of 0.4 g/m^2.

In the qualitative overview of the biotope of sand, a number of species were seen that were not encountered at the quantitative stations. Among these were several fish species including the big-eye scad or akule (_Selar crumenophthalmus_), baitfishes (both nehu or _Stolephorus purpureus_ and the i'ao (_Praneus insularum_), mullet or ama'ama (_Mugil cephalus_), uouoa (_Neomyxus chaptalii_), yellowstripe goatfish or weke (_Mulloides flavolineatus_) and the flagtail or aholehole (_Kuhlia sandvicensis_). These fishes are all schooling species; not seen but expected in this biotope are the bonefish or o'io (_Albula vulpes_) and small jacks or papio (several species of the family Carangidae). Among the macroinvertebrates found outside of the quantitative sample sites include the flea cone (_Conus pulicarius_) and the leopard cone (_Conus leopardus_).

The High Energy Biotope of Rubble and Hard Substratum

Hanamaulu Bay has an east-west orientation with the head of the bay making up the western shore and the mouth of the bay opening to the east. The shoreline along the northern and southern sides is primarily basalt forming a bench or boulder beach. Subtidally this rock substrate is covered with limestone and/or coral rubble and is the most important feature of the high energy biotope of rubble and hard substratum (designated as "B" in Figure 2). This hard substratum occurs subtidally as a narrow band in the inner reaches of the bay but becomes a much more dominant feature in the outer part of the bay (see Figure 2). Near the mouth of the bay close to the northern shore, the limestone substratum shoals such that surf will break across much of the area. The easterly tradewinds which dominate Hawaiian weather patterns will insure that some surf is present across much of Hanamaulu Bay and the outer exposed coastline most of the time. Thus the marine communities on hard substratum in these areas are frequently exposed to wave impact. Six stations (numbers 2, 4, 5, 7, 9, and 10) sampled the marine communities situated in the high energy biotope of rubble and hard substratum in and seaward of Hanamaulu Bay. One station (number 6) sampled the ecotone or zone of transition between the biotope of sand and the high energy biotope of rubble and hard substratum.

Station 2 was established about 25m from the southern rocky shoreline in Hanamaulu Bay at a depth of 3m. The substratum at this location is a mix of basalt rock (waterworn stones probably from the stream) and coral rubble. Larger basalt rocks (from 0.75 to 1.5m in diameter) provide some local topographical relief (shelter) for small fishes. These larger rocks are most common on approaching the rocky shoreline. Considerable fine silt was apparent over much of the substratum at this station and the horizontal visibility was about 2m at the time of sampling. Table 6 presents the results of the quantitative survey carried out at station 2. The quadrat survey noted 9 macrothalloid algal species having a mean coverage of 0.7 percent and the stinging hydrozoan, *Halocordyle disticha*. Rubble was the dominate substratum at this station comprising a mean coverage of 69 percent. The macroinvertebrate census noted three species including the cone shell (*Conus lividus*), the brown mantis shrimp (*Gonodactylus falcatus*) and the small swimming crab (*Thalamita ademete*). Fishes censused at this station are given in Appendix A. Five species of fishes (20 individuals) were encountered and the most common was a number of juveniles of the introduced snapper or toau (*Lutjanus fulvus*). The standing crop of fish was estimated to be 2 g/m^2. After considerable searching in the vicinity of this station, several coral colonies were found; one small colony of *Porites lobata* (about 1cm in diameter) was seen as were several colonies of *pocillopora meandrina* (maximum colony diameter not greater than 12cm). The paucity of coral at this station is probably related to the proximity of Hanamaulu Stream mouth and periodic inundation of the substratum with freshwater following storm events.

Across the bay (to the north) station 4 was established. The substratum at this station is primarily rubble covered with a thin layer of silt. Horizontal visibility at this station was about 2.5m and the water depth about 2.6m. The results of the quantitative survey of station 4 are presented in Table 7. Again the benthic community at this station is dominated by macrothalloid algae and the quadrat survey noted 9 species having a mean coverage of 2.4 percent. In terms of coverage, the most common algal species is limu alani (*Dictyota bartayresii*). The soft coral, *Zoanthus pacificus*, was present in the quadrat survey as were four coral species having a mean coverage of 1.3 percent. The most common coral is *Montipora flabellata* at this station. Again, rubble is the dominant feature of the substratum at this station comprising about 59 percent of the bottom. The macroinvertebrate census noted the hoof shell (*Hipponyx* sp.) on rubble as well as the callinasid shrimp (*Callianassa parva*) and a single black sea cucumber (*Holothuria atra*). The results of the fish census are given in Appendix A; 4 species (13 individuals) were encountered and the belted wrasse or 'omaka (*Stethojulis balteata*) was the most abundant at this station. The standing crop was estimated to be 0.8 g/m^2 and the saddleback wrasse or hinalea lauwili (*Thalassoma duperrey*) contributed the most to this biomass estimate. The poor development of the fish community at this station is probably related to the lack of topographical relief (shelter) present.

Station 5 was established about 35m from the southern shore

TABLE 6. Summary of the benthic survey conducted at Station 2 approximately 25m from the southern shore in Hanamaulu Bay in the high energy biotope of rubble and hard substratum on 13 June 1994. Results of the 6m^2 quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 3m; mean coral coverage is zero (quadrat method).

A. Quadrat Survey

Species	Quadrat Number 0m	5m	10m	15m	20m	25m
Algae						
Halymenia formosa	0.1	0.1	0.1	1		0.1
Spyridia filamentosa	0.1					
Caulerpa racemosa						0.5
Chnoospora minima					0.1	
Colpomenia sinuosa	0.1					
Halimeda opuntia	0.1				0.3	
Jania sp.						1.2
Dictyota bartayresii						0.3
Tolypiocladia sp.				0.1		
Hydrozoans						
Halocordyle disticha					0.1	
Sand	2	53	31	28	30	23
Rubble	97.6	46.9	68.9	71.8	51.5	74.9
Hard Substratum					18	

B. 50-Point Analysis

Species	Percent of the Total
Algae	
Halymenia formosa	2
Corallina sp.	2
Caulerpa racemosa	2
Dictyota bartayresii	2
Sand	28
Rubble	58
Hard Substratum	6

(Table Continued On Next Page)

TABLE 6. Continued.

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Mollusca	
Conus lividus	1
Phylum Arthropoda	
Gonodactylus falcatus	1
Thalmita ademete	2

D. Fish Census (4 x 25m)

5 Species
20 Individuals
Estimated Biomass = 2 g/m^2

TABLE 7. Summary of the benthic survey conducted at Station 4 approximately 30m from the northern shore in Hanamaulu Bay in the high energy biotope of rubble and hard substratum on 13 June 1994. Results of the $6m^2$ quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 2.6m; mean coral coverage is 1.3 percent (quadrat method).

A. Quadrat Survey

Species	Quadrat Number 0m	5m	10m	15m	20m	25m
Algae						
Amansia glomerata	0.5	0.8				
Chnoospora minima	1		0.7			
Dictyota bartayresii	2	3	0.2	1.4	0.1	
Tolypiocladia sp.		0.1				
Polysiphonia sp.				0.1		
Cladymenia pacifica			0.7			
Dictyosphaeria cavernosa			0.1			
Porolithon gardineri	2.3	0.6		0.8	0.1	
Halimeda opuntia					0.1	
Soft Corals						
Zoanthus pacificus		2				
Corals						
Pocillopora damicornis	0.8					
Porites compressa	1.1					
Montipora verrilli					1.6	
M. flabellata						4
Sand		6		18	51	83
Rubble	67	87.5	74.3	62.7	47.1	13
Hard Substratum	25.3		24	17		

(Table Continued On Next Page)

TABLE 7. Continued.

B. 50-Point Analysis

Species	Percent of the Total
Algae	
Dictyota bartayresii	2
Porolithon gardineri	4
Corals	
Porolithon damicornis	2
Montipora flabellata	4
Sand	12
Rubble	56
Hard Substratum	20

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Mollusca	
Hipponyx sp. (probably *barbatus*)	46
Phylum Arthropoda	
Callianassa parva	1
Phylum Echinodermata	
Holothuria atra	1

D. Fish Census (4 x 25m)

4 Species
13 Individuals
Estimated Biomass = 0.8 g/m^2

line in the high energy biotope of rubble and hard substratum (Figure 2). The substratum at this location is limestone with a veneer of sand over portions of it. There are several poorly-defined limestone ridges that have an orientation perpendicular to shore; these ridges are from 2 to 15m in width, up to 0.75m in height and are up to 20m in length emanating from the rocky coastline. These ridges are spaced from 5 to 25m apart. Water depth at this station is 4.5m. Table 8 presents the results of the quantitative survey carried out at station 5. The quadrat survey noted 5 algal species with a mean coverage of 1.4 percent and the alga, *Chnoospora minima* was the most abundant species. Also present in the quadrat survey was three species of corals; one large (2.2m diameter) colony of *Porites rus* (formerly *Porites* (*Synarea*) *convexa*) situated on a small limestone ridge was present in part of the quadrat survey and was the most common coral in the quadrats. Mean coral coverage was estimated to be 16.7 percent. This estimate is high because of the single *P. rus* colony in the transect; overall, coral coverage in the vicinity of this station is closer to 5 percent. The macroinvertebrate survey noted five species including two pearl oysters (*Pinctada margaritifera*), the terebellid polychaete, *Loimia medusa*, a small spiny lobster or 'ula (*Panulirus penicillatus*) and a juvenile hermit crab (*Dardanus* sp.). Despite cover afforded by the *Porites rus* colony, only five species of fishes (28 individuals) were noted in the 4 x 25m census area (Appendix A). The most abundant species was the cardinalfish or 'upapalu (*Apogon kallopterus*) followed by the squirrelfish or mempachi (*Myripristes amaenus*) and the saddleback wrasse or hinalea lauwili (*Thalassoma duperrey*). The standing crop of fish at this station was estimated to be 9 g/m^2 and the 'upapalu (*Apogon kallopterus*) comprised 36 percent of the total, the hinalea lauwili (*Thalassoma duperrey*) made up 32 percent and the mempachi (*Myripristes amaenus*) contributed 18 percent to the biomass present at this station.

Station 6 is located about 630m seaward of the sand beach at the head of Hanamaulu Bay near the middle of the bay at a depth of 6m (see Figure 2). This station was established in the ecotone or zone of tranisition between the biotope of sand and the high energy biotope of rubble and hard substratum, thus part (about 80%) of the transect samples the sand habitat and the remainder (20%) samples hard substratum rising about 0.75m above the sand. At this station the hard substratum lies primarily to the north; south of it is the biotope of sand. Table 9 presents a summary of the quantitative survey carried out at station 6. The quadrat survey noted five species of macrothalloid algae having a mean coverage of 0.6 percent; four coral species have an estimated mean coverage of 7.3 percent. In terms of coverage, the most abundant coral is *Montipora verrucosa*. The macroinvertebrate census noted only three species in the 4 x 25m tran-

TABLE 8. Summary of the benthic survey conducted at Station 5 approximately 35m from the northern shore in Hanamaulu Bay in the high energy biotope of rubble and hard substratum on 13 June 1994. Results of the 6m^2 quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 4.5m; mean coral coverage is 16.7 percent (quadrat method).

A. Quadrat Survey

Species	Quadrat Number 0m	5m	10m	15m	20m	25m
Algae						
Chnoospora minima		3	1	2		0.2
Cladymenia pacifica			1	0.3		
Halimeda opuntia		0.3	0.2			
Halymenia formosa					0.1	
Jania sp.		0.1				
Corals						
Porites rus	69.5					
Montipora verrucosa		6		0.9		
M. patula	10.5	13	0.1			
Sand	12	4	60.7	12	90.9	95.8
Rubble		73.6	28	26		
Hard Substratum	8		9	58.8	9	4

B. 50-Point Analysis

Species	Percent of the Total
Algae	
Dictyosphaeria cavernosa	2
Spyridia filamentosa	2
Halimeda opuntia	2
Corals	
Porites rus	2
Montipora patula	2
Sand	40
Rubble	38
Hard Substratum	12

(Table Continued On Nest Page)

TABLE 8. Continued.

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Mollusca	
Pinctada margaritifera	2
Phylum Annelida	
Loimia medusa	2
Phylum Arthropoda	
Panulirus penicillatus	1
Dardanus sp. (juvenile)	1
Phylum Echinodermata	
Tripneustes gratilla	2

D. Fish Census (4 x 25m)

5 Species
28 Individuals
Estimated Biomass = 9 g/m^2

TABLE 9. Summary of the benthic survey conducted at Station 6 approximately 630m offshore of the sand beach at the head of Hanamaulu Bay in the ecotone between high energy biotope of rubble and hard substratum and the biotope of sand on 13 June 1994. Results of the $6m^2$ quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 6m; mean coral coverage is 7.3 percent (quadrat method).

A. Quadrat Survey

Species	Quadrat Number 0m	5m	10m	15m	20m	25m
Algae						
Dotyella hawaiiensis					0.1	
Centroceras clavulatum				0.1	0.3	
Porolithon gardineri						1
Dictyota bartayresii						1.3
Halymenia formosa						0.5
Corals						
Porites lobata						1
P. compressa						5
Montipora verrucosa						31
M. patula						7
Sand	88	96	98	96.4	46	
Rubble	12				53.6	
Hard Substratum		4	2	3.5		53.2

B. 50-Point Analysis

Species	Percent of the Total
Algae	
Porolithon gardineri	2
Corals	
Montipora patula	2
M. verrucosa	6
Sand	80
Rubble	6
Hard Substratum	4

(Table Continued On Nest Page)

TABLE 9. Continued.

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Annelida	
Loimia medusa	1
Phylum Arthoropoda	
Aniculus sp. (juvenile)	1
Phylum Echinodermata	
Holothuria atra	1

D. Fish Census (4 x 25m)

3 Species
4 Individuals
Estimated Biomass = 0.1 g/m^2

sect area. These were the polychaete (Loimia medusa), a juvenile hermit crab (Aniculus sp.) and a single black sea cucumber (Holothuria atra). The fish census at this station noted three species (4 individuals, see Appendix A). These fishes were two juvenile tableboss or a'awa (Bodianus bilunulatus), a small flatfish or paki'i (Bothus mancus) and a single sharpback puffer (Canthigaster jactator). These fishes had an estimated biomass of 0.1 g/m^2.

Station 7 was located about 60m from the north shoreline of Hanamaulu Bay in the high energy biotope of rubble and hard substratum. The bottom at station 7 is limestone with a diverse algal mat present over much of the area. Water depth at station 7 is about 5m and this area is subjected to surf; the bottom is relatively flat and featureless providing little shelter for fishes or cryptic macroinvertebrates. Table 10 provides a synopsis of the results of the quantitative survey carried out at station 7. The quadrat survey noted 12 macrothalloid algal species having a mean coverage of 7.4 percent; the most abundant algal species were Amansia glomerata and Dictyota divaricata. Five coral species were noted in the quadrat survey and the most common species were Porites lobata and P. compressa. The mean coverage by corals at this station was estimated to be 10.5 percent. The macroinvertebrate census noted six species including the cone (Conus sponsalis, the polychaete (Loimia medusa), the 7-11 crab (Carpilius maculatus) and three sea urchin species (Echinometra mathaei, wana - Echinothrix diadema and the slate pencil urchin - Heterocentrotus mammillatus). The fish census at station 7 noted 9 species (21 individuals) having an estimated standing crop of 9 g/m^2 (Appendix A). The most abundant species at station 7 include the saddleback wrasse or hinalea lauwili (Thalassoma duperrey and the belted wrasse or 'omaka (Stethojulis balteata). Species contributing heavily to the standing crop at this station include a single moray eel or puhi (Gymnothorax petelli - 46% of the total), a single humuhumu nukunuku apua'a (Rhinecanthus rectangulus - 17%) and seven hinalea lauwili (Thalassoma duperrey - 17% of the total).

A short qualitative reconnaissance of the hard substratum to the north and seaward of stations 6 and 7 noted a number of species not seen at these stations. These included wrasses such as the hinalea aki'lolo (Coris gaimard), awela (Thalassoma trilobatum), the manybar goatfish or moano (Parupeneus multifasciatus), moray eel or puhi laumilo (Gymnothorax undulatus), hawkfish or piliko'a (Paracirrhitus arcatus), damselfishes (Plectroglyphidodon imparipennis and Stegastes fasciolatus), surgeonfishes such as the maikoiko (Acanthurus leucoparieus), manini A. triostegus) and the palani (A. dussumieri). Nowhere in this high energy area were fishes very abundant; similarly, a number of corals were seen including Porites evermanni and Pavona duerdeni as well as

TABLE 10. Summary of the benthic survey conducted at Station 7 approximately 60m from the north coastline in Hanamaulu Bay in the high energy biotope of rubble and hard substratum on 13 June 1994. Results of the $6m^2$ quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth is 5m; mean coral coverage is 10.5 percent (quadrat method).

A. Quadrat Survey

	Quadrat Number					
Species	0m	5m	10m	15m	20m	25m
Algae						
Dictyota bartayresii	3	0.8				
D. divaricata	4		4	3	2	2
Codium reediae	0.1					
Caulerpa racemosa					0.5	
Microdictyon japonicum			0.2		0.4	0.2
Enteromorpha sp.		0.1				
Jania sp.	0.1				0.2	0.3
Porolithon gardineri	3			1		
Corallina sp.					0.1	
Amansia glomerata		8	6	2	2	
Laurencia nidifica						1
Liagora tetrasporifera						0.3
Corals						
Porites lobata	5	9	5.2	6	1	1.2
P. compressa	8	0.5	2	1.7	1.4	1
Montipora verrilli	0.5				0.3	
M. verrucosa						1.2
Pavona varians					0.2	
Sand				1	12	6
Hard Substratum	76.3	81.6	82.6	85.3	79.9	86.8

(Table Continued On Next Page)

Table 10. Continued.

B. 50-Point Analysis

Species	Percent of the Total
Algae	
Amansia glomerata	6
Dictyota bartayresii	2
Laurencia obtusa	2
Galaxaura fastigiata	2
Corals	
Porites lobata	4
Pavona duerdeni	2
Hard Substratum	82

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Mollusca	
Conus sponsalis	1
Phylum Annelida	
Loimia medusa	1
Phylum Arthropoda	
Carpilius maculatus	1
Phylum Echinodermata	
Echinometra mathaei	14
Echinothrix diadema	5
Heterocentrotus mammillatus	1

D. Fish Census (4 x 25m)

9 Species
21 Individuals
Estimated Biomass = 9 g/m^2

macroinvertebrates: the calliansid shrimp (*Callianassa parva*), the swimming crab (*Thalamita ademete*), mantis shrimp (*Gonodactylus falcatus*), cone shells (*Conus miles*, *C. lividus*, *C. ebreus*), brown sea cucmber (*Actionpyge mauritana*) one juvenile octopus or he'e (*Octopus cyanea*).

Station 9 was established in the high energy biotope of rubble and hard substratum about 180m north of the tip of the old Ahukini Landing breakwater at depths ranging from 7.6 to 9.1m. The transect is located adjacent to the sand channel which exits through the outer central part of the bay. Water depth to the sand is about 11.5m, to the north emergent limestone substratum rises from 2 to 4m creating a platform on which the station was established. In the area of this station were several large cracks in the limestone which provide shelter for fishes. Again the limestone has a relatively diverse algal turf on it and the general prostrate growth forms of the corals present suggest that on occasion this area receives considerable wave impact.

Table 11 presents a summary of the results of the quantitative survey carried out at station 9. The quadrat survey noted nine species of macrothalloid algae having a mean coverage of 3.5 percent and both *Amansia glomerata* as well as the coralline, *Porolithon onkodes* were the most abundant species. Also present on the limestone in the quadrat survey is the soft coral, *Anthelia edmondsoni* as well as five species of coral having a mean coverage of 29.3 percent. The most important coral species were *Montipora patula*, *M. verrucosa* and *Porites lobata*. The macroinvertebrate census noted four species including the cone (*Conus miles*), terebellid polychaete (*Loimia medusa*), the rock boring urchin (*Echinostrephus aciculatum*) and the banded urchin (*Echinothrix calamaris*). Fifteen species of fishes (33 individuals) were censused in the 4 x 25m survey area. The most common species were the introduced snapper or toau (*Lutjanus fulvus*) and the convict tang or manini (*Acanthurus triostegus*). The standing crop of fish at station 9 is estimated to be 57 g/m^2 and two whitesaddle goatfish or kumu (*Parupeneus porphyreus*) comprised 35 percent of this biomass, ten toau (*Lutjanus fulvus*) made up 30 percent and a single eye-stripe surgeonfish or palani (*Acanthurus dussumieri*) added another 10 percent of the standing crop at this station.

Station 10 was established about 300m seaward of the breakwater built to service Ahukini Landing. This station sampled the high energy biotope of rubble and hard substratum at depths from 14.9 to 18m. The substratum at this station is limestone which slopes seaward at about a 5^o angle to a sand substratum (the biotope of sand) encountered at a depth of about 20m. Spread across the hard bottom at station 10 was a considerable amount of live ammunition (intact shells assumed to be live) which appeared

TABLE 11. Summary of the benthic survey conducted at Station 9 approximately 180m north from the tip of the old harbor breakwater in Hanamaulu Bay in the high energy biotope of rubble and hard substratum on 13 June 1994. Results of the $6m^2$ quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth ranges from 7.6 to 9.1m; mean coral coverage is 29.3 percent (quadrat method).

A. Quadrat Survey

Species	Quadrat Number 0m	5m	10m	15m	20m	25m
Algae						
Porolithon gardineri	1.5	2	0.6	2		
Amansia glomerata		3	2	0.9	4	2
Halimeda opuntia		0.2	0.1			
Dotyella hawaiiensis			0.2			
Caulerpa serrulata			0.2			
Jania sp.				0.1	0.2	
Laurencia succisa					1	0.8
Cladymenia pacifica						0.3
Corallina sp.						0.1
Soft Corals						
Anthelia edmondsoni			0.1			
Corals						
Porites evermanni	22					
P. lobata		0.2		1.5		
P. compressa				0.2		
Montipora verrucosa		3	11	11.5	19.5	41
M. patula	35		31			
Sand		2				
Hard Substratum	41.5	89.6	54.8	16.2	75.3	55.8

(Table Continued On Next Page)

TABLE 11. Continued.

B. 50-Point Analysis

Species	Percent of the Total
Algae	
Amansia glomerata	4
Porolithon gardineri	2
Soft Corals	
Palythoa tuberculosa	2
Corals	
Porites evermanni	2
P. lobata	4
Montipora patula	12
M. verrucosa	8
Hard Substratum	66

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Mollusca	
Conus miles	1
Phylum Annelida	
Loimia medusa	2
Phylum Echinodermata	
Echinostrephus aciculatum	2
Echinothrix calamaris	1

D. Fish Census (4 x 25m)

15 Species
33 Individuals
Estimated Biomass = $57\ g/m^2$

to be of World War II vintage. No attempt was made to quantify this refuse other than to note that shells ranging in size from 30 and 50 caliber to approximately 7.6cm in diameter were scattered across the bottom; in one 1m-square quadrat, 48 shells were noted. In the vicinity of the transect line were a number of large canisters that may have contained gas. Because of a lack of time, we did not attempt to determine the lateral extent of this dump but it covered all of the hard bottom in the vicinity of the station. Many of the shells had been washed into a series of shallow "cracks" that have a general orientation parallel to shore, but much of the refuse was scattered across the bottom.

Table 12 presents the results of the quantitative survey at station 10. Four macroalgal species were noted in the quadrat survey having a mean coverage of 2.8 percent with _Amansia glomerata_ providing the largest part of this coverage. The bryozoan, _Bugula_ sp. was also noted in these quadrats as were seven species of corals having a mean coverage of 6.4 percent. From the standpoint of coverage, _Leptastrea purpurea_ contributed the most, but in general, corals were not well-developed at this station. The scoured nature of the substratum suggests that the area probably on occasion receives considerable wave impact and scour which would serve to retard the growth of many corals. The macroinvertebrate census noted three species in the transect area; these were the cone shell (_Conus lividus_), the christmas tree worm (_Spirobrachus gigantea_) and the hermit crab _Aniculus aniculus_). The fish census recorded 13 species (47 individuals) in the survey area (Appendix A). The most abundant fish was the small damselfish (_Chromis vanderbilti_). The standing crop of fish was estimated to be 47 g/m^2 and seven orangebar surgeonfish or na'e-na'e (_Acanthurus olivaceus_) contributed 70 percent of the biomass of fishes at this station.

A short reconnaissance was made of the rocky intertidal region at several points in Hanamaulu Bay. High in the intertidal zone were seen the grey littorine snail (_Littorina pintado_), the false opihi (_Siphonaria normalis_); further towards the water are seen the chiton (_Acanthochiton viridis_), algae or limu including _Grateloupia phuquoensis_, 'aki'aki (_Ahnfeltia concinna_) and hulu'ilio (_Giffordia breviarticulata_) as well as the pupipi (_Nerita picea_) and the opihi (_Patella sandwichensis_). Further subtidally, other species of algae seen include _Pterocladia capillacea_ and limu palahalaha (_Ulva fasciata_) as well as the drupe shell (_Drupa nodus_), sea urchins (_Colobocentrotus atrata_, _Echinometra oblongata_ and _E. mathaei_). The pink color of many intertidal/subtidal rocks indicates that the encrusting coralline, _Porolithon onkodes_ is present. The opihi is a highly sought after species and the density of opihi was estimated at a number of locations on the rocks around the bay. The density estimates range from one animal per 5m^2 to one per 20m^2.

TABLE 12. Summary of the benthic survey conducted at Station 10 approximately 300m seaward of the tip of the old harbor breakwater in Hanamaulu Bay in the high energy biotope of rubble and hard substratum on 13 June 1994. Results of the 6m^2 quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth ranges from 14.9 to 18m; mean coral coverage is 6.4 percent (quadrat method).

A. Quadrat Survey

Species	Quadrat Number 0m	5m	10m	15m	20m	25m
Algae						
Tolypiocladia sp.	0.1					
Microcoleus lyngbyaceus		4				
Halimeda opuntia	0.1	0.2	0.1	0.1	0.1	
Amansia glomerata						12
Ectoprocta						
Bugula sp.		0.1				
Corals						
Pocillopora lingulata	3.5					5
P. meandrina					4	
Porites lobata		1	1	1.2	0.1	3
Pavona varians						1
Leptastrea purpurea						18
Montipora verrucosa	0.1				0.1	
Cycloseris vaughani			0.1			
Ammunition		3		38	9	
Sand				5		15
Hard Substratum	96.2	91.7	98.8	55.7	86.7	46

B. 50-Point Analysis

Species	Percent of the Total
Algae	
Amansia glomerata	2
Corals	
Porites lobata	2
Pocillopora meandrina	2
Sand	4
Hard Substratum	90

TABLE 12. Continued.

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Mollusca	
Conus lividus	1
Phylum Annelida	
Spirobranchus gigantea	5
Phylum Arthropoda	
Aniculus aniculus	1

D. Fish Census (4 x 25m)

13 Species
47 Individuals
Estimated Biomass = 47 g/m^2

Nowhere were the densities high and most individuals seen were small (less than 1.9cm in diameter).

Threatened and Endangered Species

Several green sea turtles (Chelonia mydas) were sighted in Hanamaulu Bay during the course of the fieldwork. Green turtles were granted protected status under the federally mandated Endangered Species Act in 1977-78. Green turtles as adults are known to forage and rest in the shallow waters around the main Hawaiian Islands. Reproduction in the Hawaiian population occurs primarily during the summer months in the Northwest Hawaiian Islands with adults migrating during the summer months to these isolated atolls and returning in late summer or early fall. In the main Hawaiian Islands, green turtles will rest along ledges, caves or around large coral mounds in coastal waters usually from 12 to 20m in depth during the day. Under the cover of darkness turtles will travel inshore to shallow subtidal and intertidal habitats to forage on algae or limu (Balazs et al. 1987). The normal range of these daily movements between resting and foraging areas is about one kilometer (Balazs 1980, Balazs et al. 1987). Thus from the present state of knowledge, an ideal green turtle habitat would have the presence of appropriate offshore resting areas (caves, ledges, undercuts, coral mounds with depressions around them) being located within a kilometer or less from a sufficient abundance of appropriate forage algal species situated in shallow water. Selectivity of algal species consumed by Hawaiian green turtles appears to vary with the locality of sampling; offshore of the southeast coast of Hawaii Island, Ptercladia capillacea appears to be important (Balazs et al. 1987). Stomach content data show Acanthophora spicifera and Amansia glomerata to be quantitatively the most important (Balazs et al. 1987); these preferences may be due to the ubiquitous distribution of these algal species.

The rocky intertidal along the north and south sides of Hanamaulu Bay have an abundant supply of Pterocladia capillacea, limu palahalaha (Ulva fasciata) and higher in the intertidal, limu 'aki'aki (Ahnfeltia cocinna), all of which could serve as a food resource for green turtles. Subtidally, one of the most common algal species encountered in this survey is Amansia glomerata which is another species consumed by turtles. Thus there appears to be an ample forage base for green turtles in the bay. Conversations with local fishermen note that green turtles are commonly seen just seaward of Hanamaulu Bay which suggests that appropriate resting habitat is present.

In Hanamaulu Bay at least five green turtles were seen during our fieldwork on 13 June 1994. Three of these turtles (with estimated straight line carapace lengths of 50cm, 65cm and 70cm) were seen in the vicinity of station 5 in water with a depth between 5 to 7m. We did not encounter any identifiable resting site, but several depressions alongside of limestone mounds could be used for this purpose at this site. A fourth turtle (estimated straight-line carapace length = 35cm) was seen in the vicinity of station 7 in water with a depth of 5-6m and the fifth turtle (estimated straight-line carapace length = 70cm) was encountered about at station 8 transiting the area. This turtle appeared to be swimming into the bay in the general direction of station 5. Seaward of Hanamaulu Bay, two additional turtles were seen; one of these was estimated to be about 80cm in straight-line carapace length and the second about 75cm. These turtles were approximately 500m south of Hanamaulu Bay and were seen while transiting the area. Balazs (1980) notes that Hawaiian green turtles with straight-line carapace lengths less than about 80cm are not sexually mature, thus only one of the turtles encountered by us appeared to be an adult; all turtles seen inside of Hanamaulu Bay appeared to be juveniles.

The endangered humpback whale (Megaptera novaeangliae) frequents Hawaiian waters during the winter months (October through April; Nitta and Naughton 1989) and is known to pass by the waters outside of Hanamaulu Bay. As expected, since the fieldwork for this study was carried out in June, no whales were seen but local fishermen note that whales are seen along the eastern coastline of Kauai during the winter months.

Fishery Resources

Hanamaulu Bay is one of the closest sheltered bays with a sand beach to Lihue which is the county seat. Thus the bay, beach park and Ahukini Landing are all popular recreational sites. Ahukini Landing is now a state park that is specifically used for hook and line fishing only. Interviewing fishermen familiar with the area, suggests that many fish are caught at this location. Many predator species including kahala (Seriola dumerili), ulua and papio (family Carangidae), omilu (Caranx melampygus), opelu (Decapterus macarellus), akule (Selar crumenophthalmus) and occasionally pelagic species such as kawakawa (Euthynnus affinis) are caught from the old pier at the landing. Mr. Lawrence (a Kauai charter vessel captain) noted that many years ago a large grouper was taken from the pier (probably Ephinephelus lanceolatus) weighing more than 500 lbs (225kg).

During the fieldwork on 13 June 1994, a team of five fishermen using a dingy set a net in the southwestern corner of Hanamaulu Bay (about 300m offshore of the stream mouth) apparently to

capture a school of akule. We do not know if these fishermen were successful, but several days preceding our visit a group captured more than 800 lbs (360kg) of akule at the same location. Also during the course of the day, several hook and line fishermen worked along both the north and southern sides of the bay either bait fishing or "whipping" for papio. The pier at Ahukini had more than 12 people present at all times during the day. Catches on 13 June were not recorded but on Tuesday 14 June, 0.5 hour was spent at Ahukini Pier recording catch and effort expended in making those catches. In this one-half hour period (0930-1000 hours) thirteen fishermen caught three adult akule (each weighing an estimated 350g) and one small omilu (about 225g). This amounts to about 196g of fish per fisherman per hour. These catch rates are much better than seen on Oahu.

It is very evident that Hanamaulu Bay is an important recreational resource to the people of Kauai.

DISCUSSION

WATER QUALITY STUDIES

Both the water quality data and information from the benthic studies suggests that Hanamaulu Stream has a major influence on both the water chemistry and benthic community development of Hanamaulu Bay particularly in the inner portions of the bay. The stream is a source of freshwater, nutrients, detritus and terrigeneous material all of which are carried into the bay. Obviously during periods of high rainfall, the delivery of these materials is greater. The higher concentration of some materials coming in via the stream and the low concentration of these same materials in oceanic waters results in the development of gradients as encountered in the water quality data for Hanamaulu Bay.

The "composite" nutrient parameters of total nitrogen and total phosphorus yield the least information about water quality of the nutrient species measured in this study. The lack of definitive information from these parameters is the result of the makeup of these two composite species. Total phosphorus and nitrogen include a myriad of unspecified groups of dissolved organic materials, some of which are of unknown biological function.

The geometric mean for chlorophyll-a exceeded State DOH standards for "wet" embayment coastlines at the time of sampling; this is probably related to the input of relatively high nutrient freshwater into the bay as well as the washout of phytoplankton from the stream and estuary into the bay. Despite the geometric mean of chlorophyll-a exceeding the "wet" criteria, it did not exceed the value specified by DOH as "not to exceed the given value more than 10% of the time". Chlorophyll-a is a measure of phytoplankton biomass and phytoplankton as well as detritus and suspended sedimentary material all contribute to the relatively high turbidity encountered in the inner reaches of Hanamaulu Bay albeit the geometric mean for turbidity did not exceed state standards. However it should be noted that the geometric mean for turbidity was only 0.01 NTU less than the wet criteria (1.50 NTU) supporting the contention that the bay's waters are very turbid despite the lack of rainfall. Turbidity measured at stations 3, 4, 5, 6 and 8 all individually exceeded the state standard for embayments.

It is interesting to note that State standards for coastal waters are frequently exceeded irrespective of the presence of nearby coastal development. Brock and Kam (1989) found that under dry conditions, nitrate + nitrite nitrogen concentrations are equal to "dry" criteria for waters fronting Lahaina, Maui (a developed area) and that chlorophyll-a exceeded the "wet" criteria; following a heavy rain (858mm or 3.38 inches over a 24-hour period) nitrate + nitrite nitrogen, turbidity and chlorophyll-a all exceeded state standards (Brock 1990a). At Mahukona, Hawaii an area with little surrounding development, both chlorophyll-a and ammonia nitrogen exceeded DOH "dry" standards (Marine Research Consultants 1989, Brock 1990b). A weekly ocean water quality monitoring program has been in place at the Natural Energy Laboratory of Hawaii (NELH) at Keahole Point, Hawaii since 1982. The waters offshore of Keahole Point are considered to be pristine; the presence of high quality deep ocean and surface water adjacent to shore were important factors in locating the NELH facility there. The longterm mean for ammonia nitrogen at Keahole Point is 0.36uM which exceeds state "dry" standards for open coastal waters (Class AA; NELH data are courtesy of the University of Hawaii Analytical Services Laboratory). In some cases the imposition of numerical standards may not be realistic especially in light of the fact that water quality measurements made on completely undeveloped coastlines may be far from compliance. This is particularly true following a high rainfall event; it is expected that following heavy rainfall, many of the parameters measured in Hanamaulu Bay will probably be out of compliance.

These same parameters measured in water offshore of a stream draining a completely undeveloped watershed may temporarily also be out of compliance (Brock 1994). The Department of Health has recognized the problem of using strict numeric standards that may not be appropriate for every coastal area and is addressing it by supporting a research program at the University

of Hawaii to determine if ecologically based standards might be developed which would avoid the use of a single set of numerical standards. The author is involved in this research effort.

BIOLOGICAL STUDIES

Studies conducted on coral reefs in Hawaii and elsewhere have estimated fish standing crops to range from 2 to 200g per square meter (Brock 1954, Brock et al. 1979). Eliminating the direct impact of man due to fishing pressure and/or pollution, the variation in standing crop appears to be related to the variation in the local topographical complexity of the substratum. Thus habitats with high structural complexity affording considerable shelter space usually harbor a greater estimated standing crop of coral reef fish; conversely, transects conducted in structurally simple habitats (e.g., sand flats) usually result in a lower estimated standing crop of fish (0.2 to 20g/m^2). Goldman and Talbot (1975) noted that the upper limit to fish biomass on coral reefs is about 200g/m^2. Recent studies (Brock and Norris 1989) suggest that with the manipulation (increasing) of habitat space or food resources (Brock 1987), local fish standing crops may approach 2000g/m^2. Thus under certain circumstances, coral reefs may be able to support much larger standing crops of fishes than previously realized.

A summary of the standing crop of fishes encountered at each of the ten stations is given in Appendix A. In no case did the standing crop exceed 57 g/m^2; these low standing crops are probably related to the general lack of shelter appropriate for fishes at these sites as well as to probable high fishing pressure exerted on the fish communities of Hanamaulu Bay. The lack of fishes over sand (station numbers 1, 3 and 8) is not unusual. As noted above, standing crop estimates in Hawaiian sand habitats range from 0 to about 20g/m^2 (Brock 1954, Brock et al. 1979).

Table 13 presents a summary of the standing crop estimates by family. The wrasses (family Labridae) appear in more stations than any other and in general contribute more to the estimated biomass at these stations (mean = 16% of the total biomass) than any other family. The hinaleas or wrasses are one of the most specious and ubiquitous on Hawaiian reefs (Gosline and Brock 1960).

Excluding the corals, the invertebrate censuses did not yield any unusual results; species common to the habitats examined in this study are the same as one would commonly encounter elsewhere in other similar Hawaiian habitats. As noted above, the census techniques used here for macroinvertebrates assesses only those species that are large (greater than 2cm in some

TABLE 13. Summary of the biomass estimates (in g/m^2) calculated from estimated individual fish lengths in the field for families of fishes that collectively contributed 99 percent or more to the standing crop of fishes at the ten stations sampled in this study.

Family	Station Number 1	2	3	4	5	6	7	8	9	10
Acanthuridae							8		15	69
Apogonidae		0.8		12.5	36					
Aulostomidae					1					
Balistidae							16		3	8
Bothidae						67		100		
Canthigasteridae						26	1		1	
Chaetodontidae		1.6					5			0.1
Cirrhitidae									2	0.2
Gobiidae				12.5						
Holocentridae					18					
Labridae		1.6		75	45	7	24		5	7
Lutjanidae		96							35	
Monacanthidae										7
Mullidae	100								39	
Muraenidae							46			4
Pomacentridae										0.4
Synodontidae			100							
Zanclidae										4
Total Station Percent	100	100	100	100	100	100	100	100	100	99.7

dimension), diurnally exposed, and are motile. The method is probably accurate for some of the echinoderm species but little else. Thus the macroinvertebrate census data are of limited value for describing the benthic community. Sessile and/or colonial forms are assessed by use of the quadrat and the point-intersect technique.

Physical disturbance from occasional storm surf is one of the most important parameters in determining the structure of Hawaiian coral communities (Dollar 1982). Numerous studies have shown that occasional storm generated surf may keep coral reefs in a non-equilibrium or sub-climax state (Grigg and Maragos 1974, Connell 1978, Woodley et al. 1981, Grigg 1983). Indeed, the large expanses of near-featureless lava or limestone substratum present around much of the Hawaiian Islands at depths less than 30m attest to the force and frequency of these events (Brock and Norris 1989). These same wave forces also impinge and impact fish communities (Walsh 1983).

The results of the biological survey of Hanamaulu Bay and waters fronting this bay suggest that much of the outer portion of the bay, like many other Hawaiian marine communities receives occasional, albeit considerable, wave impact. In general, the open substratum present in the high energy biotope of rubble and hard substratum is probably the result of wave action retarding the development of the coral communities. The small size of many of the coral colonies suggests that wave forces are important in structuring the benthic communities in these areas. The impact of wave forces is attenuated with increasing depth or in locations which are sheltered from the prevailing seas and it is in these settings that coral communities are better developed; these conditions appear to be rare in Hanamaulu Bay.

The results of the biological survey show that benthic and fish communities are not well developed at any of the stations examined in this study. A summary of the important quantitative measures (i.e., number of coral and algal species as well as cover, number of fish species and biomass) made in these communities are summarized in Table 14. Factors probably responsible for the poor development of coral communities in Hanamaulu Bay are the influence of Hanamaulu Stream that empties into the head of the bay, the disturbance caused by occasional storm surf conditions which impinge primarily on the outer portions of the bay and the large amount of sand in the bay which is not an appropriate substratum for the growth of coral. Corals, through their growth, may provide shelter for many invertebrate and fish species characteristic of coral reefs. Where this shelter is lacking or is poorly developed, these communities may not be well-developed. If the assumptions about the requisites for successful coral, other invertebrate and fish population

TABLE 14. Summary of the quantitative biological observations made at 10 stations sampling two biotopes recognized in this study.

Biotope	Station No.	Depth (m)	No. Coral Spp.	Mean Cover (%)	No. Algal Spp.	Mean Algal Cover	No. Fish Spp.	Biomass (g/m^2)
Biotope of Sand	1	5	0	0	0	0	1	1
	3	2.4	0	0	0	0	1	0.3
	8	8.8	0	0	0	0	1	0.4
	MEANS	5.4	0	0	0	0	1	0.6
High Energy Biotope of Rubble and Hard Substratum	2	3	0	0	9	0.7	5	2
	4	2.6	4	1.3	9	2.4	4	0.8
	5	4.5	3	16.7	5	1.4	5	9
	6	6	4	7.3	5	0.6	3	0.1
	7	5	5	10.5	12	7.4	9	9
	9	8	5	29.3	9	3.5	15	57
	10	18	7	6.4	4	2.8	13	47
	MEANS	6.7	4	10.2	8	2.7	8	18

growth are correct, this suggests that the diversity in the benthic and fish communities resident to the study area is related to the presence of appropriate hard substratum generally removed from the direct influence of Hanamaulu Stream and protected from storm surge and surf. Such locations in Hanamaulu Bay are rare.

POTENTIAL IMPACTS TO MARINE COMMUNITIES WITH THE PROPOSED DEVELOPMENT

The diversity and development of the nearshore communities in Hanamaulu Bay are those that have persisted under the present conditions of occasional storm surf, runoff both under normal as well as storm conditions and fishing pressure.

Approximately 97 percent of the 555 acres proposed for development has been under sugar cultivation for many years. The cycle of this crop requires clearing of the land but in general, coverage by cane during growth is high which reduces sediment loss if a rainfall event occurs during this time. A 100-year storm with a 17-inch rainfall simulation is presented in Appendix D of the Final EIS by Kodani & Associates for this parcel. The simulation model found that sediment loss under a 100-year rainfall event was significantly greater from this parcel under every stage of sugar cultivation relative to when the land is developed either with or without retention basins. The model suggests that the present use of these lands is probably responsible for a greater loss of sediment to the ocean (via Hanamaulu Stream) than would occur if these lands are to be developed as proposed. Overall, following development, the sediment loading should decrease to approximately 20 percent of the existing conditions (Kodani & Associates, Appendix D, Final EIS).

In terms of freshwater input to Hanamaulu Stream and all other drainage sites from the property with a 100-year storm, it is calculated that the total discharge rate would be 2,595 cfs under present conditions. With the proposed development and the 100-year storm, this discharge rate would increase to 3,045 cfs which amounts to an 17 percent increase under this worse case scenario (Kodani & Associates, Appendix D, Final EIS). Considering Hanamaulu Stream alone, the calculated increase in runoff under the 100-year storm event with development is about 25 percent over the present agricultural situation. In summary, the model shows a increase in freshwater flow under the conditions of development and a 100-year rainfall event. However, thus despite the increase in freshwater to Hanamaulu Stream with development, the model indicates that the input of sediment will be less to the stream than would occur with a 100-year event under present conditions of cultivation.

It should be pointed out that the project area represents approximately 3 percent of the total watershed draining Hanamaulu Stream. Thus despite an increase in stormwater runoff during high rainfall events, this input is small relative to the runoff from the entire drainage basin.

Extreme rainfall events are not the usual case; the 100-year rainfall event is calculated to occur with a frequency of approximately 100 years. Most rainfall events are much less intense and some of this water is carried into the soil horizons, eventually reaches the groundwater. To assist in this process, the development will create a number of settlement basins within the development. Temporary retention basins will be constructed for use during construction; permanent basins will be constructed to service most rainfall events and will throttle excess water flowing from the project site thus mitigating the increased volume of runoff anticipated with the development.

The proposed development will increase the potential for runoff during the construction phase. Historically, impacts to marine communities in Hanamaulu Bay due to sedimentation following high rainfall must have occurred while adjacent lands were under cultivation. The estuary probably has served as a "bio-filter" sequestering some sediment and materials bound to these particles by slowing the flow of water as it moves through the meandering estuarine system. The decrease in flow rate allows heavier sedimentary materials to be deposited rather than being carried to the sea. Since the estuary will not be disturbed with the proposed development, it should continue to function in the same capacity.

Probably the period of greatest potential impact by sediment to the marine communities of Hanamaulu Bay will be during the construction phase if a high rainfall event were to occur. Presently, these lands are similarly stripped of their vegetative cover approximately every 22 months (when the cane is harvested) and the same potential impact exists at that time. If prudent construction practices are followed during the construction process (i.e., not uncovering too much soil at any one time, building temporary catchment and settling basins, etc.) little or no sediment should reach the sea even with a high rainfall event. The development is planned to be completed over a 15 to 20 year period, hence construction will occur in increments thus limiting the amount of land to be exposed at any one time. Following project completion, the soil should be covered and/or planted such that the opportunity for sediment from the project site to reach the sea will be less than at present as suggested by the model.

Sedimentation has been implicated as a major environmental problem for coral reefs. Increases in turbidity may decrease light levels resulting in a lowering of primary productivity. Perhaps a greater threat would be the simple burial of benthic communities that may occur with high sediment loading. Many benthic species including corals are capable of removing sediment settling on them but there are threshold levels of deposition where cleaning mechanisms may be overwhelmed and the individual becomes buried. However the impact of sedimentation on Hawaiian reefs may be overstated. Dollar and Grigg (1981) studied the fate of benthic communities at French Frigate Shoals in the Northwest Hawaiian Islands following the accidental spill of 2000 tons of kaolin clay. These authors found that after two weeks there was no damage to the reef corals and associated communities except where the organisms were actually buried by the clay deposits for a period of more than two weeks.

As noted above, coral, other invertebrate and fish communities are not well-developed in Hanamaulu Bay. This is probably due to the influence of Hanamaulu Stream that empties into the head of the bay, the disturbance caused by occasional storm surf conditions which primarily impinge on the outer portions of the bay, and the large amount of sand present in the bay. Because of its unstable nature, sand is not an appropriate substratum for many coral reef species and sand is a dominant substratum type in the inner reaches of the bay. If an increase in the volume of freshwater to Hanamaulu Bay via the stream was to occur, little change or impact to the biota would be expected. This is because much of the shallow area under the influence of the stream (as well as seaward of it) is sand and the benthos present is, for the most part, comprised of species that tolerate the conditions of occasional brackish water. In the surface layers, brackish water is evident over the inner two-thirds of the bay during dry (low stream flow) periods; salinity measurements taken close to the bottom suggest that at depths below about 3m (approximately 200m offshore), the salinity is close to normal seawater. Increasing freshwater input as occurs during storm conditions, will probably move these low salinity conditions further seaward but will primarily impinge sand substratum or high energy rocky coasts where rapid mixing minimizes the potential for any impact to the biota.

The chemical environment may, to a large degree, dictate the structural and functional characteristics of aquatic communities thus alteration in this environment may serve to change marine communities. If changes in physio-chemical inputs are not too great, a potential for chronic, low-level disturbance can result in adjacent aquatic communities. The present study suggests that considerable disturbance does now occur to the marine communities of Hanamaulu Bay via the stream (freshwater and sedimentation) as well as occasional wave impact. The proposed development will take these lands from the present agricultural use and place the majority of them into residential, mixed use, industrial, school, park and open space; these land use changes could result in changes to the quantity and kinds of materials being carried from the project site to Hanamaulu Stream and the sea during periods of high rainfall.

Past studies primarily on the West Hawaii coast have shown that urbanization of coastal areas may bring changes in the concentration of inorganic nutrients reaching the groundwater beneath porous lava but that these changes are small, being less than the concentration of these materials measured in a number of totally undeveloped sites. Thus despite a measurable increase in some nutrients when taking lands from an undeveloped to an urbanized state, the increases are less than the concentrations measured at other sites with no surrounding development (Brock et al. 1988, Brock and Norris 1987, 1988a, Brock and Kam 1990, 1992, 1994). Studies involving a search for pesticides and herbicides in aquatic communities adjacent to coastal lands undergoing development have been carried out on the West Hawaii (Kona) coast, Lanai and Kaanapali, Maui. In these cases, analyses focused on either chemicals that have been used or are being used. At Waikoloa in West Hawaii, annual sampling since 1987 for pesticides and herbicides used on golf courses has not detected these compounds in water or sediment (Brock and Norris 1987, 1988a, Brock and Kam 1990, 1992, 1994). Work with the Hawaii State Department of Health on possible bioaccumulation of materials in a long-lived aquatic species on the Kona coast, has not detected any insecticide or herbicide, despite the collection of some samples from brackish water ponds within 20m of a golf course constructed in the mid-1970's (Brock and Kam 1992). In total more than 60 compounds have been targeted in these studies, sampling both developed and undeveloped sites, and the results have been negative. Lanai and Kaanapali, Maui studies have focused on insecticides and herbicides that are used on golf courses; Kaanapali samples were also examined for products used with sugar cultivation and in all cases no materials were detected in the samples (Brock 1992a, 1992b).

The U.S. Geological Survey monitors a number of fresh (drinking water) wells in the state. In the Hanamaulu area, a County well (No. 2-5921-01) located approximately 1.0 mile west of Hanamaulu Beach Park is the closest routinely monitored well to the bay. Water quality monitoring for pollutants (heavy metals, pesticides and herbicides) has not detected any problem at this site in either 1991 or 1992 (Matsuoka, Lum and Kunishige 1992, 1993).

Despite recent studies not detecting modern pesticides and

herbicides, problems have occurred in the past in Hawaii. Both pesticides and heavy metals have been detected in fishes in Honolulu's streams that pass through urban areas and elsewhere by the Department of Health's monitoring program. In general, the chemicals detected are long-lived products used years ago and have been banned for some time (e.g., chlordane, DDT, etc.). As time has passed the materials allowed for use by the Environmental Protection Agency have changed towards products that are effective on application but have reduced half-lives once released into the environment. The use of products with short half-lives reduces the potential for contamination in the environment. Thus products available today carry considerably less risk of contamination to the environment than do the products used in times past. This suggests that the proposed development of the present agricultural parcel should not pose a great potential risk of pesticide/herbicide contamination with the change in land use.

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APPENDIX A. Results of the quantitative visual censuses of fishes conducted at ten locations in Hanamaulu Bay, Kauai on 13 June 1994. Each entry in the body of the table represents the total number of individuals of each species seen; totals are presented at the foot of the table along with an estimate of the standing crop (g/m^2) of fishes present at each location.

Family and Species	Station Number 1	2	3	4	5	6	7	8	9	10
ACANTHURIDAE										
Acanthurus olivaceus										7
A. nigrofuscus									2	
A. dussumieri							1		1	
A triostegus									4	
APOGONIDAE										
Apogon kallopterus					18					
Foa brachygramma		4		2						
AULOSTOMIDAE										
Aulostomus chinensis					1					
BALISTIDAE										
Rhinecanthus rectangulus							1			
Melichthys vidua										1
Sufflamen bursa									2	2
BOTHIDAE										
Bothus mancus						1		1		
CANTHIGASTERIDAE										
Canthigaster jactator						1	1		2	
C. cornata									1	
CHAETODONTIDAE										
Chaetodon miliaris		1					2			
C. quadrimaculatus										
C. fremblii										1
CIRRHITIDAE										
Paracirrhitus forsteri									1	
P. arcatus										2
Cirrhitus pinnulatus									1	
GOBIIDAE										
Bathygobius fuscus				3						
HOLOCENTRIDAE										
Myripristis amaeneus					4					

APPENDIX A. Continued.

Family and Species	Station Number 1	2	3	4	5	6	7	8	9	10
LABRIDAE										
Bodianus bilunulatus						2				1
Thalassoma duperrey				2	4		7		3	1
T. ballieui							1			
T. fuscum					1					
Stethojulis balteata		1		6			6			
Coris venusta							1		1	
Pseudojuloides cerasinus										1
Labroides phthirophagus									1	
LUTJANIDAE										
Lutjanus kasmira		4							1	
L. fulvus		10							10	
MONACANTHIDAE										
Cantherhines dumerili										1
MULLIDAE										
Upeneus arge	1									
Parupeneus porphyreus									2	
P. multifasciatus									1	
MURAENIDAE										
Gymnothorax petelli							1			1
POMACENTRIDAE										
Chromis vanderbilti										26
C. hanui										1
SYNODONTIDAE										
Saurida gracilis			1							
ZANCLIDAE										
Zanclus cornutus										2
Total Number of Species	1	5	1	4	5	3	9	1	15	12
Total Number of Individuals	1	20	1	13	28	4	21	1	33	47
Estimated Biomass (g/m^2)	1	2	0.3	0.1	9	0.2	9	0.4	57	47

H-1

Report Addendum 1:
Marine Communities and Water Quality in the Vicinity of Three Existing Ocean Discharges

REPORT ADDENDUM I:

MARINE COMMUNITIES AND WATER QUALITY

IN THE VICINITY OF THREE EXISTING OCEAN DISCHARGES

R.E. Brock

December 1994

1. PURPOSE

In the vicinity of Lihue Airport are two channels that handle runoff from the northeastern portion of this facility (the Ahukini Makai area). These channels drain directly into the sea to the east of the airport and function only during periods of high rainfall. The southern part of the airport as well as lands mauka of this facility (i.e., Molokoa) drain into Nawiliwili Stream which flows into the ocean at Nawiliwili Bay. With the development of the Lihue-Hanamaulu Master Planned Project in the area adjacent to the airport, it has been proposed that some the runoff from Ahukini Makai be routed to the two existing channels at the north end of the airport; most of the drainage from the Molokoa area of the project site will enter Nawiliwili Stream. In all cases, drainage from the proposed project will utilize existing pathways that now service these same lands. Detention basins are planned along some of the flow paths which will decrease the peak flows during periods of high rainfall. Kodani and Associates, Inc. (Final EIS, Appendix D) have estimated that the project, when completed, will result in a 17 percent increase in the volume of runoff from a 100-year, 24-hour storm event.

If allowed to proceed, the proposed plan calls for increasing the flow of storm water runoff in one and decreasing it in the second of the two existing drains at the north end of the airport and having the volume entering Nawiliwili Stream remain at the present level. Because these proposed changes could have an impact to marine communities in the receiving waters, an analysis of these communities in the vicinity of the drainage channels and fronting Nawiliwili Stream was undertaken. Additionally, water quality was examined at these locations. This report presents the results of this analysis thus providing a "baseline" during normal (dry) conditions. An analysis of the wet conditions (i.e., following heavy rainfall) will be undertaken at the first available opportunity.

2. LOCATION AND PHYSIOGRAPHY

A. North Drains

The locations of the two northerly ocean discharges are given in Figure 1; The most northerly channel drains directly into the head of Ahukini Bay (hereafter the "Ahukini Bay channel"). This drain discharges across a basalt boulder/coral rubble beach. The second channel is located about 450m south of Ahukini Bay (hereafter the "large south drain"). The large south drain discharges across a basalt boulder bench and into the sea. Both of these channels cut through a steep boulder strewn slope mauka of the beach.

Most of the coastline east of Lihue Airport faces directly east and is exposed to the prevailing tradewinds and seas. There is no offshore reef to protect and dissipate the impact of ocean swells which break directly on the shoreline. As a consequence, shallow marine communities are under the influence of frequent high energy conditions. The shoreline is primarily comprised of basaltic lava and loose boulders. Subtidally, the substratum is mostly limestone and/or large basalt boulders which gently slope seaward such that the 10m isobath is about 300m from shore. The study encompassed the area from the shoreline to about the 10m isobath; however, because impacts due to the operation of these drains would be most evident at points closest to the input, most of the field work was carried out within 200m of the shoreline.

B. Nawiliwili Stream

Nawiliwili is a periennal stream which carries some of the stormwater runoff from Lihue and surrounding residential areas during heavy rainfall and delivers it to Nawiliwili Bay. This stream originates near Kilohana Crater about 8 km inland and discharges into Nawiliwili Bay across the sand at Kalapaki Beach. Figure 2 shows the terminus of Nawiliwili Stream and adjacent nearshore area of Nawiliwili Bay.

Because of the near continuous input of freshwater from Nawiliwili Stream, marine communities are not well developed in the shallow water fronting the stream terminus. The substratum is a mix of sand and rubble until a depth of about 4.5m (about 80m offshore) where some wave scoured limestone is encountered. Seaward of this, the limestone continues to be the dominant substratum type and it remains relatively smooth and featureless due to wave action. Water depth decreases to a point where it is only 2.5m deep about 250m from shore. This shoaling creates a situation where incoming waves peak and break. Again because of the high energy conditions in this more seaward area, marine communities are not well developed.

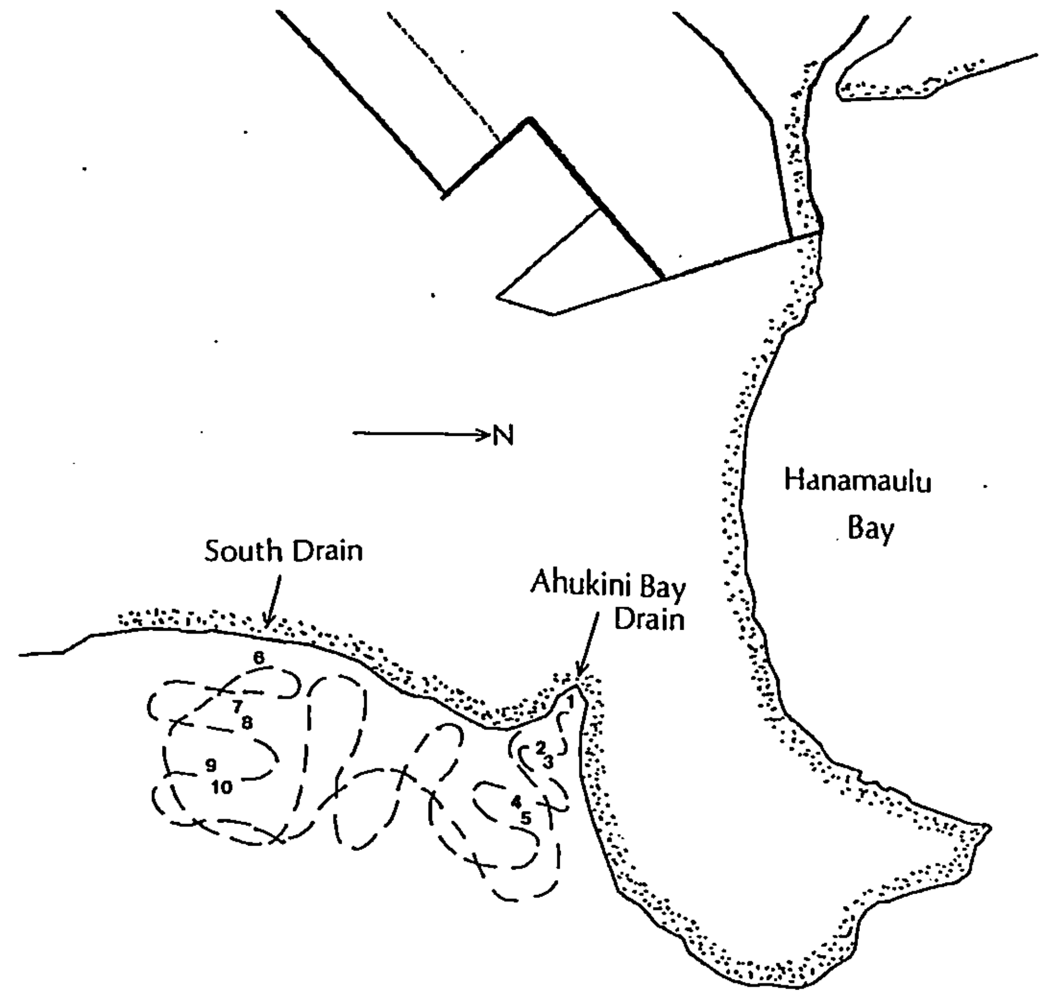

FIGURE 1. Map of the Ahukini makai area showing the approximate locations of the two drains that service the north portions of Lihue Airport and Ahukini makai. One drain enters the ocean at Ahukini Bay and the second (the large south drain) discharges into the ocean at a point approximately 450m south of Ahukini Bay. Also shown are the approximate tracks of the biological reconnaissance on 15 and 25 October 1994 (dashed lines). The locations of water quality sample sites are numbered (nos. 1-10). Figure not to scale.

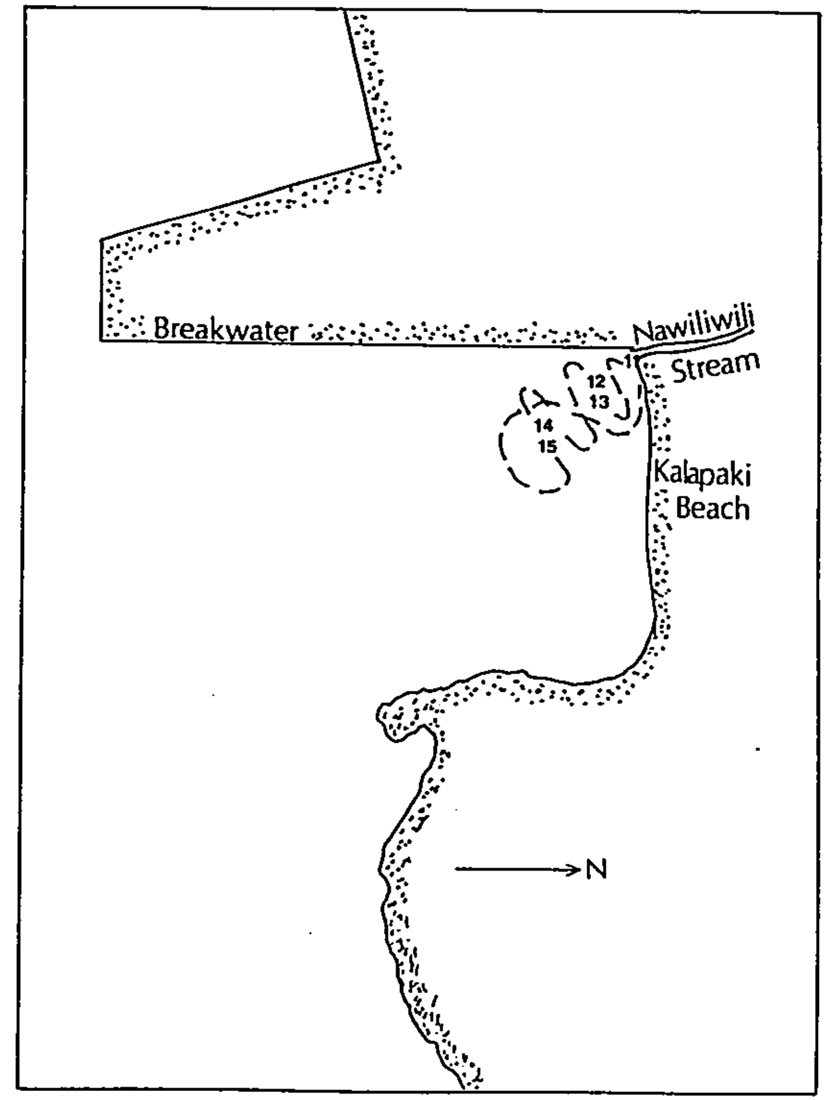

FIGURE 2. Map of the Kalapaki Beach area in Nawiliwili Bay. Also shown is the mouth of Nawiliwili Stream. The approximate track of the biological reconnaissance is shown as a dashed line and the locations of the five water quality sample stations are numbered (nos. 11-15). Figure not to scale.

From the limestone crest, the limestone gently slopes seaward to a point about 300m offshore of the stream terminus, where sand is encountered at a depth from 4 to 5.5m. As with the limestone, the sand slopes seaward such that at about 350m offshore the depth is about 8m.

3. STUDY METHODS

A. Biological Methods

Under the present configuration, stormwater runoff with other pollutants (sediment, etc.) is carried directly to the sea via the two drains at the northern end of the airport. Stormwater runoff from the Molokoa area and sections of Lihue enters Nawiliwili Stream which flows into Nawiliwili Bay at Kalapaki Beach. Thus marine communities directly seaward of these discharges are exposed to this input. If impacts are occurring to these communities due to the present level of input, a gradient of stress should be evident. The stress or impact will be greatest at the point of stormwater entry to the sea and will decline with distance from the discharge point.

Numerous studies have shown that sessile species such as the corals are particularly sensitive to freshwater input (Maragos 1972). Many motile species such as the fishes are usually less sensitive to these impacts; if conditions are not favorable, fishes may temporarily migrate to adjacent areas. Because of their sessile nature and inability to survive when subjected to low salinity water, the presence or absence of corals can, then, provide a rough measure of this perturbation. However, wave stress may similarly impact the growth and success of corals which can confound interpretation of causal mechanisms of local distribution. Usually where wave stress is a dominate parameter affecting distribution of corals, there will be some small amount of coral growth usually taking on very prostrate growth forms due to the scouring action of waves. Strong freshwater influence will generally result in little or no coral present on hard substratum exposed to this perturbation.

With this in mind, our sampling of benthic and fish communities was carried out using qualitative and semiquantitative techniques. An additional consideration here is the exposed nature of this coastline and usual rough sea conditions create a hazardous situation for entry and exit to the ocean as well as presenting a difficulty in carrying out the regular quantitative biological assessment techniques, particularly in areas close to shore. Because of these conditions particularly in the waters east of the airport, a qualitative/semiquantitative approach was used to determine the status of the marine communities in the

vicinity of the two drains as well as area around Nawiliwili Stream terminus.

For the rocky coastline, the approach entailed walking the shoreline, noting intertidal species (algae, snails, sea urchins, etc.) and their relative abundance. It also required entry into the water and snorkeling through much of the nearshore region fronting the two drainage channels and other adjacent areas noting species present and their relative abundance from a point adjacent to shore seaward to about the 8m isobath (up to 200m offshore). The waters fronting Kalapaki Stream were examined by snorkeling and avoiding the surfers in the area. Again, the local distribution and relative abundance of macroinvertebrates, algae (limu) and fish were noted in the area.

For safety reasons, two individuals carried out the field work on 15 and 25 October 1994. These individuals were equipped with snorkel gear as well as a slate and pencil to record information. During the biological work, a series of water samples were collected in the waters fronting each discharge point by the divers. Because a 3 to 4 foot swell was running at the time of the field surveys of the two drains east of the airport, divers entered and exited the ocean at Ahukini Bay, swimming down to the area fronting the larger drain.

Fishes, algae and diurnally exposed macroinvertebrates (i.e., those greater than 2cm in some dimension were recorded along with their relative abundances. These data were utilized in determining the present level of impact due to the operation of the discharges and the impact that may occur to nearby marine communities if stormwater flows were to change.

B. Water Chemistry Methods

Water quality parameters were measured at 15 locations (station numbers 1 through 15, Figures 1 and 2). Samples were taken in an "onshore-offshore" transect. In general a sample was taken along the shoreline, a pair of samples (one on the surface and the second at depth beneath the surface sample) that represent a "mid-distance" from shore, and a second pair (surface and deep) well offshore. At the Ahukini Bay drain, sample 1 was taken in the shorebreak, sample 2 near the bay mouth (about 100m from shore) on the surface, sample 3 in 3.5m of water just beneath sample 2, sample 4 from the surface about 200m offshore and sample 5 from beneath sample 4 at a depth of 7m. Fronting the large drain, 450m south of Ahukini Bay, the shoreline sample was taken in the shorebreak (a difficult area to sample), a second pair about 100m offshore (surface and 7m depth), and the second pair about 250m offshore (surface and 10m depth). Samples taken in the waters fronting Nawiliwili Stream were at the shoreline, a pair at a distance of 100m offshore (surface and 3m depth) and a second pair seaward of the surf break (about 300m offshore) on the surface and at a 7m depth.

Water quality parameters that were evaluated are the same as those studied in Hanamaulu Bay. These include the specific criteria for "Class A waters for embayments" as well as those for "Class A for open coastal waters" as given in Title 11, Chapter 54, Amended Administrative Rules for Water Quality Standards (1992). These criteria include ammonia nitrogen, nitrate + nitrite nitrogen (hereafter nitrate nitrogen), total nitrogen, orthophosphate phosphorus, total phosphorus, chlorophyll-a and nephelometric turbidity. Also collected were samples for the non-specific criteria including oxygen, temperature, pH and salinity as well as the nutrient, silica at each station.

Water samples were collected by opening one-liter polyethylene bottles at the desired depth. These bottles were all triple rinsed using the sample water prior to sample collection. Subsamples for nutrient analyses were filtered through glass fiber filters and immediately placed in 125ml acid-washed, triple rinsed polyethylene bottles and stored on ice until returned to Honolulu for later analysis. Analyses for ammonia nitrogen, orthophosphate and nitrate are performed using a Technicon autoanalyzer following standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). Total nitrogen and total phosphorus are similarly analyzed following digestion.

Turbidity samples were collected as unfiltered water and stored on ice in 125ml polyethylene bottles until measurements were made. Turbidity was measured on a Monitek Model 21 nephelometer following procedures as described in Standard Methods (1985). Chlorophyll-a samples were collected by filtering known volumes of sample water through glass microfiber filters; filters were stored frozen in dark containers until analysis. Pigments were extracted in 90 percent acetone in the dark for 12 to 24 hours and flourscence before and after acidification was measured on a Turner Designs flourometer. Salinity samples were collected in triple rinsed 125ml polyethylene bottles and were analyzed on a AGE Model 2100 laboratory salinometer with precision of 0.0001%. In-situ field measurements of temperature, oxygen and pH were made using a YSI Model 58 oxygen meter and a Hanna Instruments pH/mV pH meter (model no. HI 9025).

All methods used in the water quality sampling program were identical to those used previously in Hanamaulu Bay and follow those as outlined by the West Hawaii Coastal Monitoring Task Force (1992) recommendations for water quality studies.

4. EXISTING CONDITIONS

A. General Considerations

Permits issued for most coastal construction today require the development of retention basins on-site. The two subject drains were constructed to service Lihue Airport and do not have retention basins. Development of retention basins adjacent to the airport would result in these basins retaining water following periods of heavy rain. These "ponds" could serve to attract waterfowl. In most settings, providing additional habitat for shore and wading birds (some of which are endangered) would be considered a positive benefit. However with the proximity of the airport, birds are considered to be a liability with aircraft. As a result the Department of Transportation does not favor the development of retention basins in proximity to the airport and the existing channels carry runoff directly to the ocean.

B. Flow Rates

According to Kodani and Associates, Inc. (Final EIS, Appendix D) the Ahukini Bay drain will carry 382 cfs during a projected 24-hour, 100-year storm event. The proposed changes to the mauka lands will decrease this maximum flow to 224 cfs which amounts to a 41 percent decrease. This change will result in less stormwater and sediment discharging into Ahukini Bay during a major storm event thus lessening possible impacts to marine communities in the bay.

The southern drain has a calculated discharge of 1511 cfs during a projected 24-hour, 100-year rainfall event. With the development, the discharge will be increased to 1902 cfs, an increase of 391 cfs (or 26 percent). Overall, it is projected that the proposed development will increase the flow of stormwater to the ocean during a 24-hour, 100-year storm by 12 percent over what would enter the sea from these two drains if a 100-year storm were to occur now (i.e., predevelopment = 1893 cfs, postdevelopment = 2126 cfs; Kodani and Associates, Inc., Final EIS, Appendix D).

The flow of stormwater into Nawiliwili Stream from the Molokoa portion of the project during a 24-hour, 100-year storm event under present conditions is projected to be 811 cfs; following the development of the Molokoa area, this peak flow is calculated to be 810 cfs, thus little change in flow from this project to Nawiliwili Stream is anticipated (Kodani and Associates, Inc., Final EIS, Appendix D).

C. MARINE COMMUNITIES

(1). Ahukini Bay

As noted above, most of the subject coastline is subject to the direct impact of ocean swells. Ahukini Bay is one of the few places that provides a relatively safe entry into the ocean during periods of surf (which is most of the time). However, the bay is small and is not well protected from surf.

At the head of the bay is a rubble/cobble beach; otherwise the shoreline of the bay is similar to the remainder of the coast which is dominated by a mix of lava/limestone bench and basalt boulders. At Ahukini Bay the intertidal portion of the boulders and bench have a characteristic assemblage of species. High in the intertidal is the snail (Littorina pinctado). Further seaward is found the alga hulu'ilio (Giffordia breviarticulata). Below this, the algal community becomes much more complex with a number of species present including Acanthophora spicifera, Padina japonica (in tidepools), limu kala (Sargassum echinocarpum), Turbinaria ornata, aki'aki (Ahnfeltia concinna), Grateloupia hawaiiana, Grateloupia phuquoensis, and mane'one'o (Laurencia nidifica). Lower in the intertidal is the encrusting coralline alga Porolithon onkodes and the limu loloa (Pterocladia capillacea). There are a number of other algal species present, many of which are small and less easily identified in the field. A number of invertebrates are encountered in the intertidal at Ahukini Bay; among these are the opihi (Patella sandwichensis), the snake head cowry (Cypraea caputerpentis), the reticulated cowry (Cypraea reticulata), the hebrew cone shell (Conus ebreus), the brown sea cucumber (Actinopyge maruitana), the vermetid (Vermetus alii), the green urchin (Echinometra mathaei), the black urchin (Echinometra oblongata), the shingle urchin (Colobocentrotus atratus) and the ama'ama crab (Grapus grapus). Opihi are not common along this coast; estimated densities range from 1 individual per 3 to 15m^2. On more exposed sections of the coast where the prevailing surf impinges directly onshore and opihi picking is more dangerous (i.e., near the large drain), densities will range up to one individual/0.1m^2.

Intertidal or tidepool fishes include the blenny or pao'o (Istiblennius zebra and Entomacrodus marmoratus), the manini (Acanthurus triostegus), the aholehole (Kuhlia sandvicensis) and the awela (Thalassoma trilobatum). This intertidal and tidepool community is found as a near continuous band along much of the coastline including the area around the large drain 450m south of Ahukini Bay.

The approximate tracks of two visits through the bay and areas seaward and to the south are given in Figure 1; these

tracks depict areas examined in this study and reported on below.

Subtidally the communities in Ahukini Bay are more diverse than those found on the intertidal bench. The subtidal substratum is primarily a mix of large basalt boulders with smaller material including some sand between them; further offshore, the boulders mix with some limestone and eventually sand becomes more common at a distance of about 200m offshore. Corals in Ahukini Bay are first encountered at a distance of about 40m from the head of the bay at a depth of 1.5 to 2m. At a point commencing about 50m from the shore the coral, Pavona duerdeni, is encountered and forms colonies up to 1.2m in diameter suggesting that this part of the bay is reasonably sheltered from the east swell that dominates most of this coastline. Corals found in this area besides Pavona duerdeni include Porites lobata, Pocillopora meandrina, Montipora patula, M. verrucosa and M. verrilli and mean coverage varies between 5 to 10 percent. Seaward of this small area at a distance of about 80m from shore and below a depth of about 3.5m, coral coverage declines to less than 1 percent.

The macrothalloid algae or limu is not particularly conspicuous in Ahukini Bay. The boulders have a mix of the encrusting coralline Porolithon onkodes and down in crevices is seen Amansia glomerata.

Other species seen in Ahukini Bay include the soft coral Palythoa tuberculosa with coverage less than 1 percent, the sea cucmbers (Holothuria atra and Actinopyge mauritana), wana (Echinothrix diadema and E. calamaris), the black urchin (Tripneustes gratilla) and the green urchin (Echinometra mathaei). Invertebrate species of commercial value seen in Ahukini Bay include several small 'ula or spiny lobster (Panulirus penicillatus), the humpback cowry (Cypraea mauritiana) and one small octopus or he'e (Octopus cynaea). Fish communities are reasonably well developed in Ahukini Bay with numerous surgeonfishes and wrasses present. Common species include puhi laumilo (Gymnothorax undulatus), piliko'a (Paracirrhitus arcatus), hilu piliko'a (P. forsteri), weke (Mulloides flavolineatus), moano (Parupeneus multifasciatus), kikakapu (Chaetodon fremblii, C. multicinctus), kupipi (Abudeduf sordidus), damselfishes (Plectroglyphidodon imparipennis, P. sindonis, Stegastes fasciolatus), hinalea 'akilolo (Coris gaimard), hinalea lauwili (Thalassoma duperrey), awela (Thalassoma trilobatum), 'akilolo (Gomphosus varius), 'omaka (Stethojulis balteata), uhu (Scarus sordidus), kihikihi (Zanclus cornutus), manini (Acanthurus triostegus), maikoiko (Acanthurus leucoparieus), na'ena'e (Acanthurus olivaecus), palani (Acanthurus dussumieri), paku'iku'i (Acanthurus achilles), ma'i'i'i (Acanthurus nigrofuscus), kole (Ctenochaetus strigosus), umaumalei (Naso lituratus), humuhumu lei (Sufflamen bursa), humuhumu 'ele'ele (Melichthys niger) and the sharpback puffer (Canthigaster jactator). On both visits to Ahukini Bay a large school of the introduced "Marquesan" sardine (Herklotsichthys quadrimaculatus) was present; accompaning this school of baitfish were several kaku (Sphyraena barracuda) and small omilu (Caranx melampygus).

Corals are absent from the innermost reaches of Ahukini Bay as are a number of echinoderm species (i.e., some sea urchins and sea cucumbers that are sensitive to lower salinity conditions) suggesting that freshwater runoff emanating from the drain has retarded their development in this shallow, confined area (up to 1.2m deep). However as noted above, corals are first encountered about 40m from the shore at a depth from 1 to 1.2m and increase in abundance over the next 30m seaward to a depth of about 3.5m. Outside of this area which is near the mouth of the bay, the hard bottom appears to be scoured and benthic communities are poorly developed suggesting that wave activity retards their development from this point seaward. Thus Ahukini Bay appears to afford a small amount of shelter from the prevailing seas allowing better development of corals than encountered in more seaward areas. The fish communities are reasonably well developed but the behavior of most fishes in Ahukini Bay suggest that spearfishing occurs more frequently there than in the areas outside and south of the bay.

Seaward of Ahukini Bay a largely sand substratum is encountered at a distance of about 250m from shore (the outer limit of this study) where the depth is about 8 to 10m. Since the sand affords no solid substratum for corals and does not provide shelter for many coral reef species, few diurnally exposed macroinvertebrates or fishes are usually seen in this habitat.

(2). Large South Drain

This drain is located about 450m south of Ahukini Bay and as noted above, discharges across a boulder strewn intertidal bench. The fauna and flora of this bench is similar to that seen at Ahukini Bay; the only major differences are the greater abundance of opihi (Patella sandwichensis - up to 1 individual/$0.1m^2$) and shingle urchins (Colobocentrotus atratus - up to 1 individual/$0.3m^2$) probably due to the greater difficulty in harvesting these species on this wave swept bench.

Within 100m of shore in the area between Ahukini Bay and fronting the main south drain, the subtidal substratum is a mix of large basalt boulders and limestone. The boulders are more prevalant close to shore creating cover for fishes and invertebrates. Further offshore, the flat limestone and lava substratum

becomes a more dominant feature eventually grading into a largely sand habitat at a distance of 250-300m from shore (about 10m depth).

Corals are not a common element in the benthic communities within 200m of shore. Indeed, in an area about 40m in width and extending about 30m to 40m offshore of the area where the large south drain discharges into the ocean, corals are notably absent. To either side of this, the coral community within 100m of shore is dominated by Pocillopora meandrina; other species commonly seen include Porites lobata, Pocillopora molokensis, Porites rus, Montipora patula, M. verrilli and M. verrucosa as well as the soft coral, Palythoa tuberculosa. Nowhere does coral coverage exceed 1 percent; however, in the area between 100-200m offshore, the same species persist and coverage may locally range up to 15 percent (in areas from 2 to $20m^2$) but overall, it remains at less than 5 percent.

The most common macrothalloid algal species seen offshore is the encrusting coralline, Porolithon onkodes. Other species seen include Amansia glomerata, mane'one'o (Laurencia nidifica) and a Liagora species. Macroinvertebrates seen include the brown sea cucumber (Actinopyge mauritana), wana (Echinothrix diadema and E. calamaris), black urchin (Tripneustes gratilla), he'e (Octopus cyanea), polychaete (Loimia medusa) and 'ula or spiny lobster (Panulirus penicillatus).

Fishes are a common element in these waters; species that are commonly encountered include the menpachi (Myripristes amaena), ala'ihi (Flammeo sammara, Sargocentron diadema, S. xantherythrum), aholehole (Kuhlia sandvicensis), aweoweo (Heteropriacanthus cruentatus), la'i (Scrombroides laysan), papio (Caranx orthogrammus), po'opa'a (Cirrhitus pinnulatus), piliko'a (Paracirrhitus arcatus), hilu piliko'a (P. forsteri), taape (Lutjanus kasmira), nenue (Kyphosus bigibbus), mu (Monotaxis grandoculis), roi (Cephalopholis argus), weke (Mulloides flavolineatus), weke'ula (Mulloides vanicolensis), kumu (Parupeneus porphyreus), moano (Parupeneus multifasciatus), kikakapu (Chaetodon fremblii, C. unimaculatus, C. auriga, C. multicinctus, C. lunula), lauwiliwili nukunuku'oi'oi (Forcipiger flavissimus), kupipi (Abudefud sordidus), mamo (Abudefduf abdominalis), damselfishes (Plectroglyphidodon imparipennis, P. sindonis, Stegastes fasciolatus), a'awa (Bodianus bilunulatus), hilu (Coris flavovittata), hinalea 'akilolo (Coris gaimard), hinalea lauwili (Thalassoma duperrey), awela (Thalassoma trilobatum), 'akilolo (Gomphosus varius), 'omaka (Stethojulis balteata), uhu (Scarus sordidus), uhu'ahu'ula (Scarus perspicillatus), palukaluka (Scarus rubroviolaceus), kihikihi (Zanclus cornutus), manini (Acanthurus triostegus), maikoiko (Acanthurus leucoparieus), na'ena'e (Acanthurus olivaecus), palani (Acanthurus dussumieri), pualu (Acanthurus blochii), paku'iku'i (Acanthurus achilles), ma'i'i'i (Acanthurus nigrofuscus), maiko (Acanthurus nigroris), kole (Ctenochaetus strigosus), umaumalei (Naso lituratus), humuhumu lei (Sufflamen bursa), humuhumu 'ele'ele (Melichthys niger), keke (Arothron hispidus) and the sharpback puffer (Canthigaster jactator).

Physical disturbance from occasional storm surf is one of the most important parameters in determining the structure of Hawaiian coral communities (Dollar 1982). Numerous studies have shown that occasional storm generated surf may keep coral reefs in a non-equilibrium or sub-climax state (Grigg and Maragos 1974, Connell 1978, Woodley et al. 1981, Grigg 1983). Indeed, the large expanses of near-featureless lava or limestone substratum present around much of the Hawaiian Islands at depths less than 30m attest to the force and frequency of these events (Brock and Norris 1989). These same wave forces also impinge and impact fish communities (Walsh 1983).

The results of the biological survey of the area offshore of the two drains suggest that this area, like many other Hawaiian marine communities receives occasional, albeit considerable, wave impact. In general the open substratum with low coral coverage is probably the result of wave action retarding the growth and development of coral communities. The small size of many of the coral colonies suggests that wave forces are important in structuring the benthic communities in these areas. The impact of wave forces is attenuated in locations which are sheltered from the prevailing seas such as in a small part of Ahukini Bay and in this location, coral communities are better developed. However, these conditions appear to be rare on this coast.

One green sea turtle was seen in the area between Ahukini Bay and the large south drain on 15 October 1994. This turtle was in water approximately 4m in depth and appeared to be transiting the area (moving north towards Hanamaulu Bay). The straight line carapace length was estimated to be 60cm.

In the shallows fronting the large south drain there is evidence (by the lack of corals) of freshwater input; to either side (north and south) corals (Pocillopora meandrina and Porites lobata) are seen albeit in low coverage probably due to the impact of waves and sand scour. Seaward of this area corals are more obvious but throughout the entire area the high degree of exposure to wave impact in water less than 10m in depth appears to be a major factor affecting the distribution of corals and other benthic species along this coast. Fishes and macroinvertebrates are most evident in the areas where the basalt boulders are in close proximity to one another forming shelter. At small scales (less than $10m^2$) corals appear to be best developed on hard substratum that is elevated above the general topography,

thus away from some of the sand scour due to wave activity.

The high energy conditions along this coast suggest that freshwater discharged into the sea is rapidly mixed and advected out of the shallow areas where corals are present.

(3). Nawiliwili Bay

As noted above, the substratum directly offshore of Nawiliwili Stream terminus is primarily sand eventually becoming a smooth limestone that shoals about 250m from the shore creating the wave break enjoyed by surfers. This hard substratum gently slopes seaward and terminates about 300m offshore at a depth of 4 to 5.5m where sand is again encountered.

Species seen on the inshore sand substratum were few; present was the black sea cucumber (Holothuria atra), the flea cone (Conus pulicarius), the 'ulae (Synodus binotatus) and a small papio (Caranx ignobilis). On the seaward adjacent hard substratum, a number of black sea urchins (Tripneustes gratilla), wana (Echinothrix diadema and E. calamaris), were present. The fish community in this area is not well developed probably because of the scarcity of appropriate shelter. Among the few species seen in our survey, were 'omaka (Stethojulis balteata), hinalea lauwili (Thalassoma duperrey), la'i (Scrombroides laysan), and o'opu (Bathygobius fuscus). Interviewing fishermen in the area indicated that papio (various species of the family Carangidae), 'oio (Albula vulpes), and moi'li'i (Polydactylus sexfilis) are among the species caught in the area. We expect that hahalalu (Selar crumenophalmus) must also enter Nawiliwili Bay on occasion and provide a source of recreation and protein to the residents of the area. However, none of these species were seen during our survey.

Other than coralline algae (primarily Porolithon onkodes), little else was seen on the hard substratum in the area of the surf break; however seaward of the shallow crest are some small corals (Porites lobata and Pocillopora meandrina) with coverage much less than 1 percent as well as a number of depressions in the hard substratum (up to 3m in diameter). These depressions have a maximum depth of about 35cm and being undercut, afford some shelter for fishes and invertebrates. The depressions are spaced from 10 to 35m apart and a number of fishes and invertebrates were noted in them. Included were the following fishes: hinalea lauwili (Thalassoma duperrey), 'omaka (Stethojuli balteata), wrasse (Coris venusta), maiko (Acanthurus nigroris), ma'i'i'i (Acanthurus nigrofuscus), manini (Acanthurus triostegus), pualo (Acanthurus blochii), humuhumu nukunuku apua'a (Rhinecanthus rectangulus), malu (Parupeneus pleurostigma), kumu

(_Parupeneus porphyreus_) and damselfish (_Chromis hanui_). Among the macroinvertebrates seen were a single small he'e (_Octopus cyanea_), the cone (_Conus lividus_), several juvenile 'ula or spiny lobsters (_Panulirus marginatus_) and a single small swimming crab (_Charbydis_ sp.). On the sand seaward of the hard substratum and surf break were seen a single paki'i (_Bothus mancus_), several small nabeta (_Hemipteronotus pavonius_), auger shells (_Terebra inconstans_, _T. maculata_) and a large leopard cone (_Conus leopardus_).

The marine communities in the waters fronting Nawiliwili Stream terminus are probably not heavily impacted by the input of freshwater because this impact is probably near-continuous and the communities present are those that can exist with this perturbation. In the more seaward area, the hard substratum is subjected to considerable sand scour due to wave activity. Few corals are present (cover much less than 1%).

(4). Fishery Resources

The exposed coastline east of Lihue Airport receives some recreational fishing effort. On the 15 October 1994 visit (a Saturday) we noted four vehicles and about 15 individuals in the vicinity of Ahukini Bay and the large drain to the south; about 5 individuals were hook and line fishing and two people were using throw nets. However on the 25 October visit (a normal workday), we did not see any fishermen in this area. The relative abundance of fish along much of the exposed coast suggests that the surf conditions do not permit much fishing from shore other than shore casting. In an interview with two individuals, it was noted that when the seas are down, some people fish this coast using small boats launched in Nawiliwili but this is not a frequent occurrence.

Relative to many shallow water sites on Oahu, the fish community development on the exposed shoreline east of Lihue Airport is diverse and despite the rough sea conditions, the abundance of fishes is high. This is probably related to the relatively low fishing pressure exerted on these stocks.

In contrast, the more sheltered and easy access of Kalapaki Beach and adjacent breakwater favor shore fishing activities. We did not encounter any fishermen on Kalapaki Beach on 25 October but there were a number of pole fishermen fishing from the breakwater located west of the beach. As noted above, we did not encounter a large or diverse fish community in the water fronting the terminus of Nawiliwili Stream. Based on our limited observations in Nawiliwili Bay, most fishing appears to be carried out in areas away from the terminus of Nawiliwili Stream.

D. Water Chemistry

The results of the water quality sampling are presented in Table 1. The data are given under two classes: open coastal waters and embayments. State water quality standards for embayments are different from those for open coastal waters. The water quality samples collected offshore of the Ahukini Bay drain (samples 1 - 5) and the large south drain (samples 6 - 10) are from open coastal waters and the samples collected offshore of Nawiliwili Stream in Nawiliwili Bay (samples 11 - 15) are from an embayment. These classifications have been established in the state Department of Health Administrative Rules Chapter 11-54 and with each are a different set of water quality standards. The water quality standards for embayments are given in Table 2 and Table 3 presents the more stringent standards for open coastal waters.

There are several generalizations that can be drawn from the data in Table 1. First, there is a slight salinity depression and concurrent higher concentration of nitrate nitrogen and silica in the nearshore samples at Ahukini Bay. Freshwater from land (groundwater and runoff) usually has much greater concentrations of these nutrients than found in ocean water. Thus, a concentration gradient is often apparent where freshwater is entering the sea. The same trend is apparent for the samples collected offshore of Nawiliwili Stream but is absent in the waters fronting the large south drain. The second trend is that the geometric mean for chlorophyll-_a_ exceeds the state standards for both embayments (Table 2) and open coastal waters (Table 3). Similarly, the geometric mean for nitrate nitrogen exceeds the state "dry" standards for embayments. "Dry" criteria for embayments apply when the average freshwater flow from land is less than one percent of the embayment volume. Five streams flow into Nawiliwili Bay (Nawiliwili Stream, Puali Stream, Papakolea Stream, Huleia Stream and Puakukui Stream). Lacking data on the average flow of freshwater and the volume of Nawiliwili Bay, we have applied the more stringent "dry" criteria for embayments in this analysis. "Dry" coastlines for open coastal criteria are those defined as receiving less than 3 million gallons of freshwater per shoreline mile from land. The open coastline east of Lihue Airport probably does not have significant stream and groundwater flow under normal conditions, thus the dry criteria would apply.

It is interesting to note that State standards for coastal waters are frequently exceeded irrespective of the presence of nearby coastal development. Brock and Kam (1990) found that under dry conditions, nitrate nitrogen concentrations are equal to dry criteria for waters fronting Lahaina , Maui (a developed coastline) and that chlorophyll-_a_ exceeded the wet criteria.

TABLE 1. Summary of the water quality parameters as measured at 15 sites in this study. In the body of the table concentrations of dissolved nutrients are given in uM. Open coastal water samples (nos. 1-10, the two northern drains) are separated below from embayment (Nawiliwili Bay) samples. Geometric means for open coastal waters and embayments are given separately at the foot of the table. Underlined values are at or exceed "dry" Department of Health water quality standards. ND = below detection limits. Table continued on the next page.

Station	Nitrate N	Ammonia N	Total N	Ortho P	Total P	Silicate	DON	DOP
Open Coastal Samples								
1	2.72	0.94	8.41	0.26	0.47	13.65	5.69	0.21
2	0.24	ND	5.22	0.16	0.39	4.04	4.98	0.23
3	0.14	ND	5.37	0.16	0.39	5.77	5.23	0.23
4	0.14	ND	4.93	0.15	0.35	4.23	4.79	0.20
5	0.12	ND	4.79	0.16	0.41	4.04	4.67	0.25
6	0.16	ND	5.08	0.16	0.38	5.00	4.92	0.22
7	0.16	ND	4.64	0.13	0.39	4.42	4.48	0.26
8	0.18	ND	5.22	0.13	0.42	6.54	5.04	0.29
9	0.12	ND	4.79	0.15	0.39	4.23	4.67	0.24
10	0.24	0.03	5.08	0.14	0.39	9.04	4.84	0.25
GEOMETRIC MEANS	0.21	0.10	5.27	0.16	0.40	5.59	4.92	0.24

Station	Nitrate N	Ammonia N	Total N	Ortho P	Total P	Silicate	DON	DOP
Embayment Samples								
11	3.34	0.31	8.85	0.17	0.45	25.38	5.41	0.28
12	1.12	0.13	6.96	0.16	0.43	15.38	5.84	0.27
13	1.04	0.16	6.82	0.16	0.47	10.96	5.78	0.31
14	1.16	0.16	6.53	0.16	0.43	10.58	5.37	0.29
15	0.56	0.34	6.82	0.15	0.53	7.50	6.26	0.38
GEOMETRIC MEANS	<u>1.21</u>	0.20	7.15	0.16	0.46	12.77	5.72	0.30

TABLE 1. Continued.

Station	Turbidity (NTU)	Chlorophyll a (ug/l)	Salinity (°/oo)	Temp (°C)	Oxygen (% Sat)	pH
Open Coastal Samples						
1	0.75	0.537	33.851	26.5	103	8.05
2	0.13	0.333	34.393	26.5	102	8.10
3	0.14	0.307	34.392	26.5	102	8.12
4	0.12	0.409	34.321	26.5	101	8.10
5	0.09	0.358	34.331	26.5	103	8.10
6	0.21	0.486	34.244	26.5	102	8.09
7	0.16	0.537	34.248	26.5	103	8.08
8	0.14	0.486	34.258	26.5	102	8.09
9	0.09	0.486	34.298	26.5	101	8.10
10	0.19	0.486	34.311	26.5	102	8.09
Geometric Means	0.16	<u>0.435</u>	34.264	26.5	102	8.09

Station	Turbidity (NTU)	Chlorophyll a (ug/l)	Salinity (°/oo)	Temp (°C)	Oxygen (% Sat)	pH
Embayment Samples						
11	0.32	0.435	31.863	26.5	104	8.12
12	0.31	0.588	33.466	26.5	102	7.92
13	0.28	0.588	33.389	26.5	103	7.99
14	0.22	0.537	33.586	26.5	102	8.05
15	0.36	0.960	34.235	26.5	103	8.07
Geometric Means	0.29	<u>0.600</u>	33.299	26.5	103	8.03

TABLE 2. Specific criteria specified by the Department of Health water quality standards for embayments with Class A waters as amended in 1992. Standards converted from ug/l to uM.

Parameter	Geometric mean not to exceed the given value	Not to exceed the given value more than 10% of the time	Not to exceed the given value
Total Nitrogen (uM)	14.29* 10.71**	25.00* 17.86**	35.71* 25.00**
Ammonia Nitrogen (uM)	0.43* 0.25**	0.93* 0.61**	1.43* 1.07**
Nitrate+Nitrite Nitrogen (uM)	0.57* 0.36**	1.43* 1.00**	2.50* 1.79**
Total Phosphorus (uM)	0.81* 0.65**	1.61* 1.29**	2.42* 1.94**
Chlorophyll-a (ug/l)	1.50* 0.50**	4.50* 1.50**	8.50* 3.00**
Turbidity (NTU)	1.50* 0.40**	3.00* 1.00*	5.00* 1.50**

1. * "Wet" criteria apply when the average freshwater inflow from the land equals or exceeds one percent of the embayment volume per day.
2. ** "Dry" criteria apply when the average fresh water inflow from the land is less than one percent of the embayment volume per day.
3. Applicable to both "wet" and "dry" conditions:
4. pH Units - shall not deviate more than 0.5 units from a value of 8.1, except at coastal locations where and when freshwater from stream, storm drain or groundwater discharge may depress the pH to a minimum level of 7.0.
5. Dissolved Oxygen - Not less than 75% saturation, determined as a functio of ambient water temperature and salinity.
6. Temperature - Shall not vary more than 10% from natural or seasonal changes considering hydrologic input and oceanographic factors.
7. Orthophosphate was eliminated from the list of requirements in the revised 1988 document but because of its biological importance, it was measured in this study.

TABLE 3. Specific criteria specified by the Department of Health water quality standards for open coastal marine waters as amended in 1992. Concentrations are given in uM.

Parameter	Geometric mean not to exceed the given value	Not to exceed the given value more than 10% of the time	Not to exceed the given value
Total Nitrogen (uM)	10.71* 7.85**	17.86* 12.86**	25.00* 17.86**
Ammonia Nitrogen (uM)	0.25* 0.14**	0.61* 0.36**	1.07* 0.64**
Nitrate+Nitrite (uM)	0.36* 0.25**	1.00* 0.71**	1.79* 1.43**
Total Phosphorus (uM)	0.65* 0.52**	1.29* 0.97**	1.94* 1.45**
Chlorophyll-a (ug/l)	0.30* 0.15**	0.90* 0.50**	1.75* 1.00**
Turbidity (NTU)	0.50* 0.20**	1.25* 0.50**	2.00* 1.00**

* "Wet" criteria apply when the open coastal waters receive more than three million gallons per day of fresh water discharge per shoreline mile.

** "Dry" criteria apply when the open coastal waters receive less than three million gallons per day of fresh water discharge per shoreline mile.

Applicable to both "Wet" and "Dry" conditions:

Salinity - shall not vary more than 10 percent from natural or seasonal changes considering hydrologic input and oceanographic factors.

Orthophosphate was eliminated from the list of requirements in the revised 1988 document but because of its biological importance, it was measured in this study. The old "Wet" criteria was 0.23 uM and the "Dry" standard was 0.16 um.

Following heavy rainfall (858mm or 3.38 inches over a 24-hour period), nitrate nitrogen, turbidity and chlorophyll-a all exceeded state standards (Brock 1990a). At Mahukona, Hawaii an area with little surrounding development, both chlorophyll-a and ammonia nitrogen exceeded dry standards (Marine Research Consultants 1989, Brock 1990b). A weekly ocean water quality monitoring program has been in place at the Natural Energy Laboratory of Hawaii Authority (NELHA) at Kehole Point, Hawaii since 1982. The waters offshore of Keahole Point are considered to be pristine; the presence of high quality deep ocean water adjacent to shore was an important factor in locating the NELHA facility there. The longterm mean for ammonia nitrogen at Keahole Point is 0.36 uM which exceeds the state dry standard for open coastal waters (NELHA data are courtesy of the University of Hawaii Analytical Services Laboratory).

In some cases the imposition of numerical standards may not be realistic especially in light of the fact that water quality measurements made on completely undeveloped coastlines may be far from compliance. This is particularly true following a high rainfall event; it is expected that following heavy rainfall, many of the parameters measured in Nawiliwili Bay and offshore of the two drains east of Lihue Airport will probably be out of compliance. These same parameters measured in water offshore of a stream draining a completely undeveloped watershed may temporarily also be out of compliance (Brock 1994). The Department of Health has recognized the problem of using strict numeric standards that may not be appropriate for every coastal area and is addressing it by supporting a research program at the University of Hawaii to determine if ecologically based standards might be developed which would avoid the use of a single set of numerical standards. The author is involved in this research effort.

5. IMPACTS WITH PROPOSED CHANGES

The proposed development will create changes in the discharge of stormwater runoff to the sea through the three discharge points under consideration here, i.e., Ahukini Bay and the large drain 450m to the south both of which discharge directly into the ocean east of Lihue Airport as well as Nawiliwili Stream which discharges into Nawiliwili Bay at Kalapaki Beach. These changes include alteration in the volume of runoff with a major storm event as well as changes in the quality (i.e., chemical composition and amount of sediment) of the water being discharged.

As noted above, Kodani and Associates, Inc. (Final EIS, Appendix D) calculate that overall the increase in the volume of runoff that would be generated from the project site (on build-

out) during a 24-hour, 100-year storm would be 17 percent over the volume that would be generated during the same storm event under the present land uses. Insofar as the two drains at the north end of Lihue Airport are concerned, it is estimated that the flow of runoff from the 24-hour, 100-year storm event would decrease by 41 percent to the Ahukini Bay drain (existing calculated flow = 382 cfs, future calculated flow = 224 cfs) and it would increase by 26 percent at the large south drain (existing calculated flow = 1511 cfs, future calculated flow = 1902 cfs).

The calculated change in stormwater runoff with a 24-hour, 100-year storm event to Nawiliwili Stream from the project site (the Molokoa area) following buildout would not change (existing calculated flow = 811 cfs, future calculated flow = 810 cfs; Kodani and Associates, Inc., Final EIS, Appendix D).

Of the three discharges under consideration here, only the large drain south of Ahukini Bay will show an increased discharge (a calculated increase of 391 cfs from a 24-hour, 100-year storm event). As noted above, this drain discharges into the ocean at a very exposed location. The results of the biological inventory of the area fronting the large south drain suggests that the present operation of this drain has affected the distribution of corals over an estimated 160m^2 area just offshore and fronting the point where runoff enters the ocean. Corals are absent in this area but in the adjacent areas at similar distances offshore corals remain sparse with coverage less than 1 percent probably due to wave impact. The lack of corals in this area is the only discernible biological response to the occasional discharge of freshwater. Just seaward of the non-coral zone fronting the drain, water depth increases from 1-2m to about 3.5-4m over a short distance (10-15m). It is expected that the magnitude of increase in runoff will probably not be great enough to impact the sparse coral coverage in a seaward direction because of (1) the relatively high mixing and advection due to the exposed nature of this coast and (2) the increasing depth with greater distance from shore which decreases the probability of lighter freshwater making contact with the substratum.

Approximately 97 percent of the 555 acres of the project area is in sugar production and has been so for many years. Kodani and Associates, Inc. (Final EIS, Appendix D) present the results of a simulation model which found that sediment loss from the project site under the 24-hour, 100-year rainfall event was significantly greater under every stage of sugar cultivation relative to when the land is developed either with or without retention basins. The model suggests that the present use of these lands probably allows a greater loss of sediment today than would occur with development.

Sedimentation has been implicated as a major environmental problem for coral reefs. Increases in turbidity may decrease light levels resulting in a lowering of primary productivity. Perhaps a greater threat would be the simple burial of benthic communities that may occur with high sediment loading. Many benthic species including corals are capable of removing sediment settling on them but there are threshold levels of deposition where cleaning may be overwhelmed and the individual becomes buried. However the impact of sedimentation on Hawaiian reefs may be overstated. Dollar and Grigg (1981) studied the fate of benthic communities at French Frigate Shoals in the Northwest Hawaiian Islands following the accidental spill of 2000 tons of kaolin clay. These authors found that after two weeks there was no damage to the reef corals and associated communities except where the organisms were actually buried by the clay deposits for a period of more than two weeks.

The proposed development will take the land from its present agricultural use and place the majority of the area into residential, mixed use, industrial, school, park and open space; these land use changes could result in changes to the quantity and kinds of materials being carried from the project site to the sea during periods of heavy rainfall.

Past studies primarily on the West Hawaii coast have shown that urbanization of coastal areas may bring changes in the concentration of inorganic nutrients reaching the groundwater beneath porous lava but these changes are small, being less than the concentration of these materials measured in a number of totally undeveloped sites. Thus despite a measurable increase in some nutrients when taking lands from an undeveloped to an urbanized state, the increases are less than the concentrations measured at other sites with no surrounding development (Brock et al. 1988, Brock and Norris 1987, 1988a, Brock and Kam 1990, 1992, 1994). Studies involving a search for pesticides and herbicides in aquatic communities adjacent to coastal lands undergoing development have been carried out on the West Hawaii (Kona) coast, Lanai and Kaanapali, Maui. In these cases, analyses focused on either chemicals that have been used or are being used. At Waikoloa in West Hawaii, annual sampling since 1987 for pesticides and herbicides used on golf courses and urbanized areas has not detected these compounds in water or sediment (Brock and Norris 1987, 1988a, Brock and Kam 1990, 1992, 1994). Work with the Hawaii State Department of Health on possible bioaccumulation of materials in a long-lived aquatic species on the Kona coast, has not detected any insecticide or herbicide, despite the collection of some samples from brackish water ponds within 20m of a golf course (Brock and Kam 1992). In total, more than 60 compounds have been targeted in these studies, sampling both developed and undeveloped sites, and the results have been negative.

Lanai and Kaanapali, Maui studies have focused on insecticides and herbicides that are used on golf courses; Kaanapali samples were also examined for products used in sugar cultivation and in all cases no materials were detected in the samples (Brock 1992a, 1992b).

Despite recent studies not detecting modern insecticides and herbicides, problems have occurred in the past in Hawaii. Both pesticides and heavy metals have been detected in fishes in Honolulu's streams and elsewhere by the Department of Health's monitoring program. In general, the chemicals detected are long-lived products used years ago and have been banned for some time (e.g., chlordane, DDT, etc.). As time as passed the materials allowed for use by the Environmental Protection Agency have changed towards products that are effective on application, but have reduced half-lives once released into the environment. The use of products with short half-lives reduces the potential for contamination in the environment. Thus products available today carry considerably less risk of contamination to the environment than do the products used in times past. This suggests that the development of this agricultural parcel should not pose a great potential risk of pesticide/herbicide contamination with the change in land use.

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I

Hanamaulu Stream Biological Survey

HANAMAULU STREAM
BIOLOGICAL SURVEY
KAUAI, HAWAII

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EXECUTIVE SUMMARY

A biological assessment of the Hanamaulu Stream was conducted in association with a proposed development by AMFAC/JMB Hawaii, Inc. near the town of Lihue, Kauai. This biological survey was conducted by BHP Engineering- Environmental Technologies International from March 7-11, 1994. Starting at the Hanamaulu Bay estuary, this longitudinal survey of Hanamaulu Stream continued upstream to the uppermost accessible reaches of the stream on the flanks of Kilohana Crater in southeastern Kauai. Thirteen sampling stations were assessed for native and introduced stream fish, molluscs, amphibians, crustaceans, and aquatic insects. The results of this stream assessment indicate the Hanamaulu Stream and its associated tributaries have been heavily impacted by past and current land-use practices. Consequently, low diversity and low overall numbers of native stream fish and aquatic insect species were found in the Hanamaulu Stream watershed. This is typical of many urbanized streams found in Hawaii, with the introduced aquatic biota being predominant. The area of Hanamaulu Stream with the highest quality aquatic stream habitat was found upstream of Kapaia Reservoir. However, Kapaia Reservoir and other reservoirs in the Hanamaulu Stream system block access by migratory native fish to this portion of stream, and the fish community instead consists of introduced bluegills and guppies. Category 2 or Category 1 candidate endangered damselfly species in the genus *Megalagrion* were not found after intensive longitudinal aquatic insect surveys in the Hanamaulu Stream watershed. Due to the predominance of introduced aquatic biota throughout the Hanamaulu Stream, and the heavily disturbed nature of this watershed, no significant impacts to native stream biota are expected from the proposed AMFAC/JMB Hawaii, Inc. development.

TABLE OF CONTENTS

Section | Page
1.0 Introduction 1
2.0 Study Sites 1
3.0 Methods 7
 3.1 Fisheries 7
 3.2 Aquatic Insects 8
4.0 Results 8
 4.1 Fisheries and Aquatic Macrofauna 8
 4.2 Aquatic Insects 15
5.0 Discussion 15
 5.1 Fisheries and Aquatic Macrofauna 15
 5.1.1 Potential Impacts to Native Fish 17
 5.2 Aquatic Insects 18
 5.2.1 Potential Impacts to Aquatic Insects 19
6.0 References Cited 20
7.0 Tables 22
8.0 Photographic Record 29
 Data Sheets

1.0 INTRODUCTION

BHP Engineering- Environmental Technologies International (ETI) was retained by AMFAC/JMB Hawaii, Inc. to perform a biological stream reconnaissance in the Hanamaulu Stream, Kauai, Hawaii. The objective of this survey was to define the longitudinal distribution and relative abundance of native and introduced stream fishes, crustaceans, molluscs, and aquatic insects in the order Odonata (dragonflies and damselflies). This survey also determined whether any significant native insect taxa were present, particularly *Megalagrion* damselflies, certain of which are listed as Category 2 or Category 1 candidates on the Federal Register. Additionally, the dominant riparian vegetation was qualitatively described. This survey was conducted between 7-11 March 1994.

The Hanamaulu Stream was separated into representative areas, with sampling stations being established in each section. This survey began at downstream end of the Hanamaulu Stream estuary and extended into the upper tributaries of Hanamaulu Stream on the flanks of Kilohana Crater to approximately 800 ft. (244 m) elevation. Personnel conducting this survey were Ron Englund from Environmental Technologies International, and Dan A. Polhemus, Ph.D. from the Bishop Museum.

2.0 STUDY SITES

The Hanamaulu Stream drainage is a small bowl-shaped catchment, covering 8.9 mi^2 (DLNR 1974). Seven minor and one major tributary flow downstream and enter the Hanamaulu Stream. Located in southeastern Kauai, and originating from inside of the Kilohana crater, the named Hanamaulu branch that discharges into Kapaia Reservoir has the greatest flow of the upper Kilohana crater tributaries (Personal communication, Jeffrey Kohn, AMFAC/JMB Hawaii Land Manager).

The stream originates in the interior of Kilohana Crater at 840 feet elevation, breaching the northeastern section of the rim and descending along a gradual profile through an open valley with sloping walls. The stream then traverses a set of open plains behind Kalepa Ridge, finally skirting the southern end of the ridge and reaching a seaward terminus at Hanamaulu Bay. From its origin in Kilohana crater, the main branch of the Hanamaulu Stream flows for 10.1 miles to its estuary in Hanamaulu Bay. The Hanamaulu Stream and its associated tributaries are not presently gauged, and apparently have never been gauged in recent times by the U.S. Geological Survey. The watershed is bounded by Kalepa Ridge at the southern end, and by gently sloping divides between other drainages that originate from the flanks of the Kilohana Crater, such as the Wailua River on the eastern side, and Nawiliwili Stream on the west.

Hanamaulu Stream has been extensively modified along its entire length by diversions for sugar cane irrigation, including the Upper Lihue Ditch at 540 feet elevation, the Hanamaulu Ditch at 400 feet elevation, and the Lower Lihue Ditch at

350 feet elevation. These ditch, flume and headgate systems cut across all the headwater branches of the Hanamaulu, carrying a significant portion of the stream flow to the sugar cane fields of the Lihue plantation which occupy the surrounding benchlands. Below 200 feet elevation the stream traverses the outskirts of Lihue, the largest town on Kauai, where it is channelized in certain sections and subject to contamination by runoff from storm drains and a variety of light industrial establishments. Vegetation throughout the Hanamaulu stream catchment is predominantly introduced species, with the stream being covered along much of its length by nearly impenetrable tangles of hau (*Hibiscus tiliaceus*). Only in the extreme upper section of the stream, near the breach through the walls of Kilohana Crater, is the stream bordered by a partially native vegetative assemblage dominated by uluhe fern (*Dicranopteris linearis*).

Figure 1 was compiled from a combination of the USGS topographic quad maps, and contains the precise locations of all sampling stations. In the upper areas of the Hanamaulu Stream watershed only one branch above the reservoir is named. Due to this, unnamed tributaries that were sampled were labeled A-D (Figure 1). Tributary A (Station 7) is the southernmost tributary draining Kilohana Crater, and tributary B (Station 8) is the next tributary north of tributary A. Tributary C (Station 9) is essentially in the middle of these unnamed Kilohana Crater tributaries, and tributary D (Station 10) is the next tributary to the north with flowing water. The Hanamaulu Stream (the one tributary named on the Waialeale USGS topo quad that actually drains Kilohana Crater and flows into Kapaia Reservoir) has by far the greatest amount of water flowing of all the upper elevation Hanamaulu watershed streams. Due to extreme vegetation thickness, access to these tributaries was limited to only a few locations, mainly where the Lower Lihue ditch crossed the stream channels.

The following is a description of each sampling station (Figure 1) for the Hanamaulu Stream and its associated tributaries. Intensive collections of aquatic insects were made at sampling Stations 1, 8, 10, 12, and 13. Qualitative observations for *Megalagrion* sp. (damselflies) were made at all other stations.

STATION 1: 0 ft elevation

Hanamaulu Stream estuary, immediately upstream of Hanamaulu Bay (Photograph 1). The stream bottom in this area is unchannelized and appears to be in a relatively natural state, consisting of a sandy bottom mixed with reef rubble. The stream substrate consists of coarse sand near the mouth, and becomes finer grained in the upstream direction. The stream is completely choked with California grass (*Brachiaria mutica*) and water hyacinth (*Eichornia crassipes*) starting at 558 ft. upstream of the (stream) entrance into Hanamaulu Bay. Snorkeling and netting was not possible in the portions of stream that were overgrown with these plants. Underwater visibility at this station was estimated at between 6-8 ft. Stream habitat consisted of shallow pools and runs, from 1 to 3 ft. deep. This station was sampled at low tide.

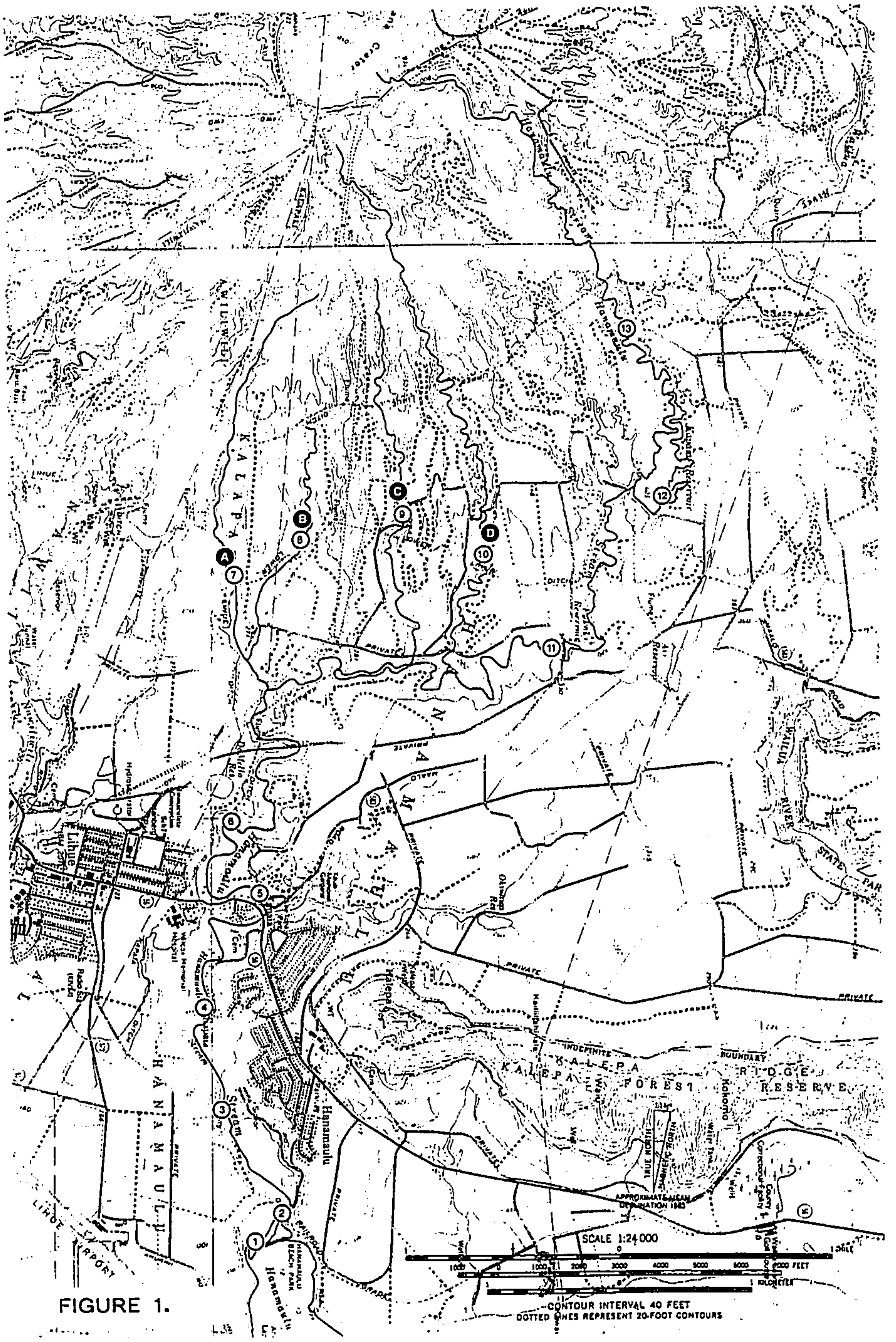
Lihue
Hanamaulu
KALAPA
KALEPA
FOREST
RESERVE
RIDGE
INDEFINITE
BOUNDARY
PRIVATE
SCALE 1:24 000
CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 20-FOOT CONTOURS

FIGURE 1.

At its seaward terminus the stream becomes pooled behind a bar of white sand stablized by ironwood (*Casuarina equisetifolia*), finally entering the sea at the southern end of a broad white sand beach flanked by rocky shores of basalt boulders. Insect collections were made along the stream behind the terminal bar at the Hanamaulu Beach Park, and from the wave-splashed rocks along the margin of Hanamaulu Bay immediately south of the stream mouth. The stream water temperature at this station was 23.5° C.

STATION 2: 0 ft elevation

Lower Hanamaulu Stream, starting adjacent to the Hanamaulu Beach Park restroom facilities. Stream substrate in this station consists of fine sand particles overlaying thick deposits of fine silty clay. California grass on the beach park side of the stream appears to be regularly sprayed with herbicide, and was dead. Water hyacinth and California grass completely filled the stream channel and flood plain at this station, with the exception of 100 ft. of open stream channel. This open section was visually surveyed by two snorkelers, with one snorkeler observing each side of the stream.

Insect sampling was undertaken along the terminal reach of Hanamaulu Stream below the Highway 56 bridge. The channel in this area is wide and unshaded, and the stream current is very slow, with many nearly imponded sections. In these slack water areas the water surface is thickly covered by water hyacinth, while the banks have a dense cover of introduced grasses.

STATION 3: 5 ft elevation (Approximately)

Lower Hanamaulu Stream, 0.5 mi above Kapule Highway in a cow pasture. This station consisted entirely of deep, slow moving pools that meandered through heavily grazed pastureland. Visibility was less than one foot, and too poor for effective underwater visual observation. Stream water quality was poor at this station, being extremely turbid and having a noticeable odor.

Riparian vegetation was exclusively California grass at this station.

STATION 4: 40 ft elevation

Hanamaulu Stream, at the Rego Truck company baseyard low water bridge crossing, to Kuhio Hwy 56. Hanamaulu Stream exhibited characteristics typical of Hawaiian streams flowing through an urbanized area. Channelization by straightening and berming of the stream channel banks has occurred here (Photograph 2), and the stream does not meander as it did in the pasture area at Station 3. Riparian vegetation does not exist in this station and has been eliminated through the use of herbicides sprayed along the stream riparian zone (Photograph 2). Running through the middle of a heavily urbanized area, this station contains the most degraded aquatic habitat in Hanamaulu Stream.

The stream channel gradient increases here from one of stagnant and deep slow moving pools to a riffle/run and pool habitat. The first riffle is found approximately 300 ft. above the low water bridge crossing at the Rego Truck Company baseyard. Substrate size ranged from 6 to 12 in. and was embedded in fine silty clay. Underwater visibility was 3 ft. at this station.

STATION 5: 40 ft elevation

Hanamaulu Stream, immediately upstream of the Kuhio Hwy 56 bridge. Hanamaulu Stream at this station flows through a truck painting and housing area and appears to be heavily impacted by urbanization, having channelized and straightened banks.

Stream gradient in this station increases, with riffle/run habitat separated by pools up to three feet deep. Riparian vegetation starts to reappear upstream of the Kuhio Hwy bridge, and eventually thick stands of hau virtually enclose the stream, with banana and California grass common here also. Brown algae is growing on rocky substrate where hau completely encloses the stream, and in more sunny, open riffle areas a green filamentous algae was found.

STATION 6: 120 ft elevation

Hanamaulu Stream, adjacent to canefields near Immaculate Conception School in Lihue. Hanamaulu Stream at this station was accessed by hiking through an old pasture that is below the benchland of the canefields. Access was difficult here due to extremely dense vegetation that occurs within 300 ft. of the stream, most of which was hau.

Stream habitat at this station was observed to be poor for native fish, consisting completely of stagnant deep pools. Stream water here was too turbid to allow for underwater visual observation.

STATION 7 (Tributary A): 271 ft elevation

Station 7 is the southernmost tributary of the Hanamaulu Stream draining the flanks of Kilohana Crater, tributary A on Figure 1 (Photograph 3). This tributary was accessible at the Lower Lihue Ditch Crossing. This small feeder tributary runs through a mud/clay substrate; flow was minimal, and estimated at between 2 to 4 cfs. Riparian vegetation consisted mainly of strawberry guava (*Psidium cattleanum*). Aquatic habitat was extremely poor at tributary A, with the stream here upstream of the Lower Lihue Ditch consisting of a notch 1 to 2 ft. wide in the clay bottom, with little or no substrate for aquatic insect habitat.

Riparian vegetation in this area was being damaged by feral pigs (*Sus scrofa*), with erosion due to pig wallows evident throughout this station.

STATION 8 (Tributary B): 340 ft elevation

Station 8 is located in tributary B of Hanamaulu Stream, refer to Figure 1 for location. The Lower Lihue Ditch at this site flows downslope in the original channel of an eastward flowing tributary to Hanamaulu Stream, then swings south into an artificial channel at a headgate structure and continues for a short additional distance before entering a tunnel. The original stream channel of tributary B below the headgate is dry except for minor seepages trickling around and through the diversion structure. The lower Lihue ditch thus completely diverts all flow from tributary B, and aquatic habitat downstream of this ditch should only be considered intermittent. Water temperature at this station was 22.5° C.

The waters in the ditch are clear and swift, flowing over a substrate of gravel intermixed with a few moderate sized rocks, and there are intermittent riffles formed by fallen trees and other debris jams resulting from Hurricane Iniki. The channel is heavily shaded by a mixed forest of introduced trees, including hau, guava, and java plum, with the banks immediately adjacent to the water thickly covered by introduced gingers. Aquatic insect collections were made from the tunnel to the headgate, and then for an additional several hundred yards upstream from the headgate. Riparian vegetation in this area consisted mainly of java plum (*Syzygium cumini*) and ginger (*Hedychium coronarium*).

STATION 9 (Tributary C): 360 ft elevation

Station 9 is located in tributary C of Hanamaulu Stream, refer to Figure 1 for location. Flow in this tributary was non-existent upstream of the lower Lihue ditch (Photograph 4) and should only be considered intermittent. Tributary C above the lower Lihue ditch consisted of a muddy depression containing an occasional waterpocket 1 to 2 inches deep. Almost all the aquatic habitat at this station was found in the lower Lihue ditch. Water leaking from the ditch caused slight water flow downstream. Habitat in tributary C below this seepage consisted mainly of silt filled pools.

Riparian vegetation in this reach consisted of java plum, strawberry guava, and hau.

STATION 10 (Tributary D): 360 ft elevation

Station 10 is located in tributary D of Hanamaulu Stream, refer to Figure 1 for location. The Lower Lihue Ditch at this site exits from a hillside tunnel, crosses a tributary of Hanamaulu Stream via a wooden flume (Photograph 6), and then continues on a contour across the opposite hillside. Significant leakage from the wooden flume augments flow of Tributary D. Sampling of tributary D at the area of the wooden flume was limited to about 100 ft of open stream in the immediate vicinity of the wooden flume support legs. Impenetrable, thick stands of hau blocked sampling access up and downstream of tributary D at the wooden irrigation flume. Stream habitat consisted of hau enclosed pools 1 to 2 ft deep, and substrate was 2 to 3 ft of silt overlaid on a clay bottom.

Another access point for this tributary was reached at a cane road crossing of the tributary approximately 0.25 mi upstream of the wooden flume of the lower Lihue ditch (Photograph 5). Stream habitat at the cane road crossing consisted of shallow runs and debris pools 1 to 2 ft. deep having a fine silt substrate. Riparian vegetation here consisted of a more open canopy containing java plum, strawberry guava, and kukui (*Aleurites moluccana*).

Sampling was undertaken within and along the ditch, and from seepages coming out of the flume structure itself. The stream below was completely overtopped with hau making access impossible. The surrounding vegetation was predominantly sugar cane and planted eucalyptus. Water temperature was 23° C at tributary D.

STATION 11 (Downstream of Pukaki Reservoir): 260 ft elevation

Station 11 is on the main branch of Hanamaulu Stream, immediately downstream Pukaki Reservoir. Aquatic habitat below Pukaki Reservoir consisted of large, deep pool habitat with a sandy and silty bottom. Approximately 100 ft of the stream was open below the Pukaki Reservoir spillway after which the stream canopy became enclosed with hau, banana and California grass. Downed vegetation, debris, and thick stands of hau made access impossible on the main branch of the Hanamaulu Stream in this region except for this short reach of stream.

Stream habitat for native fish is noticeably poor in this area, as habitat consists entirely of deep pools choked with silt and debris.

STATION 12 (Kapaia Reservoir): 405 ft elevation

Sampling at this station was for aquatic insects only, and sampling for native fish did not occur at this station as these stream fish do not occupy reservoir habitat. This is a primary storage reservoir set amid cane fields, and surrounded by low banks with a cover of introduced grasses. Collections were made by trolling a hand net in the reservoir itself, by hunting for Zygoptera amid the waterside vegetation, and by sweeping along a wide beach of damp red earth bordering the reservoir along its eastern side. The reservoir water temperature was 27° C.

STATION 13 (Upstream of Kapaia Reservoir): 465 ft elevation

Station 13 is located upstream of Kapaia Reservoir, near where the upper Lihue ditch intersects the Hanamaulu Stream (the only named branch on Waialeale USGS Topo quad). This station was accessed by walking down into the stream flood plain where the upper Lihue ditch enters a tunnel. At this site Hanamaulu Stream occupies an open, shallow gulch cut into the flanks of Kilohana Crater. The slopes above the gulch are covered by low banks of uluhe fern (*Dicranopteris linearis*), while the riparian vegetation consists of a dense overtopping canopy of guava (*Psidium* sp.), hau and rose apple (*Syzygium jambos*). Native uluhe fern was the dominant plant above the floodplain, and covered the hillsides up to the canefields.

Aquatic habitat at this station was observed to be the highest quality seen in the entire Hanamaulu watershed. The stream maintains a low baseflow of approximately 10 to 13 cfs in this area, and habitat consists of higher gradient riffle/pool complexes (Photograph 7). The stream itself is clear and moderate sized at this point, running relatively swiftly over a substrate of gravel, rocks, and scattered small boulders, with occasional exposures of soft underlying bedrock/clay as well. Stream substrate consisted of boulders (1 to 4 ft diameter) embedded in bedrock/clay, with smaller 3 to 9 inch rocks in deeper pools providing potentially good habitat for native aquatic organisms. Although the dense stream riparian vegetation prohibited most sunlight from reaching the stream area, the rocks exhibited a thick growth of filamentous green algae. Excluding the upper and lower Lihue ditches, which contained clear and apparently high quality water, water clarity at this station was the highest for the Hanamaulu Stream watershed. Water temperature was 21° C at this site.

For aquatic insect sampling, a Malaise trap and several yellow pan traps were emplaced at this site and run for 24 hours; general hand net collections were also made for several hundred yards along the stream channel upstream from the Malaise trap site. Further collections were made from the Upper Lihue Ditch, which runs parallel to the stream immediately upslope on the north bank.

3.0 METHODS

3.1 FISHERIES - METHODS

Underwater visual observations using mask and snorkel were made at each station with sufficient water depth and visibility. Frequently the run/riffle habitat was too shallow to allow for underwater visual observation, therefore above water visual observations were conducted, and all aquatic habitats were assessed. Hand nets, and kick nets were utilized to verify underwater observation and to obtain voucher specimens. Clear post-larval ʻoʻopu voucher specimens were collected at Station 1 of the Hanamaulu Stream. As some ʻoʻopu specimens were too small to identify in the field, they were raised in aquaria to verify identification. Distances surveyed for each station were either determined by a measuring tape or estimated. Total stream length distance was determined by planimeter readings taken from USGS topographic maps.

Drift net and Surber samples were collected in several stations to qualitatively assess if any larval drift of shrimp or fish was occurring. With the exception of the lowest reaches of Hanamaulu Stream, point counts for ʻoʻopu were inappropriate due to low native fish densities in most areas (Baker and Foster 1992). Relative population abundance estimates of native fish were determined through two to three observers snorkeling and counting total native gobiid fish observed in each area visually observed underwater. Discharge (in cubic feet/second) at station 4 was estimated by using the Robins-Crawford method (Nielsen and Johnson 1983).

The dominant riparian vegetation in the immediate vicinity of the stream was identified for each station. Altitudes were determined through using a combination of USGS topographic maps, a Lihue Plantation topographical map, and a hand held Casio altimeter. Note: The nomenclature for the native stream fish *Awaous stamineus* was recently changed to *A. guamensis*. To avoid confusion the older, more familiar species name is used in this report.

3.2 AQUATIC INSECTS - METHODS

Methods

The streams studied during the present survey were reached by road, and then surveyed longitudinally on foot to the extent practical, within the constraints of time, vegetation, and local topography. A total of 12 hours was spent making aquatic insect collections at various elevations along Hanamaulu Stream and its tributaries. Weather during all of these surveys was good, with full sun throughout the day on 10 March, and high clouds with a stiff breeze on 11 March.

Aquatic insects were collected passively by rigging a malaise trap across the stream, and by setting yellow pan traps along the stream margins. Extensive general collections were also undertaken by hand, using aerial and aquatic nets. The specimens thus obtained were stored in 75 percent ethanol and subsequently transported to the Bishop Museum in Honolulu for curation and identification.

Aquatic insect sampling effort in this survey was focused on the order Odonata (dragonflies and damselflies). Emphasis was placed on collecting species in the genus *Megalagrion*, whose members include species that are currently listed as Category 2 and Category 1 Candidate Endangered Species.

4.0 RESULTS

4.1 FISHERIES AND AQUATIC MACROFAUNA RESULTS

STATION 1:

Fisheries

Sampling effort at this station consisted of three observers conducting snorkel transect observations 492 ft upstream from where Hanamaulu Stream entered the ocean. Three native species of freshwater stream fish were observed here: ʻoʻopu nakea (*Awaous stamineus*), ʻoʻopu akupa (*Eleotris sandwicensis*), and ʻoʻopu naniha (*Stenogobius hawaiiensis*). Of the three native stream fish observed, akupa and naniha were abundant at this station, while only three *A. stamineus* from 3 to 6.5 in were observed. Other native fish that were common at this station were ʻamaʻama (mullet) (*Mugil sp.*), aholehole (*Kuhlia sandvicensis*), and papio (*Caranx melanpygus*). See Table 6 for a complete listing of fish found at Station 1, and throughout the Hanamaulu Stream watershed.

Post-larval recruitment of hinana from the ocean was evident in this station as well. Hinana, such as clear *S. hawaiiensis* and *A. stamineus* 15 to 20 mm in length were common in the shallow (1 to 2 inches deep) sandy areas of the stream, and were captured and grown out in aquaria to verify identification.

Introduced fish species at this station consisted of large numbers of adult tilapia (*Tilapia melanotheron*), with 6 to 7 large mound shaped nests visible near the edge of the water hyacinth growth that has completely overgrown the stream.

Crustaceans, Molluscs, Amphibians

The only crustacean observed at this station was the introduced Tahitian prawn, *Macrobrachium lar* which was common. Hapawai (*Theodoxus vespertinus*), a native mollusc species was observed at this station and was common. Hihiwai (*Neritina granosa*) were not observed at this station, or in the entire Hanamaulu watershed. Amphibians were not observed at this station. See Table 6 for a complete listing of crustaceans, molluscs, and amphibians found at station 1, and throughout the Hanamaulu Stream watershed.

STATION 2

Fisheries

The only area that could possibly be sampled at this station was a 100 ft. open channel, and this area was surveyed visually by two snorkelers. Total counts of native 'o'opu were conducted, and relative abundances of the more common introduced species were made. A single 12 cm *A. stamineus* was observed at this station, while two *E. sandwicensis* 11 and 14 cm, and two *S. hawaiiensis* 10 cm in length were observed. Other native fish observed were large numbers of schooling aholehole (*Kuhlia sandvicensis*) and *Mugil* sp.

Introduced fish at this station were mainly large numbers of *Tilapia melantheron*, an estimated 25 to 30 large adults 25 to 35 cm in size. Topminnows (Poeciliidae) were also abundant at this station, with high densities of guppies (*Poecilia reticulata*) and green swordtails (*Xiphophorus helleri*) observed in the fringes of the dense vegetation.

Amphibians

Amphibians were not observed at this station, although they undoubtedly occur in the dense vegetation surrounding Hanamaulu stream in this area.

Crustaceans and Molluscs

Crustaceans and molluscs were not observed at this station.

STATION 3

Fisheries

Aquatic habitat was poor at this station with Hanamaulu Stream running through a heavily grazed livestock pasture. Only introduced topminnows (Poeciliidae) were observed at this station.

Amphibians and Crustaceans

Amphibians and crustaceans were not observed in this station.

Molluscs

The recently introduced apple snail (*Pomacea canliculata*) was observed at this station, and is reproducing as several egg cases were observed on the stalks of California grass.

STATION 4 AND 5

Fisheries

The results from these two stations were combined as stream elevation and aquatic habitats were similar for Stations 4 and 5. The stream channel is heavily altered and in poor condition in this area, especially at the area of the Rego Trucking Company Baseyard. Station 4 has the first riffle that is found in Hanamaulu Stream upstream of the ocean, located in the middle of the truck baseyard. A 15 minute drift sample was collected at this riffle, and later laboratory analysis found no fish or aquatic organisms in the drift. Benthic (Surber) bottom samples also resulted in no fish or other aquatic organisms being collected. Discharge was estimated to be 42 cfs at this station, and was measured immediately below the first riffle.

Fish counts at Station 4 were conducted using methodologies described in Baker and Foster (1992), with a total of 10 randomly selected (by a random number generator) square meter sample points collected by two observers at the first riffle of Hanamaulu Stream. Aquatic habitat upstream and downstream of this riffle was slow moving, deep and turbid, thus point counts were not appropriate for these areas. The results of these point counts are presented in Table 1. Densities of native freshwater 'o'opu were low at this station, with the mean number of 'o'opu nakea per 1 m^2 = 0.30; S.E. (standard error) = 0.483. The mean number of 'o'opu naniha per 1 m^2 = 0.10; S.E. = 0.316. Aholehole, the other native fish observed at this station in low numbers, was not observed in 10 sample point counts.

Introduced fish species were the predominant fish species at Stations 4 and 5, with *T. melanotheron* adults found in high densities. Also abundant were the topminnows; guppies and green swordtails.

Table 1. Results of one square meter point counts (n = 10) conducted in the first riffle of Hanamaulu Stream, March 7, 1994.

Sample Number	Species	Fish Size	Fish Numbers	Observer
1	Tilapia	6-8 cm	5	Friedlander
2	No Fish		0	Friedlander
3	Aholehole Green Swordtail Tilapia Tahitian Prawn	4-5 cm 8-10 cm 8 cm 8 cm	2 8 3 1	Friedlander
4	'O'opu naniha	13 cm	1	Friedlander
5	'O'opu nakea	10 cm	1	Friedlander
6	'O'opu nakea	11 cm	1	Englund
7	No fish		0	Englund
8	'O'opu nakea	12 cm	1	Englund
9	No fish		0	Englund
10	Tahitian Prawn	10 cm	1	Englund

Amphibians

Amphibians were not observed at this station.

Crustaceans

Tahitian prawns were observed in low numbers at this station. The mean number per 1 m^2 = 0.20; S.E. = 0.422.

Molluscs

The introduced asiatic clam (*Corbicula fluminea*) was abundant at these stations.

STATION 6

Fisheries

Station 6 could not be visually surveyed underwater due to extremely dense hau that blocked access to the stream. However, it appears that aquatic habitat is

poor in this area, consisting of turbid silty pools. Aquatic habitat at this station is typically quite poor for native stream fish species, and was verified to be poor for native fish species in other stations on Hanamaulu Stream where access to the stream was possible.

Amphibians, Crustaceans, and Molluscs

Amphibians, crustaceans, and molluscs were not observed at this station.

STATION 7 (Tributary A)

Fisheries

Two introduced species of topminnows were common at this station, green swordtails and guppies. Native fish were not present at this station, and aquatic habitat was generally poor due to the mud/clay substrate.

Amphibians

The giant marine toad (*Bufo marinus*) was common at Station 7.

Crustaceans

The only crustacean species observed at this station was the introduced crayfish (*Procambarus clarkii*), and was the most common aquatic organism at this station.

Molluscs

No molluscs were observed at this station.

STATION 8 (Tributary B)

Fisheries

Introduced fish species entirely composed the fish fauna at this station. Guppies were common, and high densities of large (25 to 30 cm) *T. melanotheron* adults were also found at Station 8 (Tributary B).

Amphibians

Amphibians were not observed at this station, but undoubtedly the giant marine toad is common in this area as it was observed in nearby Station 7 (Tributary A).

Crustaceans

Tahitian prawns were abundant at this station.

Molluscs

The introduced asiatic clam was common at this station.

STATION 9 (Tributary C)

Fisheries

The only fish actually observed in this tributary and not in the Lower Lihue ditch which bisects Tributary C was the guppy. Above the Lower Lihue ditch aquatic habitat consisted of shallow, muddy pools that were almost dry, and appeared to fill only after heavy rains. Fish were mainly found in the Lower Lihue irrigation ditch itself, especially side pools found along the ditch. One largemouth bass (25 cm in length) and at least four large *T. melanotheron* were observed to be using the ditch in this manner. Additionally, the only native 'o'opu found above the vicinity of the Kuhio Hwy 56 bridge was found in the Lower Lihue ditch here. One 19 cm in length 'o'opu nakea (*A. stamineus*) was observed at this Station in the Lower Lihue ditch.

Seepage from the Lower Lihue ditch increased stream flow downstream of the ditch and appeared to be enough to support guppies. Tributary C downstream of the Lower Lihue ditch would probably be dry except for seepage of excess irrigation water.

Amphibians

Amphibians were not observed here, but undoubtedly are found in this area.

Crustaceans

Tahitian prawn were common at this station, and were found both in the Lower Lihue ditch and Tributary C downstream of the ditch seepage.

Molluscs

The asiatic clam was common in the Lower Lihue ditch.

STATION 10 (Tributary D)

Fisheries

The only fish species present at Station 10 was the guppy, which was abundant.

Amphibians

The wrinkled frog (*Rana rugosa*) was common at this station.

Crustaceans

Crayfish were abundant at this station, and constituted the majority of the biomass of aquatic organisms at Tributary D.

Molluscs

Molluscs were not observed at this station.

STATION 11 (Downstream of Pukaki Reservoir)

Fisheries

Aquatic habitat downstream of Pukaki Reservoir consisted of deep, slow moving pools covered by dense stands of hau. Approximately 100 ft of the stream here was surveyed underwater visually before debris blocked further downstream assessment. The accessible areas contained largemouth bass in several size classes; 10 to 15 cm and 30 to 35 cm. *T. melanotheron* were also abundant at this station, and consisted of only large adults, with numerous nests visible in the sandy substrate. Guppies were also common at this station.

Amphibians, Crustaceans, and Molluscs

This station consisted of deep pools with limited visibility. Amphibians, crustaceans, and molluscs probably could not be observed but were most probably present at this station.

STATION 12 (Kapaia Reservoir)

Kapaia Reservoir was not sampled for fisheries and other aquatic macrofauna for the Hanamaulu Stream Survey because reservoir sampling was not in the scope of work for this project. However, native stream fish in the gobiidae family normally do not inhabit large bodies of still water such as the Kapaia Reservoir. Of interest, large schools of *Tilapia* were observed in the reservoir while conducting the aquatic insect survey.

STATION 13 (Upstream of Kapaia Reservoir)

Fisheries

The Upper Hanamaulu Stream (above Kapaia Reservoir) at this station contained the best aquatic habitat in the entire Hanamaulu watershed. The stream in this area becomes a higher gradient riffle/run shallow pool stream in contrast with a sluggish, stagnant, turbid stream found in the lower reaches. Underwater observations by two snorkelers for approximately 1650 ft. were made in this reach.

Two species of introduced fish were observed at this station, guppies and bluegill (*Lepomis macrochirus*). Fish densities were low, with only 15 to 16 bluegill observed in two separate pools. One bluegill was captured and preserved as a voucher specimen.

Amphibians

Both bullfrogs (*Rana catesbiana*) and the smaller wrinkled frog were observed at this station, being found both in the Upper Lihue ditch and the upper Hanamaulu Stream. Frog tadpoles of apparently both species were also common.

Crustaceans

Crayfish were the most abundant aquatic organism at this station, constituting the majority of the biomass of all aquatic organisms here.

Molluscs

Asiatic clams were observed in the Upper Lihue ditch, which is immediately adjacent to station 13. Two species of introduced aquarium snails were observed at this station, *Helisoma* sp. and *Thiaria* sp. Verification of snail identification was provided by Dr. Robert Cowie of the Bishop Museum.

4.2 AQUATIC INSECTS RESULTS

The distributions of aquatic insect species present at the five sampling stations intensively surveyed along Hanamaulu Stream are summarized in Tables 1 to 5. Additionally, Stations 1 to 13 were surveyed for damselflies in the *Megalagrion* genus, and were only found at stations 10 and 12 (Tables 3 to 4). Of particular interest is that due to the silt/clay substrate found in stations 2, 3, 7 (tributary A), 9 (tributary C), and 11, the aquatic insect population was essentially non-existent at these stations.

5.0 DISCUSSION

5.1 FISHERIES

The Hanamaulu Stream system appears to be dominated by introduced fish and crustacean species. The entire stream system is influenced by introduced fish species, channelization, irrigation diversions, and runoff from urban and agricultural areas. Tilapia, two topminnow species, and two introduced gamefish (largemouth bass and bluegill) constitute most of the fish numbers and biomass.

Three species of native endemic 'o'opu were found within the Hanamaulu Stream system: *A. stamineus*, *E. sandwicensis*, and *S. hawaiiensis*. Two species are

found only in low elevation areas in Hawaiian freshwater streams, *E. sandwicensis* and *S. hawaiiensis*, and were restricted to the estuary and lower stations of the Hanamaulu Stream. Although *A. stamineus* can be found in elevations of up to 1300 ft. (Ron Englund, personal observation), it was found in unusually low numbers and at low elevations in the Hanamaulu Stream system, as compared to other urbanized streams on Oahu (Ron Englund, unpublished database). Two native 'o'opu species, *S. hawaiiensis* and *E. sandwicensis*, were found in a wide range of size classes, indicating recruitment of hinana from the ocean has been and continues to be successful.

With the exception of one large *A. stamineus* found in the Lower Lihue Ditch, native gobies were not found in the upper watershed or upper tributaries of Hanamaulu Stream. This indicates that the lower area of the Hanamaulu Stream contains altered and disturbed aquatic habitats that preclude native 'o'opu from gaining access to the upper reaches of the stream. Some of the reasons native fish do not appear to recruit to the upper Hanamaulu Stream include introduced fish predators, amphibians, and crustaceans, stream channelization, stream diversions, and large reservoirs. The large reservoirs in the Hanamaulu watershed not only significantly increase water temperature from 21°C to 27°C, but also contain large populations of highly predaceous largemouth bass and *Tilipia melanotheron*. Additionally, Hanamaulu Stream reservoir dams also block access of newly hatched 'o'opu larvae to the ocean and not allow returning post-larval 'o'opu to reach upper stream areas.

For example, ascending post-larval *A. stamineus* must face high densities of the introduced predator *Tilapia melanotheron*, which are suspected to be a major predator of native fish (Devick 1991). Additionally, the escape of largemouth bass and bluegill into stream habitat, and their presence in the large reservoirs in the Hanamaulu Stream system would also severely hinder migration by any native amphidromous 'o'opu species. The negative effects of introduced piscivores (fish predators) have been documented on fish populations in many areas, for example North Carolina and the Colorado River basin (Minckley 1983, Lemly 1985).

However, a lack of baseline population data, and the combination of the previously mentioned factors make it difficult to assess what the population status of native endemic fish in the Hanamaulu Stream system was prior to these anthropogenic disturbances. Other factors such as sedimentation and water quality problems may also continue to influence native stream fish populations in unknown ways.

Five species of native 'o'opu inhabit streams in the Hawaiian Islands. Four species (*Stenogobius hawaiiensis, Awaous stamineus, L. concolor, Sicyopterus stimpsoni*) are in the family Gobiidae (goby) and one species (*Eleotris sandwicensis*) is a member of the family Eleotridae (sleeper). Hawaiian 'o'opu have recently been reclassified, and all species are now considered endemic (Devick et al. 1992).

'O'opu have an amphidromous life cycle; they migrate to and from the sea but do not use the ocean for reproduction (Meyers, 1949). 'O'opu spend their entire adult lives in freshwater streams and migrate downstream to spawn adjacent to estuaries or the ocean. Downstream spawning runs are believed to be triggered by the first large rainstorm in the fall. However, post-larvae have been found throughout the year, indicating that spawning may occur during more than one season. Eggs are laid in freshwater on the upper surfaces of rocks and hatch within 48 hours (Ego 1956). Larvae then drift out to the ocean and spend up to 160 days in a planktonic state. Returning post-larval 'o'opu, called hinana, may ascend streams in great numbers. Some species such as *A. stamineus, S. stimpsoni*, and *L. concolor* are capable of climbing waterfalls and areas of rapids. *L. concolor* is the strongest climber of all Hawaiian 'o'opu and uses modified pectoral fins to ascend waterfalls. Individuals of this species have been reported to climb single waterfalls as high as 450 ft, or a series of falls 1,000 ft high (Maciolek 1977, Devick et al. 1992).

A major ecological requirement for 'o'opu is the need to pass through a stream mouth two times during the life of the individual (Kinzie 1990). The most important factor for the existence of endemic 'o'opu in streams is that access to and from the ocean is maintained. Stream channelization and diversions can eliminate or significantly limit native fish populations within a specific stream watershed.

None of the native endemic 'o'opu found within the Hanamaulu Stream are currently listed as threatened or endangered by the Federal Government. *L. concolor* is the 'o'opu species that is currently under consideration for being listed as an endangered species by the U.S. Fish & Wildlife Service, but was not found during this survey. *L. concolor* is listed as threatened by the American Fisheries Society (Deacon et al. 1979), and is currently a Category One Candidate Endangered Species (Dodd et al. 1985). The probability of *L. concolor* being found in this stream is extremely low due to its preference for unchannelized streams and streams with unsilted channels and lower water temperatures (Englund 1993).

5.1.1 POTENTIAL IMPACTS TO NATIVE FISH

The proposed development by AMFAC/JMB Hawaii, Inc. should have no significant impact to current populations of native freshwater Hawaiian stream fish within the Hanamaulu Stream or within the Island of Kauai. As the Hanamaulu Stream exhibits characteristics of a highly impacted stream with numerous past disturbances, the proposed development should result in a minimal impact on the existing native fish biota. Both this study and Timbol (1991) found that the 'o'opu nakea, the native fish in this system with the widest use of different stream habitats, were found in exceptionally low densities in the Hanamaulu Stream system.

According to AMFAC/JMB Hawaii, Inc., the stream channel itself will not be modified by this development. The proposed development will incorporate erosion control measures during construction and provide landscaping and ground cover for long-term erosion control to mitigate runoff into the stream. The future conditions

will be an improvement over the current land use of cultivated sugar cane. The current cultivation practice of sugar cane leads to long periods of bare and exposed soil. Additionally, assuming the stream watershed continues to be highly urbanized, diverted, and channelized, potential impacts due to this development are expected to be minimal, especially as the upper reaches of the stream currently have large reservoirs and ditches that block the access of native fish to the more unimpacted aquatic habitats found upstream of Kapaia Reservoir.

5.2 AQUATIC INSECTS

Hanamaulu Stream is a highly disturbed catchment that retains little of its original vegetative character, except perhaps in its uppermost headwater reaches. Although the aquatic insect communities along the stream showed a predominance of native species at three out of the five stations sampled, these results must be taken in proper biological context. First, the overall diversity of aquatic insects at all sampling stations was quite low in comparison to other streams of similar character at similar elevations on Kauai. Second, the native species that are present are for the most part relatively ubiquitous taxa that can persist even after the stream and its surrounding environment have been extensively disturbed. Third, the predominance of native species at Station 1, the stream mouth, is due to the presence of several native marine taxa, whose persistence is not tightly linked to the condition of the stream itself.

The current survey, although attempting to profile the entire range of aquatic insect diversity present in the Hanamaulu Stream catchment, concentrated particularly on searching for native damselflies in the genus *Megalagrion*. Twelve species and subspecies of *Megalagrion* are currently held as C2 listing candidates on the Federal Register, of which two, *M. adytum* and *M. pacificum*, could conceivably have occurred in the area under study. One species of *Megalagrion* was indeed found along Hanamaulu Stream, this being *M. vagabundum* (Perkins). Although restricted to Kauai, this is still a relatively common species that breeds in water seepages over rock and other substrates, and as such it is not currently a candidate for listing as endangered. The adaptability of this taxon was illustrated by the fact that it was found breeding in the seepages from a flume along the Lower Lihue Ditch at Station 10, an utterly artificial environment. A single cast skin was also taken from midstream rocks at Station 13, indicating that the species is also breeding in the more natural portions of the watershed as well.

In addition to the native *Megalagrion vagabundum*, all three species of introduced damselflies occurring in Hawaii were also present in the Hanamaulu drainage. *Ischnura posita* (Hagen), a small and delicate species that breeds in slow moving sections of streams, was taken from vegetation along the banks of the Upper Lihue Ditch at Station 13, although it was not encountered along the stream nearby. A related species, *Ischnura ramburi* (Selys), which breeds in similar habitats but at generally lower elevations, was taken from grasses along the margins of the terminal reach at Station 1. The bright blue and black *Enallagma civile* (Hagen), which is a species of upland ponds and stream pools, was taken along the margins of Kapaia Reservoir. In general, the presence of introduced damselflies is correlated with an absence of native Zygoptera, although whether this is due to competitive interactions between such taxa is currently unknown. The domination of the Hanamaulu damselfly fauna by exotic species further emphasizes the disturbed character of the system, and makes it extremely unlikely that other native damselfly taxa persist in the catchment, except perhaps in the extreme headwater reaches near the breach in the rim of Kilohana Crater.

5.2.1 POTENTIAL IMPACTS TO AQUATIC INSECTS

The Hanamaulu Stream drainage has been highly modified for agricultural uses, and contains a limited aquatic insect biota with approximately fifty percent native species representation. None of the native species present are rare or endangered, and none of the damselfly species occupying the catchment are currently held as listing candidates on the Federal Register. It does not appear that the proposed development will have any adverse impact on the aquatic insect biota of this system, since the probable disturbances will be negligible in comparison to previous environmental perturbations that have occurred along the length of the catchment.

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7.0 TABLES

Table 1: Aquatic insect taxa sampled from Station 1, mouth of Hanamaulu Stream, sea level, 11 March 1994

Insect Taxon	Taxon Type
DIPTERA	
Canacidae	
Canaceoides angulatus Wirth*	N
Chironomidae	
Orthocladius wirthi Hardy*	N
Telmatogeton japonicus Tokunaga*	I
Ephydridae	
Scatella hawaiiensis Grimshaw	N
ODONATA	
Aeschnidae	
Anax junius (Drury)	N[1]
Coenagrionidae	
Ischnura ramburi (Selys)	I
Libellulidae	
Tramea lacerata Hagen	I[1]
Pantala flavescens (Fabricius)	N[1]
Number of taxa present	
Native	5
Introduced	3
Total	8
Percentage of native species	62 %

Explanations of codes used in table:
Taxon type: N = native species, I = introduced species
Notes:
* = marine species
[1] = sight record

Table 2: Aquatic insect taxa sampled from Station 8, Lower Lihue Ditch, 340 ft., 10 March 1994

Insect Taxon	Taxon Type
DIPTERA	
Ceratopogonidae	
Forcipomyia sp. undet.	N
Chironomidae	
Micropspectra sp. undet.	N
Cricotopus bicinctus (Meigen)	I
Culicidae	
Aedes albopictus (Skuse)	I
Dolichopodidae	
Chrysotus pallidipalpus Van Duzee	N
Tipulidae	
Limonia perkinsi (Grimshaw)	N
Number of taxa present	
Native	4
Introduced	2
Total	6
Percentage of native species	67 %

Explanations of codes used in table:
Taxon type: N = native species, I = introduced species

Table 3: Aquatic insect taxa sampled from Station 10, Lower Lihue Ditch, 320 ft., 10 March 1994

Insect Taxon	Taxon Type
DIPTERA	
Tipulidae	
Limonia advena (Alexander)	I
ODONATA	
Coenagrionidae	
Megalagrion vagabundum (Perkins)	N
Number of taxa present	
Native	1
Introduced	1
Total	2
Percentage of native species	50 %

Explanations of codes used in table:
Taxon type: N = native species, I = introduced species

Table 4: Aquatic insect taxa sampled from Station 12, upper Hanamaulu Stream, 460 ft., 10 March 1994

Insect Taxon	Taxon Type
DERMAPTERA	
Chelisochidae	
Chelisoches morio (Fabricius)	I
DIPTERA	
Ceratopogonidae	
Forcipomyia sp. undet.	N
Culicidae	
Aedes albopictus (Skuse)	I
Dolichopodidae	
Chrysotus pallidipalpus Van Duzee	N
Tipulidae	
Limonia perkinsi (Grimshaw)	N
Limonia swezeyi (Alexander)	N
HETEROPTERA	
Saldidae	
Saldula exulans White	N
ODONATA	
Coenagrionidae	
Ischnura posita (Hagen)	I
Megalagrion vagabundum (Perkins)	N
Libellulidae	
Pantala flavescens (Fabricius)	N[1]
TRICHOPTERA	
Hydropsychidae	
Cheumatopsyche pettiti (Banks)	I
Number of taxa present	
Native	7
Introduced	4
Total	11
Percentage of native species	64 %

Explanations of codes used in table:
Taxon type: N = native species, I = introduced species
Notes:
1 = sight record

Table 5: Aquatic insect taxa sampled from Station 13, Kapaia Reservoir, 405 ft., 10 March 1994

Insect Taxon	Taxon Type
DERMAPTERA	
Chelisochidae	
Chelisoches morio (Fabricius)	I
DIPTERA	
Dolichopodidae	
Syntormon flexibilis Becker	I
Dolichopus exsul Aldrich	I
Ephydridae	
Scatella hawaiiensis Grimshaw	N
ODONATA	
Coenagrionidae	
Enallagma civile (Hagen)	I
Libellulidae	
Pantala flavescens (Fabricius)	N[1]
Number of taxa present	
Native	2
Introduced	4
Total	6
Percentage of native species	33 %

Explanations of codes used in table:
Taxon type: N = native species, I = introduced species
Notes:
1 = sight record

TABLE 6. Macrofauna observed in the Hanamaulu Stream, Kauai, March 1994.

Scientific Name	Common Name	Elevation (feet)					Biogeographical Status[1]
		0	40	260	360	465	
Crustaceans							
Macrobrachium grandimanus	'opae 'oeha'a	X[2]	X[2]				Endemic
Macrobrachium lar	Tahitian prawn	X	X	X	X		Introduced
Atyoida bisulcata	'opae kala'ole		X[2]				Endemic
Procambarus clarkii	crayfish				X	X	Introduced
Molluscs							
Helisoma sp.	snail					X	Introduced
Thiara sp.	snail					X	Introduced
Corbicula fluminea	asiatic clam		X		X	X	Introduced

[1] From Devick et al. 1992, Devick 1990
[2] Found by Timbol (1991)

TABLE 6. Macrofauna observed in the Hanamaulu Stream, Kauai, March 1994.

Scientific Name	Common Name	Elevation (feet)					Biogeographical Status[1]
		0	40	260	360	465	
Fish							
Eleotris sandwicensis	'o'opu 'akupa	X					Endemic
Stenogobius hawaiiensis	'o'opu naniha	X	X				Endemic
Awaous stamineus	'o'opu nakea	X	X				Endemic
Lentipes concolor	'o'opu alamo'o						Endemic
Sicyopterus stimpsoni	'o'opu nopili						Endemic
Mugil spp.	'ama'ama (mullet)	X					Indigenous
Caranx melanpygus	papio	X					Indigenous
Kuhlia sandvicensis	aholehole	X	X				Endemic
Lepomis macrochirus	bluegill					X	Introduced
Micropterus salmoides	largemouth bass			X	X		Introduced
Poecilia reticulata	guppy	X	X	X	X	X	Introduced
Xiphophorus helleri	green swordtail	X	X	X			Introduced
Tilapia melanotheron	tilapia	X	X	X	X		Introduced
Amphibians							
Bufo marinus	giant marine toad			X			Introduced
Rana catesbeiana	bullfrog				X	X	Introduced
Rana rugosa	wrinkled frog				X	X	Introduced

8.0 PHOTOGRAPHIC RECORD

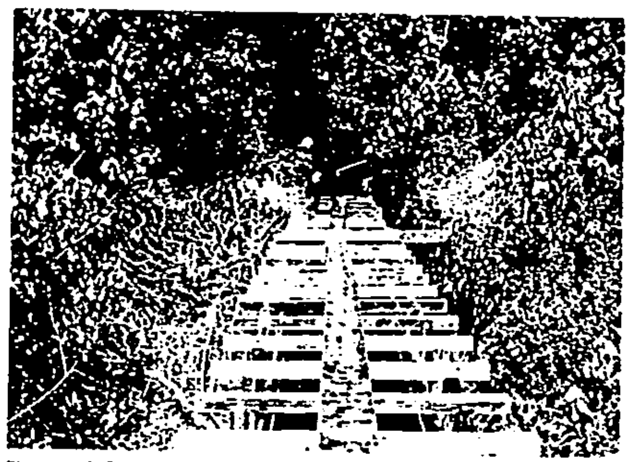
Photograph 1. Lower Hanamaulu Stream estuary, sandy area on right is where larval 'o'opu (*A. stamineus* and *S. hawaiiensis*) were common (Station 1).

Photograph 2. Hanamaulu Stream downstream of Kuhio Highway, at the heavily urbanized Station 4.

Photograph 3. Sampling stream habitat at tributary A (Station 7) of Hanamaulu Stream.

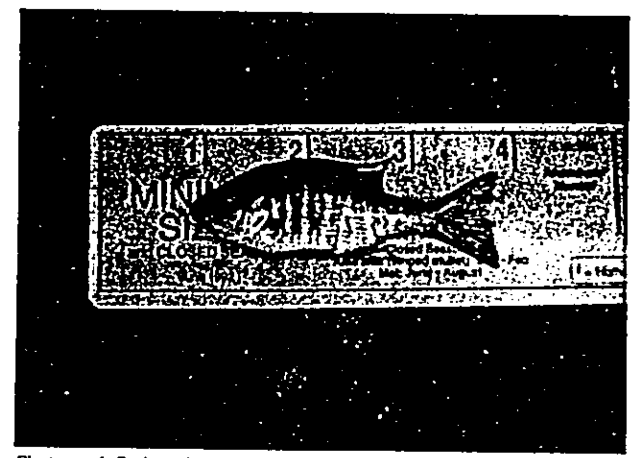
Photograph 4. Tributary C (Station 9) of Hanamaulu Stream upstream of Lower Lihue Ditch.

Photograph 5. Tributary D (Station 10) of the Hanamaulu Stream, upstream of the Lower Lihue ditch.

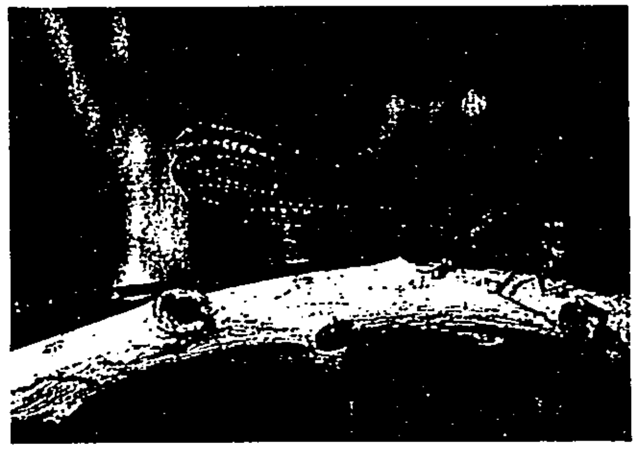


Photograph 6. Wooden flume of Lower Lihue ditch at Tributary D (Station 10), *Megalagrion vagabundum*.

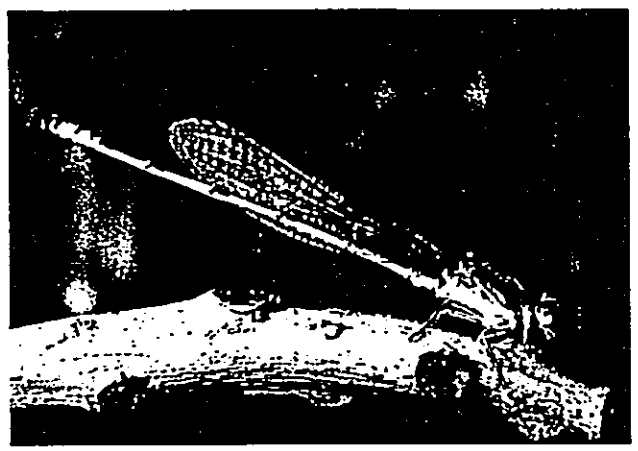
Photograph 7. Main branch of Hanamaulu Stream, upstream of Kapaia Reservoir (Station 13).



Photograph 8. Introduced bluegill collected at Station 13.



Photograph 9. Native endemic *Megalagrion vagabundum* damselfly captured at Station 10 and 12.



Photograph 10. Introduced *Enallagma civile* damselfly captured at Kapaia Reservoir Station 12.

STREAM ASSESSMENT (Station 1)

STREAM:	Hanamaulu	REACH:	0 (150m Snorkeled)
ELEVATION:	Sea Level	DATE:	3/7/94
TEMPERATURE:	72°F	TIME:	1004

NAME	Present	Habitat	Est. Density/m²	Comments
Crustaceans				
A. bisulcata				
M. grandimanus				
M. lar	✓			
P. clarkii				
Mollusca				
N. granosa				
T. verpertinus	✓	Found in slowest fastwater		
C. fluminea				
Insects				
Odonata		I. ramburi adult seen (1)		
Megalagrion				
Trichoptera				
Diptera				
Fish				
A. stamineus	✓	16.3 cm ♂ (Observed only 1)		
S. simpsoni				
L. concolor				
E. sandwicensis	✓	Common		
S. hawaiiensis	✓	Common - Small hinana also		
K. sandvicensis	✓	Common		
M. ~~cephalus~~ sp.	✓			
Tilapia sp.	✓	Melanotheron, 6-7 by nests, large adults		
Poecilia sp.				
Xiphophorus sp.				
Papio	✓	Caranx melampygus		
		- Collected post-larval 'o'opu		15-20 mm, probably Stenogobius, will grow in aquarium
Amphibians				
B. marinus				
Rana spp.				
Riparian Veg.		Hau lines bank,		
Collected		Water Hyacinth / Calif. grass chokes stream		
Photographed	✓			
Benthic Samples				
Collected				
DATA RECORDER:	Ron England			
PERSONNEL:	Charlie Chong / Alan Friedlander / Ron England			

STREAM ASSESSMENT (Station 2)

STREAM:	Hanamaulu	REACH:	Ron, 10m - Near Beach Showers Park
ELEVATION:	0	DATE:	3-7-94
TEMPERATURE:	~72	TIME:	1345

NAME	Present	Habitat	Est. Density/m²	Comments
Crustaceans				
A. bisulcata				
M. grandimanus				
M. lar				
P. clarkii				
Mollusca				
N. granosa				
T. verpertinus				
C. fluminea				
Insects				
Odonata				
Megalagrion				
Trichoptera				
Diptera				
Fish		(Snorkeled - Total Counts in 30m)		
A. stamineus		12 cm (one)		
S. simpsoni				
L. concolor				
E. sandwicensis		11, 14 cm (Two)		
S. hawaiiensis		10, cm (Two)		
K. sandvicensis		11 cm many 3 cm		
M. cephalus		many		
Tilapia sp.		1 dead, many lg. 25-30		
Poecilia sp.		many (swordtails)		
Xiphophorus sp.				
Amphibians				
B. marinus				
Rana spp.				
Riparian Veg.				
Collected				
Photographed				
Benthic Samples				
Collected				
DATA RECORDER:	Ron England			
PERSONNEL:				

EII STREAM ASSESSMENT (Station 3)

STREAM:	Hanamaulu	REACH:	Cow Pasture
ELEVATION:	0	DATE:	3/7/94
TEMPERATURE:		TIME:	1445

NAME	Present	Habitat	[illegible]	Comments
Crustaceans		(-Cow Pasture - Very Poor Habitat, grazed very		
A. bisulcata		area, Meandering thru an open grazed pasture land,		
M. grandimanus		Poor goby habitat)		
M. lar				
P. clarkii				
Mollusca				
N. granosa				
T. verpertinus				
C. fluminea				
		Snail Eggs - Apple Snails		
Insecta				
Odonata				
Megalagrion				
Trichoptera				
Diptera				
Fish				
A. stamineus				
S. simpsoni				
L. concolor				
E. sandwicensis				
S. hawaiiensis				
K. sandvicensis	✓	Abundant		
M. cephalus				
Tilapia sp.	✓	"		
Poecilia sp.				
Xiphophorus sp.	✓	"		
Amphibians				
B. marinus				
Rana spp.				
Riparian Veg.	✓	Hau, Hyacinth, Calif. Grass		
Collected		(Mostly Grass lining muddy banks)		
Photographed				
Benthic Samples				
Collected				
DATA RECORDER:	Ron England			
PERSONNEL:				

EII STREAM ASSESSMENT (Station 7)

STREAM:	Hanamaulu	REACH:	Rego Trucking Company Baseyard
ELEVATION:	40'	DATE:	3/7/94
TEMPERATURE:	≈ 72	TIME:	1511

NAME	Present	Habitat	[illegible]	Comments
Crustaceans		Very Degraded Stream here. Visibility about 3';		
A. bisulcata		can't see far in water, channelized stream		
M. grandimanus		(low Water crossing road bridge is landmark)		
M. lar		- Very Silty bottom, no riparian veg - buried ?		
P. clarkii		- First Riffle is here, at bridge		
Mollusca				
N. granosa				
T. verpertinus				
C. fluminea	✓	Abundant		
Insecta		- Drift Sample Collected at 1st Riffle		
Odonata		- Surber Sample collected here		
Megalagrion				
Trichoptera				
Diptera				
Fish				
A. stamineus	✓	3", 2.5", 4"		
S. simpsoni				
L. concolor				
E. sandwicensis				
S. hawaiiensis	✓	4 (7-8cm)		
K. sandvicensis	✓			
M. cephalus				
Tilapia sp.	✓			
Poecilia sp.	✓			
Xiphophorus sp.	✓			
Amphibians				
B. marinus				
Rana spp.				
Riparian Veg.				
Collected				
Photographed				
Benthic Samples				
Collected				
DATA RECORDER:				
PERSONNEL:				

EII STREAM ASSESSMENT (Station 5)

STREAM:	Hanamaulu	REACH:	Above Cemetery Ridge, Truck Yard
ELEVATION:	40'	DATE:	3/8/94
TEMPERATURE:	72	TIME:	1130

NAME	Present	Habitat	Est. Density	Comments
Crustaceans		Observed one naked, 3	", many	large Tilapia in
A. bisulcata		riffle areas. Higher	gradient	riffle area of
M. grandimanus		stream w/ pools	3' deep.	Vis poor, <3 ft.
M. lar		Poor water quality.		
P. clarkii		Snorkeled ~75 m,		stream completely
		overgrown, brown	algae.	Unclear spp.
Mollusca		filamentous algae.		
N. granosa				
T. verpertinus				
C. fluminea				
Insects				
Odonata				
Megalagrion				
Trichoptera				
Diptera				
Fish				
A. stamineus	✓	1-3" long		
S. simpsoni				
L. concolor				
E. sandwicensis				
S. hawaiiensis				
K. sandvicensis				
M. cephalus				
Tilapia sp.	✓			
Poecilia sp.	✓			
Xiphophorus sp.				
Amphibians				
B. marinus				
Rana spp.				
Riparian Veg.	✓	Hau completely	overgrown	in this area,
Collected		choking stream.	Also	california grass &
Photographed		bananas		
Benthic Samples				
Collected				

DATA RECORDER:

PERSONNEL:

EII STREAM ASSESSMENT (Station 6)

STREAM:	Hanamaulu	REACH:	Immaculate Conception School Reach
ELEVATION:	2120'	DATE:	3/8/94
TEMPERATURE:	72	TIME:	0920

NAME	Present	Habitat	Est. Density	Comments
Crustaceans		(Site accessed from canefields by	Immac. Conception	School, kindergarten field)
A. bisulcata		Stream habitat here is	deep, stagnant	pools. Water
M. grandimanus		turbid & slow moving. Very	poor habitat	for native fish.
M. lar		Stream too turbid and stagnant to		visually observe underwater
P. clarkii		here.		
Mollusca				
N. granosa				
T. verpertinus				
C. fluminea				
Insects				
Odonata				
Megalagrion				
Trichoptera				
Diptera				
Fish				
A. stamineus				
S. simpsoni				
L. concolor				
E. sandwicensis				
S. hawaiiensis				
K. sandvicensis				
M. cephalus				
Tilapia sp.				
Poecilia sp.				
Xiphophorus sp.				
Amphibians				
B. marinus				
Rana spp.				
Riparian Veg.	✓	Stream completely choked	w/Hau	here
Collected				
Photographed				
Benthic Samples				
Collected				

DATA RECORDER: RE

PERSONNEL:

ETI STREAM ASSESSMENT (Station 7)

STREAM:	Hanamaulu - Fork 1 (South	REACH:	~Lower Lihue Ditch Crossing, Trib "A"
ELEVATION:	≈271	DATE:	3/8/94
TEMPERATURE:	≈23	TIME:	1402

NAME	Present	Habitat	Ln. Dimension?	Comments
Crustaceans		Stream runs thru mud/c	lay su	bstrate - low flow 3-9 cfs.
A. bisulcata		Runs in a muddy relatively	flat a	rea, all introduced under
M. grandimanus		substrate [illegible] [illegible].	Veg in	[illegible] [illegible]
M. lar		Poor aquatic habitat. Upper	limit of	this fork stream flow.
P. clarkii	✓	~Common		
Mollusca				
N. granosa				
T. verpertinus				
C. fluminea				
Insects				
Odonate				
Megalagrion				
Trichoptera				
Diptera				
Fish				
A. stamineus				
S. simpsoni				
L. concolor				
E. sandwicensis				
S. hawaiiensis				
K. sandvicensis				
M. cephalus				
Tilapia sp.				
Poecilia sp.	✓	Common		
Xiphophorus sp.	✓	Common		
Amphibians				
B. marinus	✓			
Rana spp.				
Riparian Veg.		Introduced species pia	dominate	/wollows common.
Collected				
Photographed	✓			
Benthic Samples				
Collected				
DATA RECORDER:	RE			
PERSONNEL:	RE/CC			

ETI STREAM ASSESSMENT Station 8 (Trib. F:i)

STREAM:	Hanamaulu	REACH:	Tributary "B" at Lower Lihue Ditch Intersection
ELEVATION:	340'	DATE:	3/10/94
TEMPERATURE:	22.5	TIME:	1306

NAME	Present	Habitat	Ln. Dimension?	Comments
Crustaceans		Lower Lihue Ditch flows through par	t of	the old stream channel
A. bisulcata		and then flow is blocked	downstrea	m of ditch. Hurricane
M. grandimanus		blowdown	of	trees makes rough going;
M. lar	✓	Common snorkel	ed ≈	300m
P. clarkii				
Mollusca				
N. granosa				
T. verpertinus				
C. fluminea	✓			
Insects				
Odonate				
Megalagrion				
Trichoptera				
Diptera				
Fish				
A. stamineus				
S. simpsoni				
L. concolor				
E. sandwicensis				
S. hawaiiensis				
K. sandvicensis				
M. cephalus				
Tilapia sp.	✓	20-25 Larvae (25-30cm adults)		
Poecilia sp.	✓	Common		
Xiphophorus sp.				
Amphibians				
B. marinus				
Rana spp.				
Riparian Veg.				
Collected				
Photographed				
Benthic Samples				
Collected				
DATA RECORDER:	RE			
PERSONNEL:	RE/CC			

EIS STREAM ASSESSMENT Station 6 Lower

STREAM:	Hanamaulu	REACH:	Trib "B" at Lihue Ditch
ELEVATION:	228c ft	DATE:	3/9/94
TEMPERATURE:		TIME:	1728

NAME	Present	Habitat	Est. Density	Comments
Crustaceans		- Stream is completely diverted		downstream of ditch,
A. bisulcata		with the exception of a small		trickle/leakage with
M. grandimanus		only ¼ - ½ cfs of flow.		Lower Ditch uses part
M. lar		of main stream channel	for	the ditch for a short
P. clarkii		distance - need to look	up	stream of ditch.
Mollusca				
N. granosa				
T. verpertinus				
C. fluminea				
Insects				
Odonata				
Megalagrion				
Trichoptera				
Diptera				
Fish				
A. stamineus				
S. simpsoni				
L. concolor				
E. sandwicensis				
S. hawaiiensis				
K. sandvicensis				
M. cephalus				
Tilapia sp.				
Poecilia sp.	✓	- Common		
Xiphophorus sp.				
Amphibians				
B. marinus				
Rana spp.				
Riparian Veg.		Ginger, Java Plum,		
Collected				
Photographed				
Benthic Samples				
Collected				

DATA RECORDER: RE

PERSONNEL: RE/CC

EIS STREAM ASSESSMENT Lower Lihue Ditch (Station 9)

STREAM:	Hanamaulu	REACH:	Tributary C, South of Wooden Flume Trib.
ELEVATION:	360	DATE:	3/9/94
TEMPERATURE:	72	TIME:	1700

NAME	Present	Habitat	Est. Density	Comments
Crustaceans		Fish/Prawns observed in		backwater pool created at Ditch
A. bisulcata		Flow is virtually nothing		above ditch, some water
M. grandimanus		was being released below		ditch, stream below was
M. lar	✓	silty pool habitat.		Snorkeled ~ 50m below but
P. clarkii		Hau choked stream is dried up.		Walked 50m upstream of ditch
		and there was no flow,		only standing water.
Mollusca				
N. granosa				
T. verpertinus				
C. fluminea	✓	In Ditch		
Insects				
Odonata				
Megalagrion				
Trichoptera				
Diptera				
Fish				
A. stamineus	✓	Large Adult 7½" observed in		flume of Lower Lihue Ditch
S. simpsoni				
L. concolor				
E. sandwicensis				
S. hawaiiensis				
K. sandvicensis				
M. cephalus				
Tilapia sp.	✓	4 large adults		
Poecilia sp.	✓	- common below Ditch		
Xiphophorus sp.				
Largemouth Bass	✓	1 - 25 cm adult.		
Amphibians				
B. marinus				
Rana spp.				
Riparian Veg.		- Java Plum, Strawberry Guava, Hau		
Collected				
Photographed				
Benthic Samples				
Collected				

DATA RECORDER: RE

PERSONNEL: RE/CC

EII STREAM ASSESSMENT

(Station 10) ½ mile (Trib. "D") Middle

STREAM:	Hanamaulu	REACH:	Above wooden Flume, Branch (Same stream)
ELEVATION:	360'	DATE:	3/9/94
TEMPERATURE:		TIME:	1525

NAME	Present	Habitat	Est. Density	Comments
Crustaceans		silty Bottom, low flow	estima	ted at 2-4 cfs
A. bisulcata	shallow	Pool, slow run habitat	(Flow m	uch lower than at flume
M. grandimanus				wooden.)
M. lar				
P. clarkii	✓	Abundant		
Mollusca				
N. granosa				
T. verpertinus				
C. fluminea				
Insects				
Odonata				
Megalagrion				
Trichoptera				
Diptera				
Mosquitos!		Bad		
Fish				
A. stamineus				
S. simpsoni				
L. concolor				
E. sandwicensis				
S. hawaiiensis				
K. sandvicensis				
M. cephalus				
Tilapia sp.				
Poecilia sp.	✓	Abundant		
Xiphophorus sp.				
Amphibians				
B. marinus				
Rana spp.	✓	([illegible] Frog)		
Riparian Veg.		Java Plum, Strawberry Guava,	kukui	
Collected				
Photographed				
Benthic Samples				
Collected				
DATA RECORDER:	RE			
PERSONNEL:	AE/LC			

EII STREAM ASSESSMENT

(Station 10)

STREAM:	Hanamaulu	REACH:	At Wooden Flume of Lihue Ditch, Trib. "D"
ELEVATION:	2320'	DATE:	3/9/94
TEMPERATURE:	71	TIME:	1330

NAME	Present	Habitat	Est. Density	Comments
Crustaceans		(Snorkeled 75m of flume	above	river - nothing except Corbicula)
A. bisulcata		Substrate of this branch	is si	lt. silt is from 1-2'
M. grandimanus		deep. Poor habitat due	to sh	allow pools (1-2.5')
M. lar		that is overgrown wi	th hau.	
P. clarkii				
Mollusca				
N. granosa				
T. verpertinus				
C. fluminea	✓			
Insects				
Odonata				
Megalagrion	✓	Collected one at flume	- M.	vagabunda
Trichoptera				
Diptera				
Fish				
A. stamineus				
S. simpsoni				
L. concolor				
E. sandwicensis				
S. hawaiiensis				
K. sandvicensis				
M. cephalus				
Tilapia sp.				
Poecilia sp.	✓	Common		
Xiphophorus sp.				
Amphibians				
B. marinus				
Rana spp.				
Riparian Veg.	✓	Hau - extremely Dense, ca	only snorkled	≈ 50m here due
Collected		to density of Hau		
Photographed				
Benthic Samples				
Collected				
DATA RECORDER:	RE			
PERSONNEL:	AE/LC			

EII STREAM ASSESSMENT : Station 11)

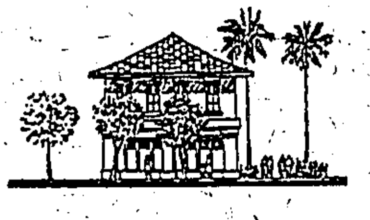
STREAM: Hanamaulu-Main Branch			REACH: Below Pukaki Res.	
ELEVATION: ≈ 260			DATE: 3/9	
TEMPERATURE: 70			TIME: 1427	
NAME	Present	Habitat	Est. Density	Comments
Crustaceans		Deep Pool Area		
A. bisulcata				
M. grandimanus				
M. lar				
P. clarkii				
Molluscs				
N. granosa				
T. verpertinus				
C. fluminea				
Insects				
Odonata				
Megalagrion				
Trichoptera				
Diptera				
Fish				
A. stamineus				
S. simpsoni				
L. concolor				
E. sandwicensis				
S. hawaiiensis				
K. sandvicensis				
M. cephalus				
Tilapia sp.	✓	Large Adults only (30cm), Tilapia Nest		
Poecilia sp.	✓			
Xiphophorus sp.				
Largemouth Bass	✓	30-35cm; Young also 10-15cm		
Amphibians				
B. marinus				
Rana spp.				
Riparian Veg.		Hau, Banana, California Grass		
Collected				
Photographed				
Benthic Samples				
Collected				
DATA RECORDER: RE				
PERSONNEL:				

EII STREAM ASSESSMENT (Station 12)

STREAM: Hanamaulu-Main Branch			REACH: Immediately above Kapaia Reservation	
ELEVATION: 410 (approx)			DATE: 3/9/94; 3/10/94; 3/11/94	
TEMPERATURE: 70			TIME: 1000-1230	
NAME	Present	Habitat	Est. Density	Comments
Crustaceans		-Good Habitat, higher gradient riffle pool, water clarity		
A. bisulcata		Fairly good - best stream habitat yet. Snorkeled ≈ 500m.		
M. grandimanus				
M. lar				
P. clarkii	✓	Extremely Abundant		
Molluscs				
N. granosa				
T. verpertinus				
C. fluminea	✓	-(In Irrigation Ditch)		
Unknown Snail	✓	-Need to I.D. in lab		
Insects	✓	Pollinators set malaise trap here overnight 3/10		
Odonata		-5 benthic kick samples, failed to get any aquatic insects!		
Megalagrion	✓	Pdhinae (Pandanus?) M vagabundo exuvia here 3/10		
Trichoptera				
Diptera				
Fish				
A. stamineus				
S. simpsoni				
L. concolor				
E. sandwicensis				
S. hawaiiensis				
K. sandvicensis				
M. cephalus				
Tilapia sp.				
Poecilia sp.	✓	-Observed in "bluegill" pool 3/11/94, 5-6		
Xiphophorus sp.				
Bluegill	✓	Caught one, observed 7-8 in two separate deep pools		
Amphibians				
B. marinus				
Rana spp.	✓	catesbiana (large bullfrogs - numerous tadpoles), 3 wrinkled frog		
Riparian Veg.	✓	Almost exclusively rose apple and some strawberry guava		
Collected		on stream floodplain area. Above floodplain almost		
Photographed		exclusively Uluhe fern.		
Benthic Samples				
Collected				
DATA RECORDER: RE				
PERSONNEL: RE/CC/DP				

I-1

Letter Report
Regarding Stormwater Discharges to
Hanamaulu Stream



Pacific Aquatic Environmental
2357 S. Beretania Street, Suite A-237
Honolulu, Hawaii 96826-1499
Phone (808)-941-7904•Fax (808)-955-8304

29 December 1994

Yukie Ohashi
PBR Hawaii
Pacific Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Yukie:

We have evaluated the latest stormwater runoff values provided by Kodani & Associates, Inc. for the Lihue-Hanamaulu Master Plan. The predicted increase in peak stormwater runoff will be 25% for the Ahukini Mauka portion of the proposed development which drains into Hanamaulu Stream, and varies for other locations within the project area. Kodani & Associates, Inc. also state that overall peak stormwater discharge for the proposed development area will increase by 17%, from the existing level of 2,608 cfs to 3,060 cfs. Conversely, Kodani & Associates, Inc. have predicted that at buildout sediment runoff from the project area will be reduced by 80% from that associated with existing agriculture.

Flow varies greatly in Kauai Streams. For example, peak flow in the South Fork of the Wailua River near Lihue (a nearby USGS gauged stream) varies dramatically throughout the year. Average flow in the South Fork of the Wailua River during the 1992 water year was about 87 cfs. During the same period three peak flows exceeded 5,800 cfs, and the maximum measured peak discharge was 28,780 cfs.

Thus, water flow in Hawaiian streams naturally fluctuates widely during the year, with no deleterious effects to native aquatic biota. The 17% (452 cfs) increase in peak runoff from the project area would be negligible compared to the existing peak flow (100-year flood event) of 28,000 cfs in the Hanamaulu Stream.

Flow in the Hanamaulu Stream already varies dramatically. Because the proposed project area accounts for only 3% of the total watershed, impacts to aquatic biota from the projected 2% increase in peak flow in the Hanamaulu Stream will most likely be immeasurable. Native stream biota are adapted to the dynamic flow regimes of Hawaiian streams. Stream 'o'opu reproduction and recruitment are timed to make use of high flows associated with flood events. 'O'opu nakea (*Awaous guamensis*) typically spawn after the first fall storm, and post-larval fish in streams with dry lower sections ascend only during flood events.

As mentioned above, Kodani & Associates, Inc. have predicted that sediment runoff from the project area will be reduced by 80%. Although the projected decrease in sediment would be small compared to background (due to other sources along the stream) sediment loading, it could have beneficial effects on aquatic biota. Fine sediment clogs interstitial spaces among substrate particles and interferes with 'o'opu spawning. In addition, decreased sedimentation would result in lower turbidity and, therefore, improved water quality. Moreover, a reduction in sediment could have beneficial effects on estuarine and near-shore marine fauna, particularly corals.

Sincerely:
Ron Englund
Ron Englund
Aquatic Ecologist

cc: Tim Johns, AMFAC/JMB

J

Botanical Survey Lihu'e-Hanama'ulu Master Plan

BOTANICAL SURVEY
LIHU'E-HANAMA'ULU MASTER PLAN
LIHUE PLANTATION COMPANY, LIMITED AND AMFAC/JMB HAWAII, INC. MOLOKOA LANDS
LIHU'E DISTRICT, ISLAND OF KAUA'I

by

Winona P. Char

CHAR & ASSOCIATES
Botanical Consultants
Honolulu, Hawai'i

Prepared for: Amfac/JMB Hawaii, Inc.

June 1994

Table of Contents

	page
INTRODUCTION	1
SURVEY METHODS	1
DESCRIPTION OF THE VEGETATION	2
Molokoa Parcel	3
Ahukini Mauka Parcel	3
Ahukini Makai Parcel	4
Hanama'ulu Parcel	5
DISCUSSION AND RECOMMENDATIONS	5
PLANT SPECIES LIST	7
LITERATURE CITED	15

BOTANICAL SURVEY
LIHU'E-HANAMA'ULU MASTER PLAN
LIHUE PLANTATION COMPANY, LIMITED AND AMFAC/JMB HAWAII, INC. MOLOKOA LANDS
LIHU'E DISTRICT, ISLAND OF KAUA'I

INTRODUCTION

The study area is composed of four parcels which together comprise a total of approximately 552 acres located in Kalapaki and Hanama'ulu, Kaua'i. All four parcels are under sugar cane cultivation by The Lihue Plantation Company, Limited. The Molokoa parcel is approximately 156 acres, the Ahukini Mauka parcel about 221 acres, the Ahukini Makai parcel about 140 acres, and the Hanama'ulu parcel approximately 30 acres. The proposed master plan calls for the development of single- and multi-family residential, village/mixed use, industrial, commercial, public facility and park, and open space uses. The developments proposed for the four parcels will require an amendment to the State Land Use District boundaries, from the Agricultural and Conservation Districts to the Urban District.

Field studies to assess the botanical resources found on each of the four parcels were conducted in June 1994; a team of three botanists was used. The primary objectives of the survey were to: 1) describe the major vegetation types; 2) inventory the flora; 3) search for threatened and endangered species as well as sensitive native plant communities; and 4) identify areas of potential environmental problems or concerns and propose appropriate mitigation measures.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. A recent black and white aerial photographs (1"=400') and topographic maps were examined to determine vegetation cover patterns, terrain characteristics, access, boundaries, and reference points. Access onto all four parcels was from the major roads and highways which border the properties. Once on the parcels, cane haul roads provided access to all points on the parcels.

A walk-through survey method was used. Notes were made on plant associations and distribution, substrate types, topography, drainage, exposure, etc. Plant identifications were made in the field; plants which could not be positively identified were collected for later determination in the herbarium, and for comparison with the recent taxonomic literature. Areas most likely to harbor native plant communities and rare species, such as along the margins of fields where they border the gulches and uncultivated lands, were more intensively surveyed.

The species recorded are indicative of the season ("rainy" vs. "dry") and the environmental conditions at the time of the survey. A survey taken at a different time of the year and under varying environmental conditions would no doubt yield slight variations in the species list, especially of the weedy, annual plants.

DESCRIPTION OF THE VEGETATION

All four parcels occur largely on soils of the Lihu'e series; these are deep, nearly level (0 to 8% slopes), well-drained soils (Foote et al. 1972). Areas with this soil series are in sugar cane cultivation. In the gulches which border the Ahukini Mauka and Ahukini Makai parcels, rocky broken lands predominate. Gulches and steep slopes support mixed introduced forests primarily of Java plum and ironwood, and koa-haole scrub.

A more detailed description of the vegetation found on each of the four parcels follows. A list of all the plants found during the field studies is presented at the end of the report.

Molokoa Parcel

The Molokoa parcel, bounded by the Hanama'ulu-Ahukini Cutoff Road, Ahukini Road, and Lihu'e Town, is covered primarily by young fields of sugar cane (Saccharum officinarum). Fallow fields composed of about 50% Guinea grass (Panicum maximum) and about 50% sugar cane from ratoon are found on a portion of the upper fields. A large reservoir no longer in use has been plowed under and is in sugar cane cultivation.

The actively cultivated fields harbor few weedy species, and then these tend to be associated with the margins of fields and roadsides. On this parcel, swollen fingergrass (Chloris barbata) is the most frequently observed weed. A weedy mixture of other species is found on the fallow fields; these include kaliko (Euphorbia heterophylla), false poinsettia (Euphorbia cyathophora), Glycine wightii, pigweed (Portulaca oleracea), ironweed (Vernonia cinerea), Chamaesyce albomarginata, and apple of Peru (Nicandra physalodes). The banks or mound around the former reservoir support dense mats of California grass (Brachiaria mutica) with a few shrubs of koa-haole (Leucaena leucocephala), lantana (Lantana camara), and Indian pluchea (Pluchea indica). A few squash plants (Lagenaria siceraria) are also found here.

Ahukini Mauka Parcel

This parcel, bounded by by Ahukini Road, the Hanama'ulu-Ahukini Cut-off Road, Hanama'ulu Gulch, and the undeveloped Weinberg Foundation property, contains largely older fields of sugar cane. Most of the weedy species are found along the margins of the

fields, along several irrigation ditches, the edges of Hanama'ulu Gulch, and a small ridge which runs parallel to the gulch. The gulch and small ridge support a forest composed mainly of Java plum (Syzygium cumini). Other trees and shrubs commonly found in these uncultivated areas are guava (Psidium guajava), lantana, China berry tree (Melia azedarach), kolomona (Senna surattensis), Christmas berry (Schinus terebinthifolius), hau (Hibiscus tiliaceus), silk oak (Grevillea robusta), and ironwood (Casuarina equisetifolia). Along the edges of the forest, California grass, Guinea grass, and molasses grass (Melinis minutiflora) form dense mats. Where people have dumped their lawn trimmings, a few ornamental species have become established; these include Monstera sp., Philodendron micans, and Chinese fan palm (Livistonia chinensis). In places, yellow granadilla vines (Passiflora laurifolia), a realtive of the passion fruit or liliko'i, form dense tangles over trees and shrubs.

Along the eastern boundary, where the parcel abuts the Weinberg Foundation property, there is a narrow strip of uncultivated land which supports a scrub composed of koa-haole shrubs, Macaranga tanarius trees, and clumps of Guinea grass and Calfornia grass. An unpaved road runs around the perimeter of this overgrown portion of the site and there are a few piles of rubbish here and there, as well as a large storage container.

Ahukini Makai Parcel

The Ahukini makai parcel, bounded by Ahukini Road, the Hanama'ulu-Ahukini Cutoff Road, and Hanama'ulu Gulch, Hanama'ulu Bay, and Lihu'e Airport, is covered by fields of older sugar cane. On this parcel, the common weedy species are swollen finger grass, fir-leaved celery (Ciclospermum leptophyllum), spiny amaranth (Amaranthus spinosus), and little bell or pink bindweed (Ipomoea triloba). Along the irrigation ditches, barnyard rice (Echinochloa crus-galli) is common. Forested areas are found on the steep slopes bordering the gulch and bay. Ironwood trees form the predominant cover, although small areas with Java plum and lemon-scented gum trees (Eucalyptus citriodora) are common. Where the tree cover is open, Guinea grass and koa-haole are dense. Otherwise, the understory is rather sparse, consisting of fallen "needles" from the iron-wood trees and scattered clumps of sour grass (Digitaria insularis). Passion fruit or liliko'i (Passiflora edulis) vines are abundant, while yellow granadilla occurs in smaller numbers.

Hanama'ulu Parcel

This parcel, bounded by the Kuhio Highway, Hanama'ulu-Ahukini Cutoff Road, and Hanama'ulu Town, is covered by recently planted fields of sugar cane. Like the other three parcels, swollen fingergrass is the most abundant of the weedy species. Other weedy species are more common along the irrigation ditches and the narrow strip of uncultivated land along the highway; these include the yellow-flowered Mexican poppy (Argemone mexicana), Job's tears (Coix lachryma-jobi), Natal redtop grass (Rhynchelytrum repens), Spanish needle (Bidens pilosa), and red pualele (Emilia fosbergii). A small clump of oleander (Nerium oleander) and Christmas berry shrubs is found along the Kuhio Highway perimeter. Along the bottoms of the irrigation ditches with standing water, Rhizoclonum sp., a filamentous green algae, and cyanobacteria form scattered mats.

DISCUSSION AND RECOMMENDATIONS

There is very little of botanical interest or concern on the four parcels which are under sugar cane cultivation. The fields support a weedy mix of species commonly associated with such agricultural activities. The uncultivated areas such as the forests which border the Ahukini Mauka and Ahukini Makai parcels are dominated

by introduced or alien species such as Java plum, koa-haole, Christmas berry, guava, Guinea grass, and California grass. None of the plants found during the field studies are listed, proposed, or candidate threatened and endangered species (U.S. Fish and Wildlife Service 1994a, 1994b); nor are any of the plants considered rare or vulnerable (Wagner et al. 1990). All of the plants inventoried on the four parcels can be found in similar environmental habitats throughout the islands. Other recent botanical studies which have included the four parcels or adjacent properties (Char 1990a, 1990b; Linney and Char 1988) have also recorded similar findings.

The proposed developments, as outlined in the master plan, are not expected to have a significant negative impact on the botanical resources of the four parcels. Development will take place on portions of the parcels now under active sugar cane cultivation. Given the findings above, there are no botanical reasons to impose any restrictions, impediments, or conditions to the proposed uses of the four parcels. No recommendations are proposed at this time.

PLANT SPECIES LIST -- Lihu'e-Hanama'ulu Master Plan

The following checklist is an inventory of the plants found during the field studies. The plants are arranged alphabetically by families into each of three groups: Ferns, Monocots, and Dicots. The taxonomy and nomenclature of the Ferns follow Lamoureux (1988); the flowering plants, Monocots and Dicots, are in accordance with Wagner et al. (1990).

For each species, the following information is provided:
1. Scientific name with author citation.
2. Common English and/or Hawaiian name(s), when known.
3. Biogeographic status. The following symbols are used:
   - I = indigenous = native to the Hawaiian Islands and also elsewhere.
   - P = Polynesian = plants brought by the Polynesians to the islands prior to Western contact (Cook's discovery of the islands in 1778); not native.
   - X = introduced or alien = all those plants brought to the islands by humans, intentionally or accidentally, after Western contact, not native.

Scientific name	Common name	Status
FERNS		
NEPHROLEPIDACEAE (Sword Fern Family)		
Nephrolepis multiflora (Roxb.) Jarrett ex Morton	hairy sword fern	X
FLOWERING PLANTS		
MONOCOTS		
AGAVACEAE (Agave Family)		
Cordyline terminalis (L.) A. Chev.	ti, ki	P
ARACEAE (Aroid Family)		
Colocasia esculenta (L.) Schott	taro, kalo	P
Monstera sp.		X
Philodendron micans (Klotzch) C. Koch.	philodendron	X
ARECACEAE (Palm Family)		
Cocos nucifera L.	coconut, niu	P
Livistonia chinensis (Jacq.) R. Br. ex Mart.	Chinese fan palm	X
Roystonea sp.		X
COMMELINACEAE (Spiderwort Family)		
Commelina diffusa N.L. Burm.	honohono	X
CYPERACEAE (Sedge Family)		
Cyperus rotundus L.	nutgrass, nut sedge	X
Kyllinga brevifolia Rottb.	green kyllinga, kili'o'opu	X
Pycreus polystachyos (Rottb.) P. Beauv.		I
MUSACEAE (Banana Family)		
Musa X paradisiaca L.	banana, maia	X
POACEAE (Grass Family)		
Brachiaria mutica (Forssk.) Stapf	California grass	X
Brachiaria subquadriparia (Trin.) Hitchc.		X
Cenchrus echinatus L.	common sandbur, 'ume'alu	X
Chloris barbata (L.) Sw.	swollen fingergrass, mau'u lei	X

Scientific name	Common name	Status
Chloris radiata (L.) Sw.	radiate fingergrass	X
Coix lachryma-jobi L.	Job's tears, pu'ohe-'ohe	X
Cynodon dactylon (L.) Pers.	Bermuda grass, manienie	X
Digitaria insularis (L.) Mez ex Ekman	sour grass	X
Digitaria radicosa (Presl) Miq.	crabgrass	X
Digitaria spp. (2)	crabgrass	X
Echinochloa colona (L.) Link	jungle rice	X
Echinochloa crus-galli (L.) P. Beauv.	barnyard rice	X
Eleusine indica (L.) Gaertn.	goose grass, wire grass, manienie ali'i	X
Melinus minutiflora P. Beauv.	molasses grass	X
Panicum maximum Jacq.	Guinea grass	X
Paspalum conjugatum Bergius	Hilo grass, mau'u Hilo	X
Paspalum dilatatum Poir.	Dallis grass	X
Paspalum fimbriatum Kunth	Panama paspalum, fimbriate paspalum	X
Paspalum urvillei Steud.	Vasey grass	X
Rhynchelytrum repens (Willd.) C.E. Hubb.	Natal redtop	X
Saccharum officinarum L.	sugar cane, ko	P
Setaria gracilis Kunth	yellow foxtail, mau'u Kaleponi	X
Sorghum halepense (L.) Pers.	Johnson grass	X
DICOTS		
ACANTHACEAE (Acanthus Family)		
Asystasia gangetica (L.) T. Anderson	Chinese violet	X
Thunbergia fragrans Roxb.	white thunbergia	X
AMARANTHACEAE (Amaranthus Family)		
Amaranthus spinosus L.	spiny amaranth, pakai kuku	X
Amaranthus viridis L.	slender amaranth, pakai	X
ANACARDIACEAE (Mango Family)		
Mangifera indica L.	mango, manako	X
Schinus terebinthifolius Raddi	Christmas berry, wilelaiki	X

Scientific name	Common name	Status
APIACEAE (Carrot Family)		
Centella asiatica (L.) Urb.	Asiatic pennywort, pohe kula	X
Ciclospermum leptophyllum (Pers.) Sprague	fir-leaved celery	X
APOCYNACEAE (Periwinkle Family)		
Nerium oleander L.	oleander, 'oleana	X
ARALIACEAE (Ginseng Family)		
Schefflera actinophylla (Endl.) Harms	octopus tree, umbrella tree	X
ASTERACEAE (Sunflower Family)		
Ageratum conyzoides L.	ageratum, maile hohono	X
Bidens pilosa L.	beggar's-tick, Spanish needle, ki	X
Conyza bonariensis (L.) Cronq.	hairy horseweed, ilioha	X
Crassocephalum crepidioides (Benth.) S. Moore	crassocephalum	X
Eclipta alba (L.) Hassk.	false daisy	X
Emilia fosbergii Nicolson	pualele, flora's paintbrush	X
Parthenium hysterophorus L.	Santa Maria	X
Pluchea indica (L.) Less.	Indian pluchea	X
Pluchea symphytifolia (Mill.) Gillis	sourbush, pluchea	X
Sonchus oleraceus L.	sow thistle, pualele	X
Tridax procumbens L.	coat buttons	X
Verbesina encelioides (Cav.) Benth. & Hook.	golden crown-beard	X
Vernonia cinerea (L.) Less.	ironweed	X
Wedelia trilobata (L.) Hitchc.	wedelia	X
Xanthium strumarium L.	cocklebur, kikania	X
BIGNONIACEAE (Bignonia Family)		
Spathodea campanulata P. Beauv.	African tulip tree	X
BRASSICACEAE (Mustard Family)		
Lepidium virginicum L.	peppergrass	X
CAMPANULACEAE (Bellflower Family)		
Hippobroma longiflora (L.) G. Don	star of Bethlehem	X

Scientific name	Common name	Status
CASUARINACEAE (Ironwood Family)		
Casuarina equisetifolia L.	ironwood, paina	X
CONVOLVULACEAE (Morning-glory Family)		
Ipomoea indica (J. Burm.) Merr.	koali 'awa	I
Ipomoea obscura (L.) Ker-Gawl.	field bindweed	X
Ipomoea triloba L.	little bell	X
Merremia tuberosa (L.) Rendle	wood rose, pilikai	X
CUCURBITACEAE (Gourd Family)		
Lagenaria siceraria (Molina) Standley	bottle gourd, hue	X
Momordica charantia L.	wild bittermelon	X
EUPHORBIACEAE (Spurge Family)		
Chamaesyce albomarginata (Torr. & A. Gray) Small		X
Chamaesyce hirta (L.) Millsp.	garden spurge	X
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	X
Chamaesyce hyssopifolia (L.) Small		X
Chamaesyce prostrata (Aiton) Small	prostrate spurge	X
Euphorbia cyathophora J.A. Murray	false poinsettia	X
Euphorbia heterophylla L.	kaliko	X
Macaranga tanarius (L.) Mull. Arg.	macaranga	X
Phyllanthus debilis Klein ex Willd.	phyllanthus	X
Ricinus communis L.	castor bean, koli	X
FABACEAE (Pea Family)		
Caesalpinia decapetala (Roth) Alston	wait-a-bit, puakele-kino	X
Canavalia cathartica Thouars	maunaloa	X
Chamaecrista nictitans (L.) Moench	partridge pea, lauki	X
Crotalaria incana L.	fuzzy rattlepod, kukaehoki	X
Crotalaria pallida Aiton	smooth rattlepod	X
Desmanthus virgatus (L.) Willd.	virgate mimosa	X
Desmodium sandwicensis E. Mey.	Spanish clover, pua pilipili	X
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	X
Glycine wightii (Wight & Arnott) Verdc.	glycine	X

Scientific name	Common name	Status
Indigofera spicata Forssk.	creeping indigo	X
Indigofera suffruticosa Mill.	indigo, 'iniko	X
Lablab purpureus (L.) Sweet	hyacinth bean	X
Leucaena leucocephala (Lam.) de Wit	koa-haole, ekoa	X
Macroptilium atropurpureum (DC.) Urb.	cowpea, wild bushbean	X
Macroptilium lathyroides (L.) Urb.	cowpea, bushbean	X
Medicago sativa L.	alfalfa, lucerne	X
Mimosa pudica L.	sensitive plant, sleeping grass, puahilahila	X
Senna occidentalis (L.) Link	coffee senna, 'auko'i	X
Senna surattensis (N.L. Burm.) H. Irwin & Barneby	kolomona	X
Vigna marina (J. Burm.) Merr.	beach pea, mohihihi, nanea	I
Vigna sesquipedalis (L.) Fruw.	yard-long bean	X
LAMIACEAE (Mint Family)		
Leonotis nepetifolia (L.) R. Br.	lion's ear	X
MALVACEAE (Mallow Family)		
Abutilon grandifolium (Willd.) Sweet	hairy abutilon, mao	X
Hibsicus tiliaceus L.	hau	I?
Malvastrum coromandelianum (L.) Garcke	false mallow	X
Sida rhombifolia L.	Cuba jute	X
MELIACEAE (Mahogany Family)		
Melia azedarach L.	China berry, pride of India, 'inia	X
MORACEAE (Mulberry Family)		
Ficus microcarpa L. f.	Chinese banyan	X
MYRTACEAE (Myrtle Family)		
Eucalyptus citriodora Hook.	lemon-scented gum	X
Psidium cattleianum Sabine	strawberry guava	X
Psidium guajava L.	guava, kuawa	X
Syzygium cumini (L.) Skeels	java plum, palama	X
ONAGRACEAE (Evening Primrose Family)		
Ludwigia octovalvis (Jacq.) Raven	primrose willow	X

Scientific name	Common name	Status
OXALIDACEAE (Wood Sorrel Family)		
Oxalis corniculata L.	yellow wood sorrel, 'ihi 'ai	P?
Oxalis corymbosa DC.	pink wood sorrel, 'ihi pehu	X
PAPAVERACEAE (Poppy Family)		
Argemone mexicana L.	Mexican poppy	X
PASSIFLORACEAE (Passion Flower Family)		
Passiflora edulis f. flavicarpa Degener	passion fruit, liliko'i	X
Passiflora foetida L.	love-in-a-mist, running pop, pohapoha	X
Passiflora laurifolia L.	yellow granadilla	X
PLANTAGINACEAE (Plantain Family)		
Plantago major L.	broad-leaved plantain, laukahi, kuhekili	X
PORTULACACEAE (Purslane Family)		
Portulaca oleracea L.	pigweed, 'akulikuli kula, 'ihi	X
PROTEACEAE (Protea Family)		
Grevillea robusta A. Cunn. ex R. Br.	silk oak, 'oka kilika	X
RUBIACEAE (Coffee Family)		
Spermacoce assurgens Ruiz & Pav.	buttonweed	X
SOLANACEAE (Tomato Family)		
Lycopersicon esculentum var. cerasiforme (Dunal) Alef.	cherry tomato	X
Nicandra physalodes (L.) Gaertn.	apple of Peru	X
Solanum americanum Mill.	popolo	I?
STERCULIACEAE (Cacao Family)		
Waltheria indica L.	'uhaloa, hi'aloa, kanakaloa	I?
URTICACEAE (Nettle Family)		
Pilea microphylla (L.) Liebm.	rockweed, artillery plant	X

Scientific name	Common name	Status
VERBENACEAE (Verbena Family)		
Lantana camara L.	lantana, lakana	X
Stachytarpheta urticifolia (Salisb.) Sims	nettle-leaved vervain, owi, oi	X
Verbena litoralis Kunth	weed verbena, owi, oi, ha'uoi	X

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Avifaunal and Feral Mammal Survey of Molokoa Lands

AVIFAUNAL AND FERAL MAMMAL SURVEY OF MOLOKOA LANDS FOR AMFAC'S LIHUE - HANAMAULU MASTER PLAN, KAUAI

Prepared for

PBR-Hawaii

by

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5 August 1994

INTRODUCTION

The purpose of this report is to summarize the findings of a four day (7-10 July 1994) bird and mammal field survey of approximately 552 acres of agricultural land which encompass the Lihue-Hanamaulu Master Plan area (Figl 1 and 2). Also summarized are the findings of the survey of the Hanamaulu Gulch wetlands which is outside of the project boundary (Fig. 4). Also included are references to pertinent literature as well as unpublished faunal reports from earlier studies of this area and similar habitat nearby.

The objectives of the field survey were to:

1- Document what bird and mammal species occur on the property or may likely occur given the habitats available.

2- Provide current baseline information on the relative abundance of each species and compare these data with the findings of earlier investigations.

3- Note the presence or likely occurrence of any native fauna particularly any that are considered "Endangered" or "Threatened".

4- Determine if this proeprty contains any special or unique faunal habitats.

GENERAL SITE DESCRIPTION

The proposed project lands are currently in sugarcane. Ditches and some introduced (exotic) brush covered habitat occurs along the edges of the cane fields. Residential and urban areas including Lihue Airport adjoin this project site. Wetland habitats in Hanamaulu Gulch consist of flooded pasture and stream habitats. Figure 1 and 2 taken from the May 1994 Environmental Assessment Notice prepared by PBR-Hawaii show the location of the project site and nearby areas.

Weather during the survey was cloudy with light brief rain showers on the first two days and partly cloudy the latter two survey days. Winds were NE trades at 10-20 mph.

STUDY METHODS

Existing roads provided access to the entire project site. The wetlands in Hanamaulu Gulch were covered on foot along both the north and south boundaries. Field observations were made with binoculars and by listening for vocalizations. These observations were concentrated during the peak bird and mammal activity periods of early morning and late afternoon/dusk. Attention was also paid to the presence of tracks and scats as indicators of bird and mammal activity.

At various locations, (Fig. 3 and 4) census (count) stations were established where all birds seen or heard over a period of eight minutes were tallied. Other important faunal observations obtained between these census stations were also recorded. These data provide the basis for the relative abundance estimates given in this report. Published and unpublished reports from earlier studies at this site and from similar habitat elsewhere on Kauai were also consulted (Pratt et al. 1987; Bruner 1980, 1986, 1988a; 1988b, 1989, 1990a, 1990b, 1990c, 1991, 1992; Hawaii Audubon Society 1993; State of Hawaii 1993). Observations of feral mammals were limited to visual sightings and evidence in the form of scats and tracks. No attempts were made to trap mammals in order to obtain data on their relative abundance and distribution. Three evenings were devoted to searching for the presence of owls and the Hawaiian Hoary Bat (Lasiurus cinereus semotus).

Scientific names used in this report follow those given in Hawaii's Birds (Hawaii Audubon Society 1993); A field guide to the birds of Hawaii and the Tropical Pacific (Pratt et al. 1987) and Mammal species of the World (Honacki et al. 1982).

RESULTS AND DISCUSSION

Resident Endemic (Native) Land Birds:

The endemic Pueo or Short-eared Owl (*Asio flammeus sandwicensis*) is active during the day and forages over open fields as well as coastal forest and thus could potentially be found at this site. None were observed on this survey. Due to the elevation and type of habitat no other resident, endemic landbirds would be expected at this site. The Pueo is listed as endangered on the island of Oahu but not elsewhere in Hawaii by the State of Hawaii Department of Land and Natural Resources Division of Forestry and Wildlife.

Hawaii's State Bird, the endangered Nene or Hawaiian Goose (*Nesochen sandvicensis*), has in recent years been reintroduced to Kauai. The Division of Forestry and Wildlife estimate that 100 Nene now occur on the island (State of Hawaii 1993). Nene have been recorded from Crater Hill at Kilauea Point National Wildlife Refuge to Poipu. None were recorded on this survey but could be expected to use the wet pasture lands in Hanamaulu Gulch. This location is outside of the project boundary and is not planned to be developed.

Native Waterbirds:

The project site provides limited habitat suitable for waterbirds. Three Black-crowned Night Heron (*Nycticorax nycticorax*) were recorded foraging along an irrigation ditch in the Ahukini Mauka parcel (Fig.2). This species is not endangered or threatened.

Outside the project area at the Hanamaulu Gulch wetlands, four Hawaiian Duck (Koloa) (*Anas wyvilliana*) and six Common Moorhen (*Gallinula chloropus*) were found. These two endangered species were also recorded in this area on an earlier survey (Bruner 1990b). Five Black-crowned Night Heron were also tallied in the Hanamaulu wetlands. No Black-necked Stilts (*Himantopus mexicanus*) or Hawaiian Coot (*Fulica alai*) were recorded on the survey but may from time to time use this area.

Resident Indigenous (Native) Seabirds:

No seabirds were recorded during this survey. The threatened Newell's Shearwater (*Puffinus newelli*) may fly over the property as it goes back and forth between its nesting burrows in the mountains and the open sea where it forages.

Migratory Indigenous (Native) Birds:

At this time of year most shorebirds are on the arctic nesting grounds. A few individuals, usually juveniles, may oversummer in Hawaii and not return to the arctic to breed until their second year of life (Johnson et al. 1981, 1989). No migratory birds were recorded on the survey, however, the following species likely occur along the cane roads and ditches from August to the end of April: Pacific Golden-Plover (*Pluvialis fulva*) and Wandering Tattler (*Heteroscelus incanus*). Neither of these species are endangered or threatened.

CORRECTION

THE PRECEDING DOCUMENT(S) HAS
BEEN REPHOTOGRAPHED TO ASSURE
LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

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<u>Exotic</u> (<u>Introduced</u>) <u>Birds</u>:

Table One lists a total of 19 exotic species found on the survey. Data from earlier surveys (Bruner 1990a, 1990b, 1990c) are also shown in Table One for comparative purposes. Information provided in Pratt et al. (1987); Hawaii Audubon Society (1993); and Bruner 1980, 1986, 1988a, 1988b, 1989, 1991, 1992) also confirm that the exotic species recorded on this survey are the ones that would be expected from this sector of the island and in this type of habitat.

<u>Feral Mammals</u>:

Feral cats as well as rats and mice were observed on the property. No trapping was conducted in order to assess the relative abundance of these mammals at this site.

Records of the endemic and endangered Hawaiian Hoary Bat (<u>Lasiurus</u> <u>cinereus</u> <u>semotus</u>) are limited but the species is believed to be fairly common on Kauai (Tomich 1986; Kepler and Scott 1990). The ecology of this native bat is poorly understood. On 9 July at 1920 hours two bats were seen foraging over the pasture area in Hanamaulu gulch. They stayed in this area until 1935 hours then moved out in the direction of Hanamaulu Bay. On other surveys I have observed bats in a variety of habitats on Kauai including: native forest, agricultural lands, residential and urban areas as well as river valleys and bays. Their occurrence in this area is, therefore, not unexpected.

A brief field survey can at best provide only a limited perspective of the wildlife present in any given area. Not all species will necessarily be observed. The number of species and the relative abundance of each species may also vary throughout the year due to food resources and reproductive success. Species which are migratory will quite obviously be a part of the faunal picture only at certain times during the year. Exotic species sometimes prosper for a time only to later disappear or become a less significant part of the ecosystem (Williams 1987; Moulton et al. 1990). Studies over a period of time can provide a comprehensive view of the bird and mammal populations in a particular area. Nevertheless, some general conclusions can be made.

1- The entire property was surveyed and all habitats were examined. Census data were obtained in order to assess the relative abundance of each species. Findings of these census are reported in Table One and elsewhere in the Results section of the report. Census data from earlier studies (1990) are also shown in Table One for comparative purposes.

2- The only native bird seen on the proposed project property was the Black-crowned Night Heron, a non-endangered or threatened waterbird. Beyond the project boundary at the nearby Hanamaulu Gulch and wetlands Common Moorhen and Hawaiian Duck, two endangered species along with the non-endangered Black-crowned Night Heron were seen. Hawaiian Coot and Black-necked Stilt, two other endangered waterbirds, were not recorded but could occur in this area along with the recently reintroduced native endangered Nene. The native Hawaiian Owl (Pueo), not endangered or threatened on Kauai, may also forage in this region.

3- No seabirds were found on the property. The threatened Newell's Shearwater nest in the mountains and frequently follow river valleys on flights back and forth from the sea to mountain nest burrows. None were seen on this survey but may overfly this area. No migratory shorebirds were recorded due to time of year. From late April to early August they are in the arctic on their breeding grounds. Pacific Golden-Plover and Wandering Tattler would be expected in this area during August through April. These species are not endangered or threatened.

4- Feral mammals found on the survey included rats, mice and cats. Two native endangered Hawaiian Bats were observed in Hanamaulu Gulch. I have previously seen bats in habitat similar to this area as well as in native forest, agricultural lands and urban/residential sites on Kauai. This species appears to be adaptable to a wide array of habitats. Whether or not bats regularly forage and roost in Hanamaulu Gulch is unknown.

5- The project property is primarily agricultural sugarcane land. Some second growth forest of introduced plants also occur at this site.

No special or unique habitat for birds and mammals exists on the property proposed for development. No threatened and endangered species exist at the project site. Therefore, no adverse impacts to native species is expected to occur with the development of the project. No mitigative measures are required.

6- The only significant habitat for native birds is in the Hanamaulu Gulch wetlands which is outside of the project area. The Hanamaulu Gulch wetlands provide habitat for a few native waterbirds. This area, however, is heavily overgrown with grass and brush and presently is usable by relatively few birds. This wetland is surrounded by existing agricultural, urban and residential habitats. The proposed land use changes for the area nearby this wetland should have little or no effect on the few native waterbirds at this site. Flooding of the gulch following heavy rain may temporarily open up the habitat and stream but without constant vegetation management the stream would be quickly overgrown by grass and brush.

7- The proposed urban/light industrial developments like the recycling project and residential areas may pose a problem for Newell's Shearwaters which are attracted to lights as they move back and forth from their nest burrows in the mountains to the sea where they forage. Bright lights confuse them and they often collide with power lines or are struck by vehicles. To help reduce this risk, street lights and other bright lights around buildings and along roads should have shields that direct the light towards the ground. Tom Telfer, District Biologist for Kauai, Department of Land and Natural Resources, Division of Forestry and Wildlife can provide specific details on how to minimize the impact of urban/residential lighting on the threatened Newell's Shearwater. In addition, I understand that a settling basin for water runoff associated with recycling center is planned for this facility. This may attract birds and present a possible hazzard for aircraft at the adjoining Lihue Airport. I also am told that a Papaya treatment facility is projected for this portion of the property. If discarded fruits are left in the open this may also attract birds. Mitigation measures for these two operations need to be identified. At the very least these potential problem areas need to be monitored and excessive increases in bird populations regulated. This may ultimately involve designing these areas to exclude birds through the use of netting or other barriers.

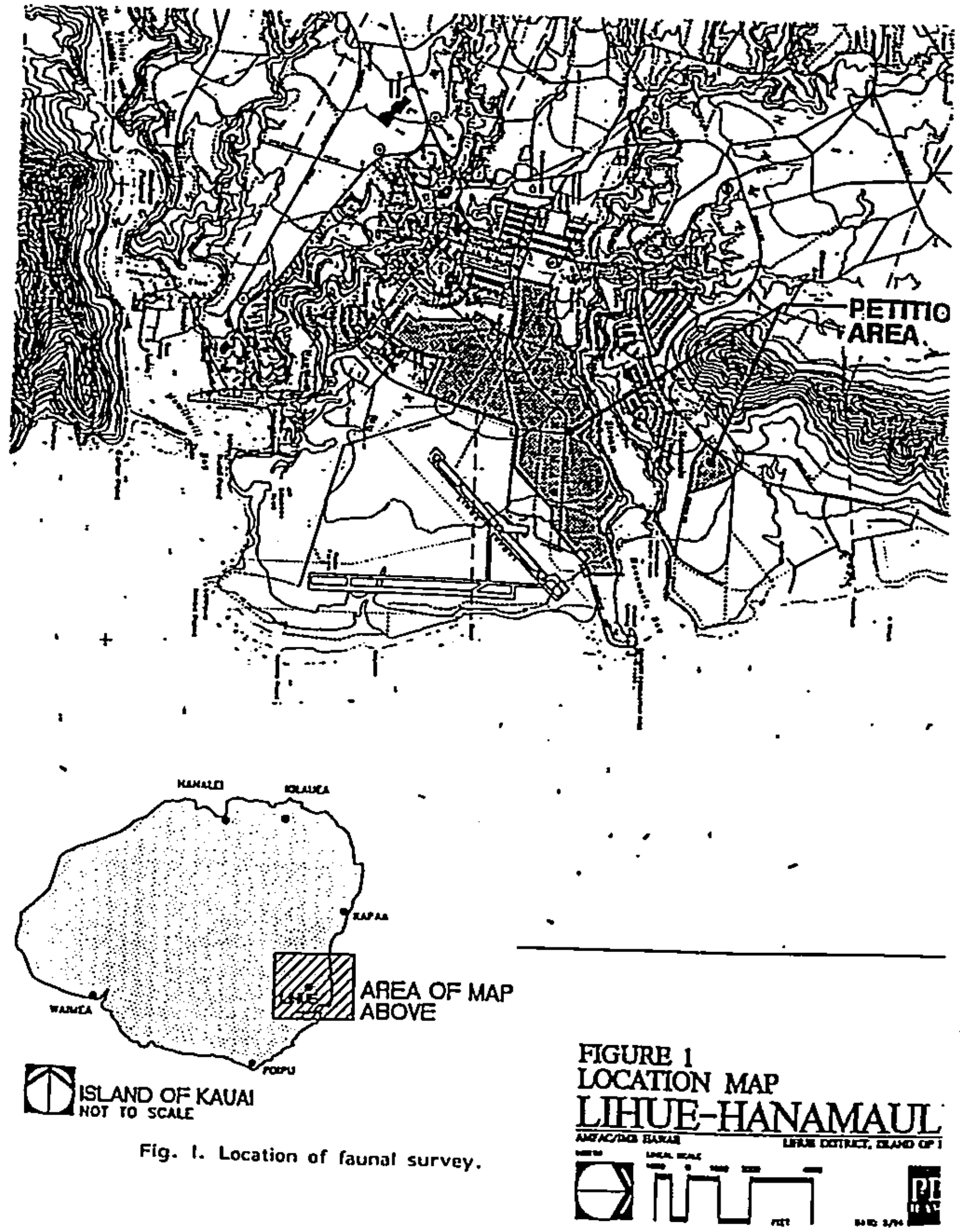

Fig. 1. Location of faunal survey.

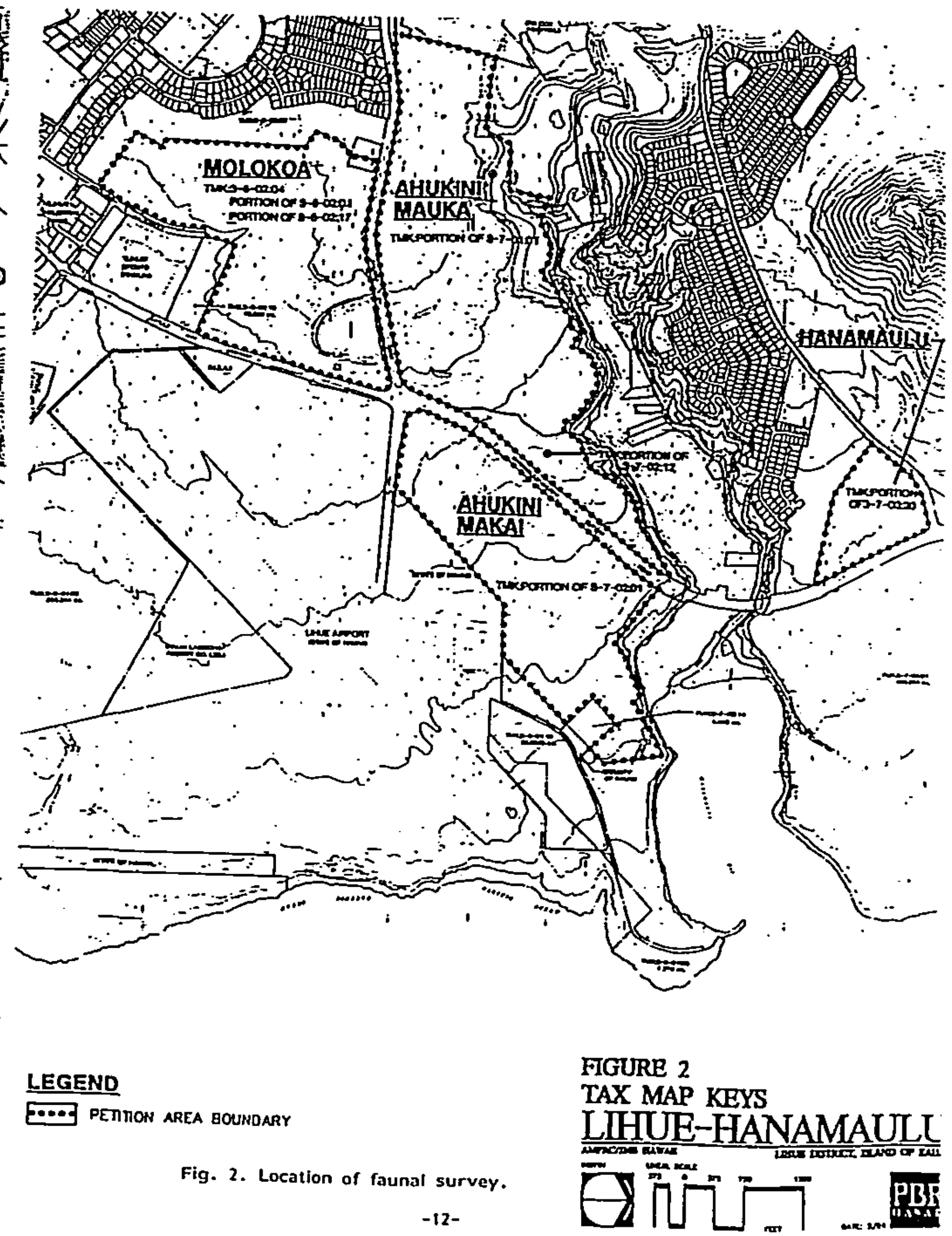

Fig. 2. Location of faunal survey.

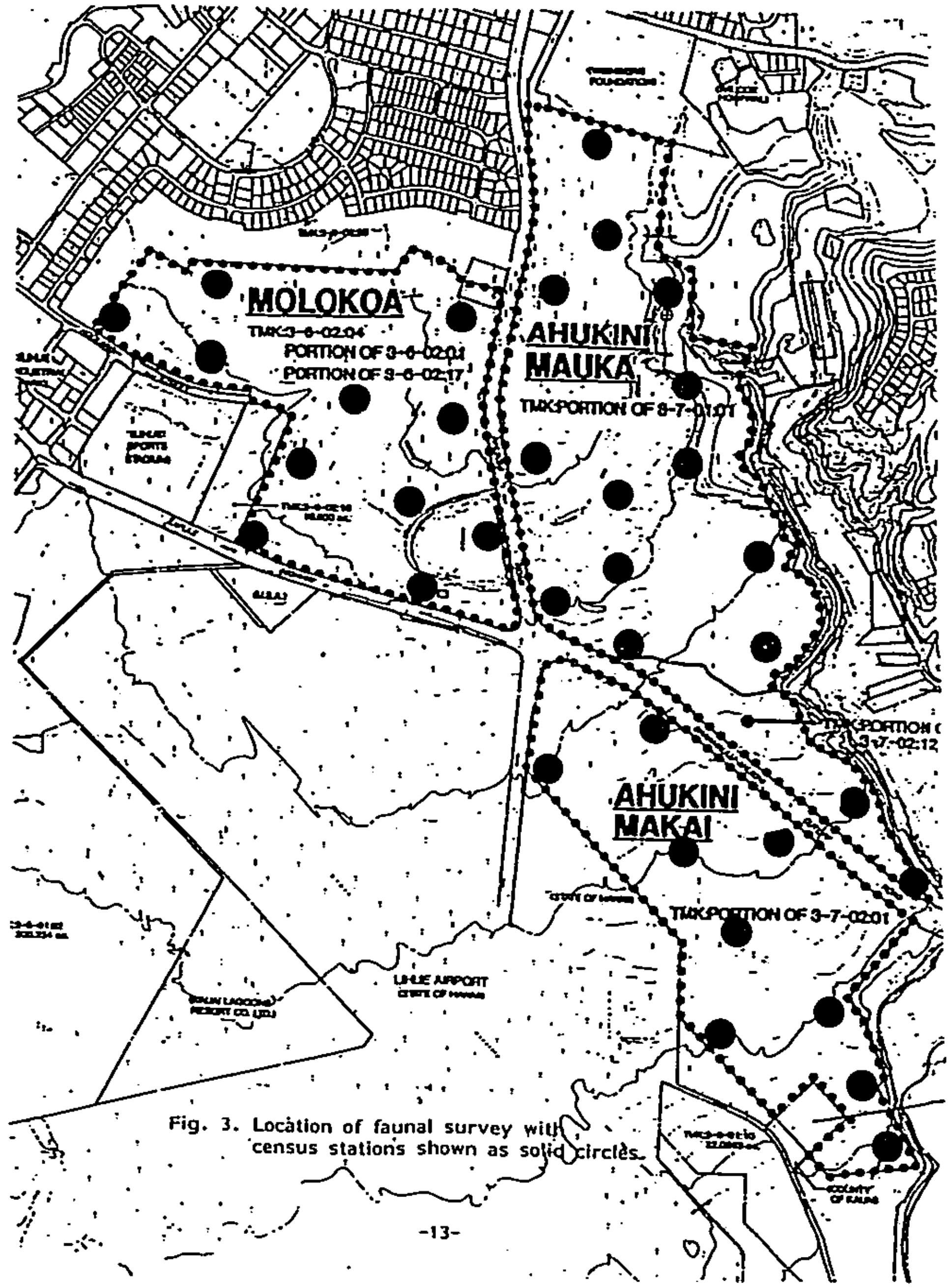

Fig. 3. Location of faunal survey with census stations shown as solid circles.

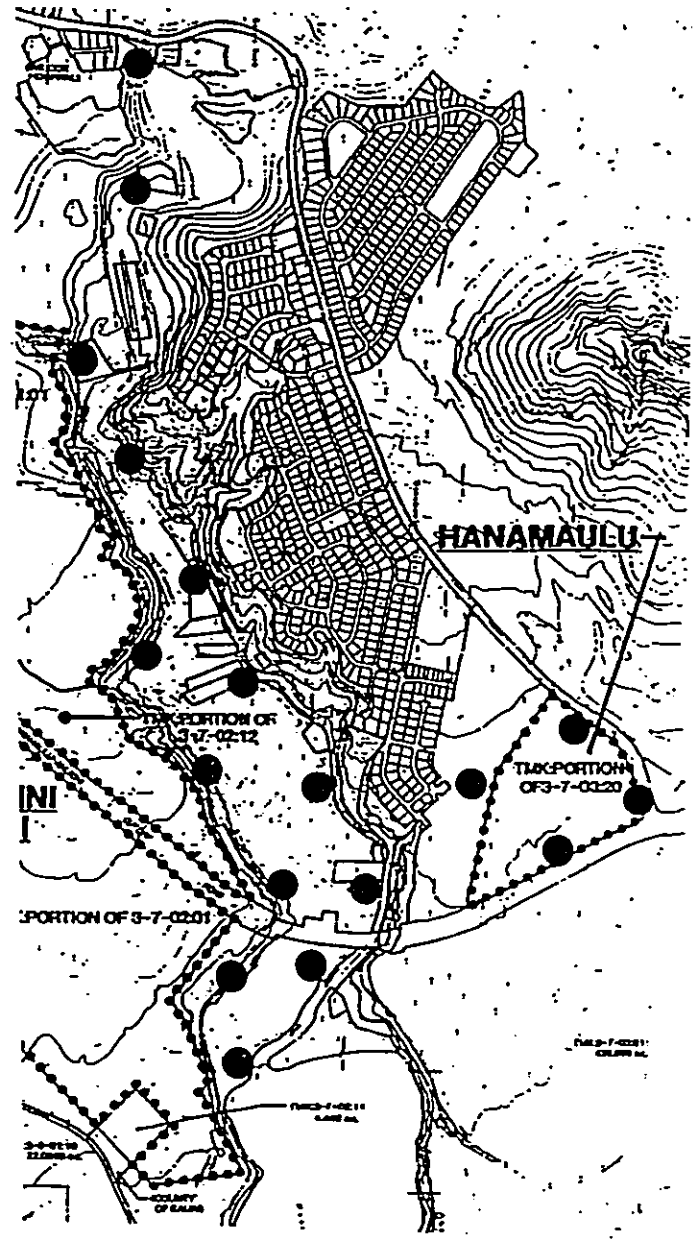

Fig. 4. Location of faunal survey with census stations shown as solid circles.

KEY TO TABLE 1

Relative abundance = number of times observed during survey or averag number on eight minute counts.

A = abundant (ave. 10+)

C = common (ave. 5-10)

U = uncommon (ave. less than 5)

R = recorded (seen or heard at times other than on 8 min. counts. number which follows is the total number seen or heard over the duration of the survey).

TABLE 1

Exotic birds recorded at Lihue, Hanamaulu, Kauai, 1994. Bruner 1990 data are averages of three separate surveys.

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE* 1994	Bruner 1990
Barn Owl	Tyto alba	R= 1	-
Cattle Egret	Bubulcus ibis	C= 9	C= 8
Feral Chicken	Gallus gallus	C= 6	C= 6
Ring-necked Pheasant	Phasianus colchicus	R= 2	U= 4
Spotted Dove	Streptopelia chinensis	A=13	C= 8
Zebra Dove	Geopelia striata	A=13	A=12
Common Myna	Acridotheres tristis	C= 8	C= 8
Northern Mockingbird	Mimus polyglottus	R= 1	-
Northern Cardinal	Cardinalis cardinalis	C= 7	U= 4
Red-crested Cardinal	Paroaria coronata	R= 6	U= 4
White-rumped Shama	Copsychus malabaricus	R= 5	U= 3
Hwamei	Garrulax canorus	R= 1	U= 4
Western Meadowlark	Sturnella neglecta	R= 2	U= 3
Japanese White-eye	Zosterops japonicus	A=11	C= 7
Nutmeg Mannikin	Lonchura punctulata	C= 8	A=12
Chestnut Mannikin	Lonchura malacca	A=10	A=15
House Finch	Carpodacus mexicanus	A=12	A=10
House Sparrow	Passer domesticus	R=10	C= 7
Java Sparrow	Padda oryzivora	R=13	-

*(see page 16 for key to symbols)

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Recommended Mitigative Measures to Reduce Bird Attractants Associated with the Lihue Debris Recycling Station and the Tropical Fruit Disinfestation Facility

RECOMMENDED MITIGATIVE MEASURES TO REDUCE BIRD ATTRACTANTS ASSOCIATED WITH THE PROPOSED LIHUE DEBRIS RECYCLING STATION AND THE TROPICAL FRUIT DISINFESTATION FACILITY

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September, 1994

TABLE OF CONTENTS

SECTION HEADING ... Page

EXECUTIVE SUMMARY ... ii

1.0 INTRODUCTION ... 1

2.0 SITE DESCRIPTION AND NEARBY HABITATS ... 1

3.0 BIRD BEHAVIOR ... 3

4.0 POTENTIAL BIRD ATTRACTING AREAS ... 4

5.0 PROPOSED MITIGATIVE MEASURES ... 4
- 5.1 LDRS STORMWATER RETENTION POND ... 4
- 5.2 GREEN WASTE DIVERSION AREA ... 6
- 5.3 TROPICAL FRUIT DISINFESTATION FACILITY CULL WASTE ... 6
- 5.4 LANDSCAPING ... 6

6.0 REFERENCES ... 7

7.0 PHOTOGRAPHS

EXECUTIVE SUMMARY

Pacific Aquatic Environmental (PAE) was retained by AMFAC/JMB Hawaii, Inc. to assess whether proposed developments associated with the Ahukini Makai project will attract additional birds to the area surrounding the Lihue Airport. In addition, PAE recommended mitigative measures to reduce future potential birdstrike hazards at Lihue Airport resulting from completion of the Ahukini Makai project.

The project area is currently cultivated in sugarcane and provides little habitat for native and introduced birds. A recycling station and a fruit disinfestation facility are proposed to be built within 1,000 ft. of runway 3-21 at Lihue Airport. These facilities could increase the use of this area by birds unless mitigative measures are implemented at each site. The area is surrounded by both permanent and ephemeral waterbird habitats. The Kauai Lagoons ponds and golf course, Hanamaulu Stream and estuary, and abandoned sugarcane settling ponds encircle the Lihue Airport. Additional habitat for seed-eating birds is also found within the grass groundcover surrounding the airport.

To reduce the possibility that birds will be attracted to new developments and present a hazard to aircraft in this area, a series of four mitigative measures is recommended. If a stormwater retention basin at the County of Kauai's proposed Lihue Debris Recycling Station must be built as proposed, it is highly recommended that the pond be covered with shade cloth. If this is not feasible, the pond must have design requirements such as steep sided banks, butyl lining of the bottom, and landscaping with unattractive (to birds) groundcover and vegetation. Hazing by USDA Animal Damage Control personnel would also be required. The most highly recommended mitigative measure is the complete diversion of stormwater from the site to the current Lihue Airport stormwater drain channel. This could preclude the need for a stormwater detention pond or settling basin and minimize the amount of standing water available to birds. This would attract the fewest birds to the site and minimize the risk of birdstrike.

Two other areas in the proposed facility could also attract additional birds: the green waste diversion area of the Lihue Debris Recycling Station and the University of Hawaii's Kauai Tropical Fruit Disinfestation Facility. However, if proposed daily operating procedures are followed, these facilities should not attract additional birds to the vicinity of the Lihue Airport.

1.0 INTRODUCTION

Pacific Aquatic Environmental was retained by AMFAC/JMB Hawaii, Inc. to assess and to recommend mitigative measures to reduce future potential birdstrike hazards at Lihue Airport that could result from certain land uses proposed within the Ahukini Makai area. This study focuses on two areas: the County of Kauai's Lihue Debris Recycling Station (LDRS) and the University of Hawaii's Kauai Tropical Fruit Disinfestation Facility. Part of AMFAC's Lihue-Hanamaulu Master Plan involves the construction and operation of a recycling center and fruit disinfestation facility adjacent to the present Lihue Transfer Station. These facilities will be within 1,000 feet of the Lihue Airport Runway 3-21, and are expected to encompass approximately 40 acres. Bruner (1994) found that the sugarcane land in this area was not significant bird habitat, but that a sedimentation basin at the LDRS could cause impacts to aircraft. Unless proper mitigative precautions are taken there is a potential to attract native and introduced birds to the recycling and fruit disinfestation centers. This could increase in the probability of birdstrikes at Runway 3-21. Engine failure can result when birds are ingested by jet engines, resulting in aviation accidents with potentially severe consequences. This is particularly true when larger birds, such as Hawaiian Duck, Hawaiian Goose, and owls, are ingested. There is currently a substantial birdstrike problem at the Lihue Airport due to the existing land use configurations near the airport. Birdstrikes have been reported to be as high as 154 per year (USDA Animal Damage Control 1993). This assessment provides several alternatives to reduce the possibility that birds will be attracted to new developments in the area.

Field observations for this report were conducted by Pat Hart and Ron Englund on 16 September 1994 and by Ron Englund in March 1994.

2.0 SITE DESCRIPTION AND NEARBY HABITATS

The proposed Lihue Debris-Recycling Station (LDRS) and University of Hawaii's Kauai Tropical Fruit Disinfestation Facility are located adjacent to the existing Lihue Transfer Station (Figure 1). This site is south of Hanamaulu Bay, on a gently sloping plateau at an elevation of approximately 90 ft. All project lands are currently used for the cultivation of sugar cane (Photos 1 and 2). Runway 3-21 at the Lihue Airport is approximately 1,000 ft. to the east and southeast of these proposed sites. Due to their proximity to the runway it is crucial to assess their potential attractiveness to birds, especially if they provide additional habitat and foraging areas for waterbirds. Existing bodies of water that provide bird habitat are described in the following list.

- The ocean is located about 400 ft. east of Runway 35-17.
- Hanamaulu Bay is located approximately 2,500 ft. north of Runway 3-21.
- Hanamaulu Stream (Photos 3 and 4), that contains fresh and brackish water at the estuary, is approximately 3,000 ft. north-northwest of Runway 3-21.
- Large freshwater and brackish ponds on the grounds of the Kauai Lagoons Resort (Photo 5) and golf course ponds located approximately 1 mile southeast of Lihue Airport.
- Irrigation reservoirs behind the horse stables at the Kauai Lagoons Resort.

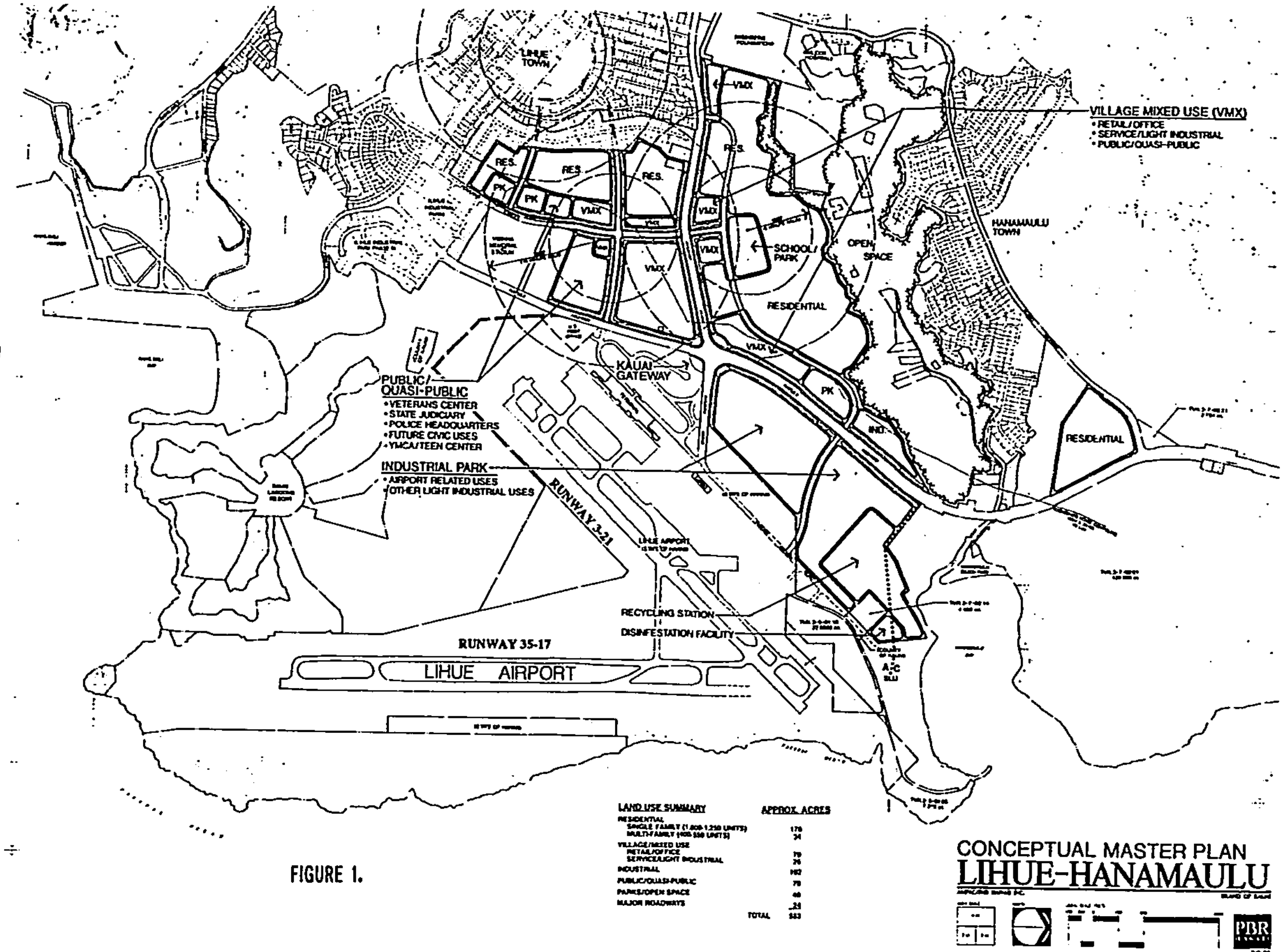
VILLAGE MIXED USE (VMX)
• RETAIL/OFFICE
• SERVICE/LIGHT INDUSTRIAL
• PUBLIC/QUASI-PUBLIC
LIHUE TOWN
HANAMAULU TOWN
RES.
PK
VMX
SCHOOL/ PARK
OPEN SPACE
RESIDENTIAL
IND.
KAUAI GATEWAY
PUBLIC/ QUASI-PUBLIC
• VETERANS CENTER
• STATE JUDICIARY
• POLICE HEADQUARTERS
• FUTURE CIVIC USES
• YMCA/TEEN CENTER
INDUSTRIAL PARK
• AIRPORT RELATED USES
• OTHER LIGHT INDUSTRIAL USES
RUNWAY 3-21
RUNWAY 35-17
LIHUE AIRPORT
RECYCLING STATION
DISINFESTATION FACILITY
LAND USE SUMMARY
APPROX. ACRES
RESIDENTIAL
VILLAGE/MIXED USE
INDUSTRIAL
PUBLIC/QUASI-PUBLIC
PARKS/OPEN SPACE
MAJOR ROADWAYS
TOTAL
CONCEPTUAL MASTER PLAN
LIHUE-HANAMAULU
PBR

FIGURE 1.

- A series of large settling ponds between airport Runway 35-17 and the ocean.
- A 20 ft by 60 ft. settling pond located near the proposed LDRS stormwater detention basin, approximately 2,000 ft. from Runway 3-21 (Photo 6).
- Numerous irrigation and drainage ditches associated with sugarcane production.

3.0 BIRD BEHAVIOR

The Hawaiian Duck, or koloa, *Anas wyvilliana*, occurs mainly on the island of Kauai and is a federally listed endangered species. They can be found in any freshwater habitat. Their food consists of freshwater vegetation, mollusks, and insects. Breeding occurs near water, usually between December and May. Small flocks of these birds often move between bodies of freshwater. These birds would likely use any exposed body of freshwater opportunistically.

The Hawaiian Goose, or nene (*Nesochen sandvicensis*), is a federally listed endangered species that has recently become re-established on the island of Kauai. This bird frequents a wide range of habitats including freshwater and feeds on a variety of native and introduced plants. Breeding occurs from November to June, and nests are usually beneath bushes. Nene are often observed flying in flocks.

The Hawaiian Coot, or 'alae ke'oke'o (*Fulica americana alai*), is a federally listed endangered species found throughout the Hawaiian Islands in fresh and brackish-water marshes and ponds. This bird prefers open bodies of water and feeds mainly on aquatic plants. Hawaiian coots build floating nests among aquatic vegetation in winter and spring. These birds are relatively sedentary but would be expected to use new aquatic habitat if it was available.

The Common Moorhen, or 'alae 'ula (*Gallinula chloropus sandvicensis*), is a federally listed endangered species in Hawaii, and is found mainly on Kauai and Oahu. This secretive bird prefers freshwater areas with large amounts of vegetation. It feeds on mollusks, water plants, and grasses. The nest is often built in folded reeds. Standing water near the LDRS facility would not likely constitute quality habitat for these birds because they are shy and prefer vegetative cover.

The Hawaiian Stilt, or ae'o (*Himantopus mexicanus knudseni*), is an endangered species that occurs on all Hawaiian Islands. They often forage in groups in ponds, marshy areas, and mudflats. Their main prey is fish, crabs, worms, and aquatic insects. Nesting occurs in colonies near mudflats. These birds would be expected to use any new body of water opportunistically.

The Black-Crowned Night-Heron, or 'auku'u (*Nycticorax nycticorax hoactli*), is a resident on all main islands. It is found along streams, lowland ponds, and estuaries. This bird often forages in groups to catch fish, frogs, mice, and insects. Breeding occurs from May to June and nests are placed in trees. This bird would be expected to use any new body of water.

The Cattle Egret, *Bubulcus ibis*, was introduced to Hawaii in 1959 to help control insect pests and is now common on all islands. This bird frequents pastures, garbage dumps, and most freshwater areas. Insects and aquatic invertebrates are its main source of food. Egrets travel in large flocks to and from their feeding areas, a habit that poses a threat to airport operations.

Cattle Egrets are the most opportunistic foragers of any bird that has been addressed in this report.

4.0 POTENTIAL BIRD ATTRACTING AREAS

Philip Bruner (1994) conducted a four-day avifaunal and feral mammal survey encompassing the lands beneath the proposed LDRS and Kauai Tropical Fruit Disinfestation Facility. Bruner found 19 introduced bird species typical of highly disturbed lowland habitat. No endemic birds and only one indigenous bird species, the Black-Crowned Night-Heron, were observed. The current land use of cultivating sugarcane in the proposed project area does not appear to attract birds or pose a major hazard to operations at the Lihue Airport. However, certain aspects of the proposed LDRS and or fruit disinfestation facilities may attract additional species or larger numbers of existing bird species if mitigative actions are not taken.

One of the potential bird attractants that would result from project completion is the proposed LDRS stormwater sediment detention basin. This detention basin, that would have an approximate surface area of 300 ft by 150 ft, would be located approximately 2000 ft. from Runway 3-21 (Russell Leong, Harding Lawson Associates, Personal Communication). The basin would trap water during periods of heavy rain becoming an ephemeral pond that could attract waterbirds from nearby areas. Of particular concern are birds flying across runways when entering and leaving the pond. Birds that could be attracted include the Hawaiian Duck, Hawaiian Goose, Hawaiian Coot, Common Moorhen, Hawaiian Stilt, Black-Crowned Night-Heron, Cattle Egret, and various migratory waterfowl and shorebirds.

The green waste diversion area of the LDRS may potentially support additional rodents and insects. This could attract flocks of Common Mynas and Cattle Egrets, and possibly Barn Owls and Short-Eared Owls. Cull waste from the Tropical Fruit Disinfestation Facility may attract Common Mynas, Spotted Doves, Zebra Doves, House Sparrows, Cattle Egrets, and possibly owls if rodents are attracted.

Landscaping or vegetation buffers could provide habitat, thereby attracting birds. Flocks of seed-eating species could be attracted to hydromulching or seed-producing grasses. Birds potentially attracted to this would include Nutmeg Mannikans, Chestnut Mannikans, House Sparrows, Spotted Doves, Zebra Doves, and the larger, (potentially more dangerous to aircraft) Ring-Necked Pheasant. Common Mynas, Spotted Doves, and Zebra Doves could be attracted to fruit producing trees and shrubs that are planted throughout the proposed project area.

5.0 PROPOSED MITIGATIVE MEASURES

5.1 LDRS Stormwater Detention basin

Any body of water will potentially attract birds. An existing 30 ft by 60 ft sugarcane run-off settling basin near the site of the proposed stormwater detention basin was not considered significant habitat for water birds by Bruner (1994). However, this situation probably changes both seasonally and among years. Field observations by Hart and Englund confirmed the presence of four Hawaiian Ducks at this pond (Photo 6). High densities of guppies (*Poecilia reticulata*) were also found, indicating the somewhat perennial nature of this pond. High food densities likely make this pond it an attractive feeding area for Hawaiian Duck. Depending on its final location and physical characteristics, a stormwater detention basin or run-off-settling basin may attract additional water birds. There are four broad mitigative actions to decrease or prevent use of this facility by water birds:

1. **Sedimentation Basin Design and Operation**

   The following mitigation measures, based on recommendations of USDA Animal Damage Control (Tim Ohashi, 1994), should be implemented if a stormwater detention pond or settling basin is constructed. These actions should prevent birds from foraging in and around the pond.

- The bottom and sides of the pond should be covered with a material, such as using a butyl lining, that would prevent growth of aquatic and emergent vegetation.
- The sides of the pond should be vertical and water depth should be maintained at 3 ft. or more to prevent use by shorebirds and wading birds.
- The surface-water level of the pond should be more than 18 in. below walls or berms.
- Posts should be constructed around the perimeter of the water basin to allow the installation of a grid of stainless-steel cable over the entire water basin.
- All surrounding vegetation should be well maintained and unattractive to birds.
- A barrier to toads should surround the entire settling basin.
- Trained USDA Animal Damage Control personnel should actively haze birds from the storm water detention or settling basins to discourage use.

2. **Visual Detraction of Sedimentation Basin**

   Birds would probably be visually attracted to the water. If a stormwater detention sediment pond must be built, it should be hidden from birds as well as unusable to them. Shade cloth or other opaque material should cover the entire pond and obstruct its view from the air. Posts and stainless steel cable could act as a support structure for the shade cloth. As a result, all birds would be excluded from using the pond and few would be attracted to it. This would preclude the need for certain mitigative measures related to the physical characteristics of the pond as described above. For example, hazing would probably not be needed if the pond is covered.

3. **Diversion of Stormwater to Drainage Channel**

   Divert all stormwater runoff to the ocean via the existing Lihue Airport storm drainage system. This could preclude the need for a stormwater detention pond or settling basin on the site and thus minimize the amount of standing water available to birds. Since this would result in the fewest birds being attracted to the site, this is the most desirable option.

4. **Sedimentation Basin and Drainage Channel**

   Divert most stormwater runoff to the ocean via the existing Lihue Airport storm drain system, but maintain a small stormwater detention pond for sediment removal. This would reduce the amount of standing water on the site, but not to the extent as in option 3. This option is not as desirable as option 3 because problems associated with standing water would persist. Mitigative measures described in options 1 and 2 would still be required.

5.2 Green Waste Diversion Area

Several facilities for the disposal of green waste currently exist on Kauai and are not considered important attractants for birds (Tim Ohashi, Personal Communication). If green waste piles are moved periodically, suitable foraging habitat for birds is unlikely to exist. However, birds have been found to be attracted to insects when composting occurs at green waste sites (Tim Ohashi, Personal Communication). Therefore, we recommend that the facilities operational procedures explicitly state that no composting will occur on site.

5.3 Tropical Fruit Disinfestation Facility Cull Waste

We recommend that culled fruits should be bagged and hauled to the Lihue Refuse Transfer Station as part of the daily operating procedures for the facility. If the facility is kept clean and free of cull waste, there would be little potential for attracting birds.

5.4 Landscaping

Landscaping mitigative measures should be implemented in association with the LDRS Tropical Fruit Disinfestation Facility, and other associated industrial areas in the Ahukini Makai project area. Hydromulching has been found to attract large numbers of zebra doves (Tim Ohashi, Personal Communication). Bird netting of the type used on fruit trees may be installed to prevent access by doves to hydromulched areas. Netting could be secured to a 3 ft. tall sub-structure of wooden posts and then removed when ground cover seeds have sprouted and are no longer a food source for zebra doves. Since netting would reduce seed predation rate, germination would also be more successful. This would reduce the need to re-apply hydromulch at a later time.

The use of seed producing grasses should be avoided. These can attract large flocks of seed-eating birds, especially when not cut regularly. Any grass used for landscaping should be cut on a regular basis. *Wedelia* sp., a yellow daisy that forms a dense ground cover and is relatively unattractive to seed eating birds, could be planted in certain areas in place of lawns.

Fruit producing shrubs and trees should be avoided because they attract fruit eating birds such as Common Mynas. Banyan trees are a special problem in this regard, and should not be planted anywhere in the project area. One potential shrub that can be used in landscaping is oleander. Oleander is a visually attractive shrub to humans but not known to attract birds.

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7.0 PHOTOGRAPHS

Photo 1: Existing solid waste transfer station adjacent to proposed recycling station and disinfestation facilities.

Photo 2: View of project area looking toward Runway 35-17.

Photo 3: Native waterbird habitat at Hanamaulu Stream estuary.

Photo 4: Hanamaulu Stream above the estuary.
This area contained native waterbirds.

Photo 5: Highly attractive bird habitat at Westin Kauai lagoons.

Photo 6. Old railroad cut that currently drains cane fields (Note flying Hawaiian Ducks at makai end of pond; circled).

M

Archaeological Inventory Survey Molokoa Lands Project Area

Additional
Archaeological Inventory Survey
Molokoa Lands Project Area

Lands of Hanamā'ulu and Kalapakī
Līhu'e District, Island of Kaua'i

BY

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SUMMARY

Paul H. Rosendahl, Ph.D., Inc. (PHRI) has prepared this additional archaeological inventory survey report at the request of Mr. Vince Shigekuni of PBR Hawaii, on behalf of PBR client, AMFAC/JMB Hawaii, Inc. This report is on the AMFAC/JMB Hawaii Molokoa Lands project area, located in the Lands of Hanamā'ulu and Kalapakī, Līhu'e District, Island of Kaua'i. The report updates and synthesizes the relevant historical research data and archaeological findings from two prior PHRI Archaeological Inventory Survey reports—Reports 729-122689 and 894-020591.

The 552.3 ac project area is divided into four parcels. Two parcels, Hanamā'ulu and Ahukini Makai, lie within the Land of Hanamā'ulu. The other two parcels, Molokoa and Ahukini Mauka, are within the Lands of Kalapakī and Hanamā'ulu. The Hanamā'ulu parcel consists of c. 30.0 ac located c. 0.2 mi (0.3 km) inland of Hanamā'ulu Bay. This parcel is bounded on the north and west by Kuhio Highway; on the east by Kapule Highway extension (Hanamā'ulu-Ahukini cutoff road); and on the south by Hanamā'ulu Stream, Hehi Road, and private residential houselots. The Ahukini Makai parcel consists of c. 131.0 ac bounded on the south and east by Līhu'e Airport and Ahukini Road; on the west by the Hanamā'ulu-Ahukini cut-off road, and on the north by Hanamā'ulu Stream valley. The Molokoa parcel consists of c. 156.5 ac bounded on the west and south by Līhu'e town; on the east by Vidinha Memorial Stadium and Kapule Highway; and on the north by Ahukini Road. The Ahukini Mauka parcel consists of c. 221.7 ac bounded on the east by the Hanamā'ulu-Ahukini cut-off road; on the west by Līhu'e town, Sun Village, and Wilcox Memorial Hospital; on the north by the Hanamā'ulu Stream gulch; and on the south by Ahukini Road.

Only 32.7% of the Hanamā'ulu parcel was surveyed due to the extent of disturbance by sugar cane cultivation. The parcel was subsequently tested for subsurface cultural deposits; nine backhoe trenches were placed throughout the parcel. The trenches yielded no cultural matrices, buried pondfields, subsurface horizontal features, portable cultural remains, or datable materials of any kind. The ground survey strategy for the Ahukini Mauka, Ahukini Makai, and Molokoa parcels also considered the extensive ground disturbance by sugar cane cultivation. A 100% ground survey was conducted in all portions of these parcels not cultivated in sugar cane. This included all unaltered stream gulches and drainages within sugar cane fields.

Only one site, a wall (SIHP Site 1842), was identified within or immediately adjacent to the project area. This site lies along the edge of the Ahukini Mauka parcel, at the top of the Hanamā'ulu Stream valley. Site 1842 is assessed as no longer significant (NLS). Significant data has been collected from this site; the site is important for information content only and no further data collection is necessary.

No significant archaeological remains of any kind were encountered in the surface or subsurface surveys of the Hanamā'ulu parcel. The only cultural remains encountered in this parcel were several small isolated coral pebbles. No significant archaeological remains were found in the Ahukini Makai and Molokoa parcels.

Contents

INTRODUCTION · 1
- Background • 1
- Scope of Work • 3
- Project Area Description • 4
- Previous Archaeological Research • 6
- Historical Documentary Research by Kepa Maly • 9
- Settlement Patterns • 17
- Field Procedures • 23

FINDINGS · 27
- Surface Survey • 27
- Subsurface Testing • 29

CONCLUSION · 32
- Summary and Discussion • 32
- General Significance Assessments and Recommended General Treatments • 32

REFERENCES CITED • 34

ADDENDUM • ADD-1

Illustrations

Figure 1. Project Area and Site Location Map • 2

Figure 2. Map Showing Boundary of Ahupua'a of Hanamā'ulu and Kalapaki • 22

Figure 3. Hanamā'ulu Parcel Showing Backhoe Trench Locations • 24

Figure 4. Survey Coverage Map • 26

Figure 5. Site 1842, View to East • 28

Tables

Table 1. Correlation of Parcel Designations • 1

Table 2. Previous Archaeological Research • 6

Table 3. Land Commission Awards in Hanamā'ulu and Kalapaki • 12

Table 4. Archaeological Sites Found in Huleia River Valley Reconnaissance (Compiled from Neller and Palama 1973) • 19

Table 5. Summary of Identified Sites and Features • 27

Table 6. Backhoe Trench Stratigraphy • 30

Table 7. Backhoe Excavation Results • 31

Table 8. Summary of General Significance Assessments and Recommended General Treatments • 33

INTRODUCTION

BACKGROUND

At the request of Mr. Vince Shigekuni of PBR Hawaii, on behalf of PBR client, AMFAC/JMB Hawaii, Inc., Paul H. Rosendahl, Ph.D., Inc. (PHRI), recently conducted an additional inventory survey for the AMFAC/JMB Hawaii Molokoa Lands project area, situated in the Lands of Hanamā'ulu and Kalapakī, Līhu'e District, Island of Kaua'i. The inventory survey involved no field work. Basically, the survey comprised updating and and synthesizing relevant historical research data and archaeological findings from two prior PHRI archaeological inventory survey reports (Report 729-122689, Walker and Rosendahl 1990; and Report 894-020591, Walker et al. 1991). In conjunction with this work PHRI also provided consultant services for the client (e.g., meetings, conferences, presentations, expert testimony, etc.) in association with the preparation of an Environmental Impact Statement (EIS), a State Land Use Commission District Boundary Amendment, and a Kauai County General Amendment Plan. The current work was conducted by Projects Supervisor Leta Franklin, M.A. Assisting on the project was Cultural Resources Specialist Kepa Maly. The work was done under the overall direction of Principal Archaeologist Paul H. Rosendahl, Ph.D., and Projects Director - Hawai'i Alan T. Walker, B.A.

Table 1 correlates parcel designations used during the two earlier studies with the present designations (personal communication from Vince Shigekuni to L. Franklin, 26 April 1994). The Walker and Rosendahl (1990) survey was a variable-coverage surface and limited subsurface testing program for the proposed Hanamaulu Affordable Housing Project. This project area lay entirely within the Land of Hanamā'ulu and within the current project area, and constitutes the Hanamā'ulu parcel of the present project area (*Figure 1*). The basic objective of the Walker and Rosendahl survey was to provide information sufficient to prepare an Environmental Assessment (EA). No sites or significant cultural resources were found during this investigation. The survey field work for the project was conducted December 20, 1989 by Supervisory Archaeologists Alan T. Walker, B.A., and Amy Dunn.

Table 1. Correlation of Parcel Designations

Present Project	Walker and Rosendahl 1990	Walker et al. 1991
Hanama'ulu	Entire project area	Not covered
Ahukini Mauka	Not covered	Section 3
Ahukini Makai	Not covered	Section 4
Molokoa	Not covered	Section 2

The Walker et al. (1991) work consisted of an inventory survey of the c. 1,550 acre Līhu'e/Puhi/Hanamā'ulu Master Plan project area, situated in the Lands of Hanamā'ulu, Kalapakī, Nāwiliwili, Niumalu, and Wailua. The overall objective of the survey was to provide information sufficient for the preparation of an Environmental Impact Statement (EIS), and

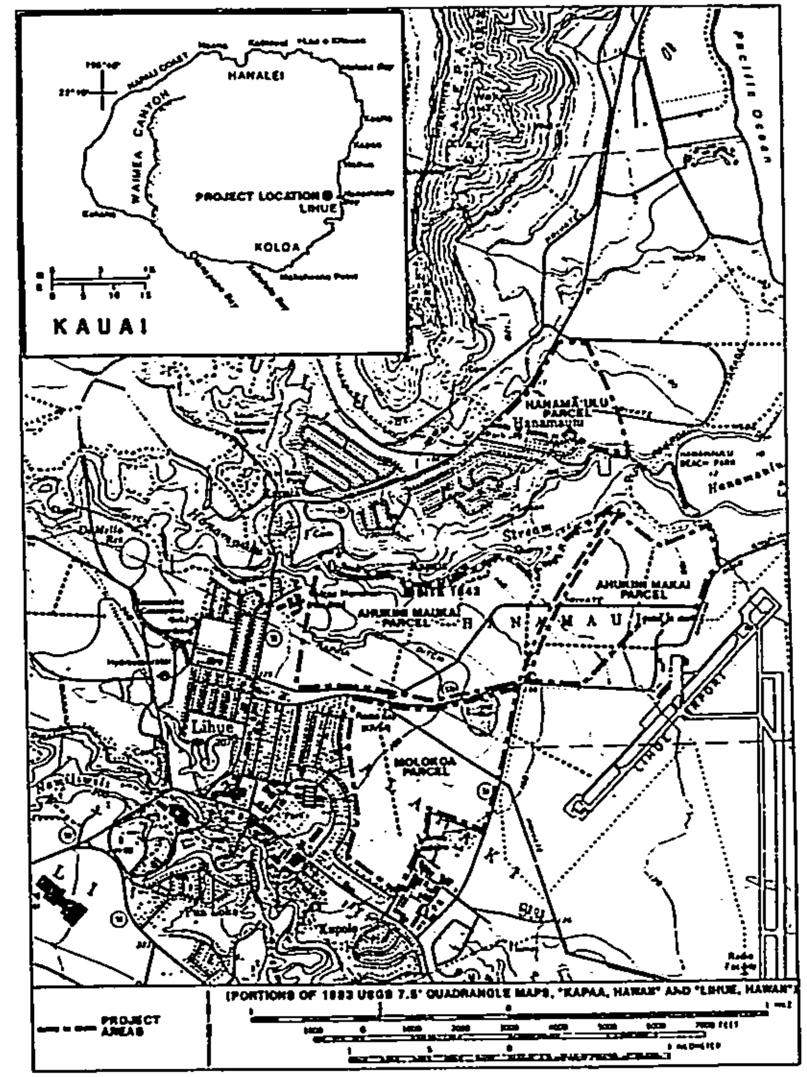

Figure 1. Project Area and Site Location Map

sufficient for satisfaction of all historic preservation inventory requirements of the Kaua'i County Planning Department (KCPD) and the Department of Land and Natural Resources - State Historic Preservation Division (DLNR-SHPD). Ten sites comprising 14 component features were found during this investigation. All except one of the sites were located outside of the parcels included in the present project area. The field work for this project was conducted October 3-11, 1990 by Supervisory Archaeologist Alan T. Walker, B.A., Assistant Supervisory Archaeologist Jenny O'Claray, B.A., and Field Archaeologists Mikele Fager, B.A., John Murray, B.A., and Jack Harris. The Līhu'e/Puhi/Hanamaulu Master Plan project area was divided into eight parcels (Sections 1- 8). Only Sections 2,3 , and 4 are within the present project area, as shown in *Table 1* and *Figure 1.*

SCOPE OF WORK

The basic purpose of an inventory survey is to identify all sites and features of potential archaeological significance present within a specified area. An inventory survey is the initial level of archaeological investigation. It is conducted to determine the presence or absence of archaeological resources within a specified project area and indicates both the general nature and variety of archaeological remains present, and the general distribution and density of the remains. Finally, it permits a general significance assessment of the archaeological resources, and helps in the formulation of realistic recommendations and estimates for any further work that might be necessary or appropriate. Such work could include further data collection—additional data collection involving detailed recording of sites and features, and selected limited excavations. It may also include subsequent mitigation—data recovery research excavations, construction monitoring, interpretive planning and development, and/or preservation of sites and features with significant scientific research, interpretive, and/or cultural values.

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

Based on a review of readily available background literature, familiarity with the general project area, and extensive familiarity with the current requirements of review authorities, the following specific tasks were determined to constitute an adequate and appropriate scope of work for the additional inventory survey report and related consultant services:

1. Review archaeological and historical literature relevant to the project area, and conduct limited historical documentary research (emphasis on readily available literature and documentary resources) and interviews with any appropriate available local informant sources;

2. Prepare an appropriate report by updating and synthesizing the historical research data and prior PHRI inventory survey reports (PHRI Report 894-020591, Walker et al. 1991; PHRI Report 729-122689, Walker and Rosendahl 1990) for the current project area to current Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD) requirements for inventory level survey reports; and

3. Provide requested and/or required consultant services related to interaction with client and review agencies (e.g., meetings, conferences, presentations, expert testimony, etc.)

The inventory survey report was prepared in accordance with the current standards for inventory-level survey required by DLNR-SHPD. The significance of all archaeological remains identified within the project area was be assessed in terms of (a) the National Register criteria contained in the Code of Federal Regulations (36 CFR Part 60), and (b) the criteria for evaluation of traditional cultural values prepared by the national Advisory Council on Historic Preservation (ACHP 1985). DLNR-SHPD uses these criteria to evaluate eligibility for both the Hawai'i State and National Register of Historic Places.

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

PROJECT AREA DESCRIPTION

The project area lies within the present-day Līhu'e District (formerly the district, or *moku*, of Puna), on the Island of Kaua'i. Kaua'i is among the oldest islands in the Hawaiian archipelago. Over the past four million years, stream erosion, faulting, gravity, and landslides, have molded the topography of the great shield volcano that formed the island. Handy and Handy describe the *moku* of Puna as "a broad *kula*, intersected by streams flowing from the eastern slopes of the ridge on the east side of Hanalei Valley, until we come to Wailua River which cuts far back to Mt. Wai'ale'ale, and also drains the northern slopes of Kilohana crater 1,134 feet high" (1972:423). The project area is situated around Hanamā'ulu Stream (also known as the Hanamā'ulu River) which also drains the slopes of Kilohana crater.

Annual rainfall on the island ranges from 20 inches near the leeward coast upwards of 400 inches in the mountainous interior—as much as 600 inches of rain has been recorded (Stearns 1966:190). Rainfall in the general vicinity of the present project area, near the coastal town of Līhu'e, ranges between 40 and 50 inches per year, with a mean annual temperature ranges from 70 to 75 degrees F (Armstrong 1983:63). Descriptions of the locations, elevation, vegetation, and patterns in recent land use for each of the four parcels will now be presented.

The Hanamā'ulu parcel consists of c. 30.0 ac located within the *ahupua'a* of Hanamā'ulu. The parcel is located c. 0.2 mi (0.3 km) inland of Hanamā'ulu Bay, and is bounded on the north and west by Kuhio Hwy; on the east by Kapule Hwy extension (Hanamā'ulu-Ahukini cutoff road); and on the south by Hanamā'ulu Stream, Hehi Road, and private residential houselots. The terrain in this parcel generally consists of a raised plateau of level soil. The upper edge and steep slope of Hanamā'ulu Stream valley constitute c. 2.8 ac in the southeast corner of the parcel, an area bordering Hehi Road. The soil in the area consists of Lihue silty clay (0-8% slope), representing the Lihue series of well-drained upland soils which developed in material weathered from basic igneous rock (Foote et al. 1972:82). According to Foote et al., Lihue silty clay soil is found:

> ...on the tops of broad interfluves in the uplands...[i]n a representative profile the surface layer is dusky-red silty clay about 12 inches [0.3 m] thick. The subsoil, more than 48 inches [1.22 m] thick, is dark-red and dark reddish-brown, compact silty clay that has subangular blocky structure. The substratum is soft, weathered rock (1972:82).

Although the Hanamā'ulu parcel ranges in elevation from c. 6 to 30 m (20 to 100 ft) AMSL (above mean sea level), the major portion of the area is level and situated between c. 24 and 30 m (80 and 100 ft) AMSL. The parcel encompasses primarily formerly cultivated sugar cane land. Vegetation within the area includes scattered uncultivated sugar cane (*Saccharum officinarum* L. hybrid) and various grasses. A stand of Java plum (*Eugenia cuminii* [L.] Pruce) and *koa-haole* (*Leucaena leucocephala* [Lam.] deWit) trees occupies the upper edge and steep slope of Hanamā'ulu River Valley, in the southeast portion of the parcel.

The Ahukini Makai parcel consists of c. 143.8 ac located in the *ahupua'a* of Hanamā'ulu. This parcel is bounded on the south and east by Līhu'e Airport and Ahukini Rd; on the west by the Hanamā'ulu-Ahukini cut-off road, and on the north by Hanamā'ulu Stream valley. Elevation within this parcel ranges from c. 47 to 64 m (155 to 210 ft). This entire parcel has been modified and is presently in sugar cane cultivation. The terrain is generally level and consists of soil classified as Lihue silty clay (0-8% slope) (Foote et al. 1972).

The Molokoa parcel consists of c. 156.5 ac located in the Lands of Kalapakī and Hanamā'ulu. This parcel is bounded on the west and south by Līhu'e town; on the east by Vidinha Memorial Stadium and Kapule Highway; and on the north by Ahukini Road. An abandoned reservoir fills the northeast corner of the parcel, and a helicopter tour office site is situated in the northwest corner of the parcel. Elevation within this parcel ranges from c. 50 to 60 m (170 to 200 ft). The entire parcel has been modified, and with the exception of the abandoned reservoir and the helicopter tour office site, vegetation within this parcel consists entirely of sugar cane. The abandoned reservoir and helicopter tour office site contain various grasses and ornamentals. The terrain is generally level and consists of two classifications of soil of the Lihue series: Lihue silty clay (0-8% slope) and Lihue gravelly silty clay (0-8% slope) (Foote et al. 1972). The Lihue gravelly silty clay (0-8% slope) is similar to Lihue silty clay (0-8% slope) "...except that it contains ironstone-gibbsite pebbles and has brighter colors in the B horizon" (Foote et al. 1972:83).

The Ahukini Mauka parcel consists of c. 221.7 ac, also located in the Lands of Kalapakī and Hanamā'ulu. This parcel is bounded on the east by the Hanamā'ulu-Ahukini cut-off road; on the west by Līhu'e town, Sun Village, and Wilcox Memorial Hospital; on the north by the Hanamā'ulu Stream gulch; and on the south by Ahukini Road. Elevation within this parcel ranges from c. 24 to 52 m (80 to 170 ft). With the exception of a narrow, unmodified gully extending from Wilcox Memorial Hospital to Hanamā'ulu Stream gulch, this entire parcel has been modified and is presently in sugar cane cultivation. The terrain is generally level and consists of three classifications of soil: Lihue silty clay (0-8% slope), Lihue silty clay (8-15% slope), and Lihue gravelly silty clay (0-8% slope) (Foote et al. 1972). [In a phone conversation between L. Franklin and V. Shigekuni on 6/23/94, V. Shigekuni confirmed that the current Ahukini Mauka parcel is actually smaller than what is shown on Figure 1, but that this difference would not affect the validity of this report.]

Vegetation within the narrow unmodified gully area consists primarily of Java plum (*Eugenia cuminii* [L.] Druce), *hau* (*Hibiscus tiliaceus* L.), and various grasses. The terrain is sloping and comprises two classifications of soil: Lihue silty clay (25-40% slope) and Rough broken land (Foote et al. 1972). According to Foote et al., Lihue silty clay (25-40% slope) "...is similar to Lihue silty clay, 0 to 8 percent slopes, except that the surface layer is thin. Runoff is rapid, and the erosion hazard is severe" (1972:83). Rough broken land is characterized by very steep slopes (40-70% slope) dissected by many intermittent drainage channels (Foote et al. 1972). This soil classification commonly occurs in gulches and on mountain sides.

PREVIOUS ARCHAEOLOGICAL RESEARCH

Table 2 presents a summary of archaeological work that has been conducted to date within the *ahupua'a* of Kalapakī and Hanamā'ulu and/or within one mile of the present project area. The locations of many of these project areas are shown in Henry et al. (1993:8; Figure 3). Where appropriate, the findings of research in nearby *ahupua'a* will be discussed in the Settlement Patterns section.

Table 2. Previous Archaeological Research

Researcher	Year	Type of Investigation	Location
Thrum	1907	Reconnaissance, recording only *heiau*	Island of Kaua'i
Bennett	1931	Reconnaissance, recorded *heiau* and a few non-*heiau* sites	Island of Kaua'i
Hammatt	1978a	Reconnaissance (18 ac)	Kalapakī
Hammatt	1978b	Reconnaissance	Kalapakī
Hammatt	1978c	Reconnaissance (118 ac)	Kalapakī
Ching	1981	Reconnaissance	Hanamā'ulu
Hammatt	1988	Reconnaissance (150 ac)	Kalapakī
Walker and Rosendahl	1988	Surface and subsurface inventory survey	Nāwiliwili, Niumalu, and Ha'iku
Ching	1988, 1989	Reconnaissance and subsurface testing	Nāwiliwili
Hammatt	1990	Archaeological assessment	Kalapakī
McMahon	1990	Field check of proposed sites for new judiciary building	Kalapakī and Hanamā'ulu
Rosendahl	1990, 1991	Archaeological field inspection, limited subsurface testing	Hanamā'ulu
Walker and Rosendahl	1990	Inventory survey	Hanamā'ulu
Walker et al.	1991	Inventory survey	Kalapakī, Hanamā'ulu, Nāwiliwili, Niumalu, and Wailua
Hammatt	1991	Inventory survey	Nāwiliwili
Gonzalez	1992	Determination of "no effect" to cultural resources	Kalapakī
Hammatt and Creed	1992	Inventory survey	Nāwiliwili
Hammatt	1992	Data recovery and preservation plan	Kalapakī

Early Research and Heiau Investigations

The earliest archaeological work begins with Thrum, who in 1906, compiled a list of *heiau* on the island of Kaua'i (Thrum 1907). Of the numerous *heiau* Thrum recorded, three (Ninini, Ahukini, and Pohakoelele) were found in the Land of Kalapakī and one was in the Land of Hanamā'ulu (Kalauokamanu). Unfortunately, Thrum did not map the locations of the *heiau* and his descriptions are brief. Thrum described Ninini *heiau* as "near the site of Nawiliwili light house. All destroyed" (1907:40). Thrum described Ahukini *heiau* as "a heiau of medium size; foundations only now remain" (1907:40). Pohakoelele *heiau* was also "a medium-sized heiau; all destroyed" (1907:40). Kalauokamanu *heiau*, in Hanamā'ulu, was described as "a large walled heiau that stood above the present mill; destroyed about 1855. Of pookanaka class" (1907:40).

In 1928 to 1929, while surveying sites on Kaua'i for B.P. Bishop Museum, Bennett described Ninini, Ahukini, and Kalauokamanu *heiau*, assigning them Site Numbers 100, 101, and 102, respectively (Bennett 1931). In addition to repeating Thrum's site descriptions, Bennett noted that Ahukini *heiau* was located "near Ahukini Point on the bluff overlooking the sea" (1931:125). Because Bennett indicates that all three *heiau* had been destroyed as of 1931, he may not have been able to relocate the remains of these sites.

The purported locations of Ninini and Ahukini *heiau* were examined by Hammatt (1988), who found no indications of the remains of either site. He did find a wall (Hammatt 1988:Site 5) in the vicinity of where Ninini *heiau* once stood, and suggested that this wall may have been related to that *heiau*. At the approximate location of Ahukini *heiau*, he observed that the entire area had been so severely modified by quarrying and bulldozing that there was no chance that any portion of the site still existed.

During his survey, Bennett recorded one other site (Site 103, dune burials) in the vicinity of the present project area. Bennett observed that "in the sand dunes that run along the shore half way between Hanamaulu and Wailua River are many burials" (1931:125). A point halfway between Hanamā'ulu and Wailua River would lie either within Wailua *ahupua'a* or just within the Land of Hanamā'ulu, near its border with Wailua. Several studies since Bennett's time have resulted in the identification of dune burials in the *ahupua'a* of Wailua, all of which are part of Bennett's Site 103. These include Cox (1977), Erkelens and Welch (1993), and Beardsley (1994).

Recent Research

In general, survey coverage of the coastal 2.4 to 4.0 km (1.5 to 2.5 mi) of the *ahupua'a* of Kalapakī and Hanamā'ulu has been moderately good.

Walker and Rosendahl (1988) and Henry et al. (1993) conducted an inventory survey of the c. 590-ac Grove Farm Līhu'e/Puhi project area. The survey resulted in the identification of two sites, a historic cemetery and a historic residence. A subsurface testing program was undertaken; no cultural remains were found within any of the 33 backhoe trenches excavated.

Ching (1988, 1989) conducted reconnaissance and subsurface testing at a parcel in the *ahupua'a* of Nāwiliwili, near the present project area. Both surface survey and subsurface testing phases confirmed a lack of cultural resources; the property had been previously disturbed by past bulldozing, which would have destroyed any sites that may have been present.

Hammatt conducted a reconnaissance survey (Hammatt 1988), a cultural resources assessment (1990), and prepared a data recovery and preservation plan (1992) of a two-mile section (150 ac) of coastal land in Kalapakī. Hammatt notes that due to the extensive modification of the coastal land for the construction of Līhu'e Airport, extensive sugar cane cultivation-related activities, the construction of shoreline access roads, rock quarrying, and dumping throughout the area, the archaeological data for the area has been severely skewed. The reconnaissance survey resulted in the identification of only five sites, in varying states of preservation, throughout the project area. These sites include two historic wall remnants (Sites 422 and 423), a c. 122 m (400 ft) long wall extending to the north from Ninini Point Lighthouse (believed to be part of Bennett's Site 100), a marine shell midden near the shoreline (Site 421), and an oval alignment/terrace (Site 424). Subsurface testing was planned for Sites 421 and 424 (Hammatt 1992:7-8).

McMahon (1990) of the DLNR Historic Preservation Program conducted a field check of three possible locations for a new judiciary building. One parcel (Location 2) was situated in Kalapakī *ahupua'a*; a second parcel (Location 3) was in Hanamā'ulu *ahupua'a*. Location 2 was situated in land currently under sugar cane cultivation. One site, a historic building (Site 9402), was identified within this parcel. No sites were identified within Location 3, which consists of gentle slopes formerly covered by sugar cane. The small valleys and gullies at this location were not checked, and McMahon noted that the small valleys and gullies would have a good chance of containing sites, as these areas are largely unmodified by sugar cane cultivation.

In late 1990, PHRI conducted an archaeological field inspection and limited subsurface testing of the Kalepa Radio Station and Kalepa Road Improvement project area, located on Kalepa Ridge in the Land of Hanamā'ulu (Rosendahl 1990, 1991). During construction at the Radio Station site, previously unidentified human burial remains were uncovered in a boulder mound, and the mound was designated as Site 1827. DLNR-SHPD was contacted and recovered portions of the burials. Field inspection of the Radio Station project area consisted of inspecting Site 1827 and the areas of burial remains previously identified by DLNR-SHPD, both disinterred and *in situ*. The purpose of the inspection was to determine if additional human burials were present and to make appropriate recommendations for further archaeological work. Because intact human burial remains were found, and because there were still undisturbed areas within the project area suitable for burials, it was felt that there were probably additional burials in the Radio Station project area. It was also discovered that Site 1827 had originally functioned as a quarry or flake reduction area. Based on the findings, it was recommended that an alternative site be selected for the Radio Station project.

Subsequently, PHRI inspected three alternate Radio Station sites and conducted backhoe testing of the area. Because one of the alternate Radio Station sites (Alternate Site 1) was located atop a portion of Site 1827, it was not tested. No portable remains or human burials were observed within the backhoe trench profiles. Based on the findings, construction of the Radio Station at its original location or at Alternate Site 1 was not recommended by PHRI. It was recommended that the Radio Station be constructed at either Alternate Site 2 or 3.

The purpose of the field inspection of the Road Improvement project area was to identify any archaeological remains on or alongside a 500 ft long section of an existing road bed. During the survey, no archaeological remains of any kind were identified, either within or immediately adjacent to the roadbed. No further archaeological work was recommended within the 500-ft section of existing gravel road.

While the findings of the entire Walker and Rosendahl (1990) survey and backhoe testing are included in the present report, only portions of the study area covered by Walker et al. (1991) are covered here. In the original c. 1550 ac parcel surveyed by Walker et al., ten sites comprising 14 features were identified. Of the ten sites, only three, all coastal sites within Hanamā'ulu, date to prehistoric times. These are Site 1838 (the habitation and possible burial site mentioned earlier), Site 1839 (a temporary habitation site), and Site 1847 (the Hanamā'ulu Stream valley, which was farmed in early historic times). The remaining seven sites are all historic, and are mostly related to sugar cane farming activities and roads.

In 1991, Cultural Surveys Hawaii conducted a small inventory survey of a c. 1-ac parcel in Nāwiliwili (Hammatt 1991). No cultural resources were found in the parcel. The following year, Cultural Surveys Hawaii conducted a second inventory survey within Nāwiliwili Valley (Hammatt and Creed 1992). Their survey of the 61.6 ac parcel resulted in the identification of four sites. Several of the features in these sites were posited to correlate with agricultural features mentioned in LCA testimony. Portions of these sites were recommended for preservation.

Most recently, Gonzalez (1992) inspected the proposed FAA radar installation facility in Kalapaki and determined the proposed work would have "no effect" on cultural resources. The land surface had already been severely disturbed in the c. 0.4 ac site, and no cultural resources were found.

Findings from the previous archaeological research will be discussed further in the section on settlement patterns.

HISTORICAL DOCUMENTARY RESEARCH by Kepa Maly

Background

The Molokoa Lands project area is situated within two *ahupua'a* (traditional units of land) in the Puna District (now called Līhu'e) of the Island of Kaua'i. The *ahupua'a*, Hanamā'ulu and Kalapakī, contain small rivers that traditionally supported wetland taro pondfields. In addition, the rivers flowed into the ocean, and providing protected canoe landings and access to marine resources. The upland slopes of these *ahupua'a* are broad flatlands that were once forested and contained rich upland resources, such as *olonā* for fiber, wood and timber resources, feathers for adornments, and stone for quarrying and tool production. Indeed, the name Molo-koa (in the land of Kalapakī) may be translated as matted, or tangled, growth of *koa* trees, and as a description of a particular place, the name could have indicated a luxuriant forest of Hawaiian koa (*Acacia koa*) trees.

There are few legendary references for either of the *ahupua'a*, and these are restricted to stories of legendary migrations, warrior heroes, and great *heiau* (ceremonial sites). The *ahupua'a* place names may be translated, and the translations also share something of the experience of the lands. Hana-mā'ulu has been literally translated "tired bay," said to be descriptive of having walked the great plain and arriving at the bay community tired (Pukui et al. 1974). Hanamā'ulu is also said to be the birthplace of Kawelo-lei-mākua, one of the great warrior chiefs of Kaua'i. Ka-lapa-kī may be interpretively translated as "the ridge struck by water spouts," phenomena that still occur.

The Legendary Setting

> *Kaua'i nui moku lehua pane'e lua i ke kai a ke ao lewa i ka lani o Kalanipu'u e alo oei i ka makani*
>
> Great Kaua'i of the *lehua* forests that appear to move in columns towards the shore, [Kaua'i] where the clouds are placed in the heavens, and Kalanipu'u faces the wind (From the Legend of Ka-Miki, *Ka hōkū o Hawai'i*, August 16, 1917)

The above saying is a traditional description of Kaua'i whose forests extended to the sea, and the beauty of the hill of Kalanipu'u, which is buffeted by the winds. Though the forests are now gone, the hill of Kalanipu'u may still be seen from the Molokoa-Hanamā'ulu plains. Because there are only a few legendary references that specifically describe Hanamā'ulu and Kalapakī, this study also considers ancient Kaua'i generally, in an effort to describe the conditions of life in the project area.

In *Archaeology of Kauai*, William Bennett (1931) offers the following overview of Kaua'i's political and cultural history:

> Two factors separate the archaeological history of Kauai from the political history: the scarcity and inaccuracy of the genealogies, and the lack of accurate legendary knowledge about the ruins and artifacts. Some of the beiaus are said to have been built by such and such a chief, but it has been possible to place few of these chiefs in chronological sequence.
>
> The mythical origins of Kauai, together with legends relating to its famous chiefs, have been recorded generally by Fornander..and locally by Rice....Fornander (pp. 291-2) writes:
>
>> The legendary history of Kauai is very unsatisfactory in any effort to restore historical form and sequence. The legends are disconnected and the genealogies are few.... That the ruling families of Kauai were the highest tapu chiefs in the group is evident from the avidity with which chiefs and chiefesses of the other islands sought alliance with them. They were always considered as the purest of the "blue blood" of the Hawaiian aristocracy; ...but of the exploits and transactions of most of the chiefs who ruled over Kauai during this period, there is little preserved to tell.
>
> As to actual history the most significant point is that Kauai remained politically independent up to 1824. The island was never conquered, though in 1810 Kaumualii ceded the island to Kamehameha I to prevent an invasion. With the death of Kaumualii in 1824 the independence of Kauai ceased (Bennett 1931:7-8).

In another reference, Bennett notes the following facts:

> It seems...that there was much more communication between all parts of Kauai than between Kauai and the other islands. In other words Kauai may be considered as a cultural unity (Bennett 1929:54)

The river valleys were all inhabited, where there is any semblance to land that could be cultivated. The distance of occupation up the river valleys is only limited by the irrigable lands, and the remains of house sites and taro terraces indicate occupation 10 or 15 miles up such valleys as the Waimea and Hanapepe (ibid).

The extent of the agricultural terraces seems to indicate that the water conditions were somewhat altered, as valleys that are today watered by intermittent streams show the remains of undoubted terraces. The amount of land that could be terraced and cultivated was remarkable....(ibid:55).

Thrum lists 124 *heiau* for the island of Kauai. The list also includes sacred places and small heiau not listed on the other islands. There seem to be many more small type of heiau, that is those under 50 feet in size, on Kauai than on the other islands. Of these there is the simple platform, the enclosure and the two terrace type. They are at all times hard to distinguish from house sites (ibid:57).

Pukui's *'Ōlelo No'eau* (1983) presents readers with the following saying about Hanamā'ulu:

No Hanamā'ulu ka ipu puehu.

The quickly emptied container belongs to Hanamā'ulu.

Said of the stingy people of Hanamā'ulu, Kaua'i - no hospitality there. At one time, food containers would be hidden away and the people of Hanamā'ulu would apologize for having so little to offer their guests (Pukui 1983).

Farmers in the Hanamā'ulu area raised taro, sweet potatoes, breadfruit, and coconuts. The Hanamā'ulu stream flows through a broad gulch which was extensively terraced up to 2-1/2 miles above the delta in olden times. Before the advent of sugarcane, the stream delta was very likely an important area for wet taro cultivation. Upland slopes would have been ideal for planting sweet potato (Handy and Handy 1972:426-427). Handy (1940) describes areas of traditional agricultural activities and land use on Kaua'i, and several of his descriptions mention the Puna district, the project area *ahupua'a*, or both:

Coconut [was] planted near sea level... in valley bottoms in Hanamaulu, Nawiliwili, and Huleia...Wauke planted in inner valley slopes, especially Koolau, Puna, [and] Kona. Olona; [was gathered from] wet median forests from 1,000-2,000' elevation [in] Koolau and Puna (1940:59).

Land Tenure

During the reign of Kamehameha III, Hawaii's traditional land-ownership system was restructured along Western lines. Called the Great Māhele, the restructuring separated and defined the undivided land interests of the King and the high-ranking chiefs and *konohiki* (*Konohiki* originally referred to the person in charge of a tract of land on behalf of the king or a chief; in later statutes, the chiefs or landlords were referred to as "*konohiki*.") (Chinen 1958:vii and Chinen 1961:13). More than 240 of the highest ranking chiefs and *konohiki* in the kingdom joined Kamehameha III in this division. The first *Māhele* was signed on January 27, 1848 by Kamehameha III and Princess Victoria Kamāmalu by her guardians Mataio Kekūanaō'a and Ione I'i. The last *Māhele* was signed by the King and E. Enoka on March 7, 1848 (Chinen 1958:16).

The *māhele* did not convey title to any land. The chiefs and *konohiki* were required to present their claims to The Land Commission and to receive awards for the lands quit-claimed to them by Kamehameha III. Until an award for these lands was issued, title remained with the government. Because of the lack of surveyors at the time of the Māhele, the lands were divided by name only, with the understanding that the ancient boundaries would be observed until the land could be surveyed. This was done to expedite the awarding of lands to the chiefs and *konohiki* by the Land Commission. However, these chiefs and *konohiki* were still required to pay commutations to the government for them to receive Royal Patents on their awards. These lands awarded to the chiefs and *konohiki* became known as Konohiki Lands (Chinen 1961:13).

The *Indices to Land Commission Awards* (1929) provides the following information on awards and awardees for lands of Hanamā'ulu and Kalapakī:

Table 3. Land Commission Awards in Hanama'ulu and Kalapakī

LCA	Awardee	Acreage
Hanama'ulu:		
3648	Kala	1.25 Acs 30 rods
3650	Kaluhiwaha	3 roods, 35 rods
3649	Kamalo	1.75 Acs 20 rods
7713	V. Kamamalu	9,177 Acs (Ap 2) ahp
3644	Kaualupa	1.25 Acs 23 rods
3558	Keko	3 roods 1 rod
3600	Koolanui	1.75 Acs 30 rods
3653	Kolu	1 Ac 37 rods
5089	Kuhaimoana	3 roods 17 rods
3640	Kumakahaohao	1 Ac 1 rood 12 rods
3271	Lalahilimoku, Lalmoku	1 Ac 1 rood 21 rods
3657	Niho	1 Ac 1 rood 13 rods
3423	Paka	1.50 Acs 33 rods
3426	Pelekane	1 Ac 17 rods
3371	Naahu	1.25 Ac 19 rods (Kapala)
3647	Kapuohi	4 Acs 32 rods (Hoala)
3647	Kapuohi	38 rods (Papesa)
Kalapakī:		
3249	Hao	3 roods 11 rods
7713	V. Kamamalu	2004 Acs. Ahp
3637	Kauhialawa	2 Acs 1 rood 14 rods
238-P	Kinipeki	1 Ac 32 rods
3643	Kukahiko	3 roods 24 rods
3642	Kuolohu	3 roods
3907	Nakala	3 Acs 25 rods
3425	Paiki	1 Ac 1rood 35 rods
3408	Papaa	2.50 Acs 33 rods
3280	Wawae	1Ac 1 rood 18 rods

V. Kamāmalu, listed above, was the high chiefess Victoria Kamāmalu, the sister of Alexander Liholiho (King Kamehameha IV), Lot Kamehameha (King Kamehameha V), Moses Kekūāiwa, and half sister of Ruth Ke'elikolani (Indices 1929:3). Her award included the entire *ahupua'a* of both Hanamā'ulu and Kalapakī. Whenever *ali'i* (royalty) procured an entire *ahupua'a*, they were bound to respect the rights of the existing native tenants (*hoa'āina*). These *hoa'āina* could continue to cultivate and live on their parcels if they filed a claim to the Board of Commissioners to quiet land titles. It appears that all of the claims by native tenants in both Hanamā'ulu and Kalapakī, were situated along the river valley flats and near the ocean. No LCAs other than Kamāmalu's are near the portion of the project in Kalapakī, and the Hanamā'ulu LCA are contained primarily in the valleys, outside of the current project area.

The registry and testimonies for claims made by native tenants provide some insight into the nature of land use during the middle 1800s. The testimonies below, are excerpted from the larger list of claims, and provide a general overview of activities in the area:

> LCA 3558 to Keke - Foreign Testimony, Vol. 13:160
> ...consists of three *lo'i* [taro pond fields] in the *'ili* [land parcel] of Wai'ao'ao and...also a small *kula* (dryland planting area) adjoining. Claimant has also a house lot at Hoeua...
>
> LCA 3600 to Keolanui - Foreign Testimony, Vol. 13:153
> ...in the *'ili* of Palaka and consists of *lo'i* and house lot...
>
> LCA 3653 to Kolu - Foreign Testimony, Vol. 13:151
> ...it consists of four *lo'i* in the *ahupua'a* of Hanamā'ulu and consists of four lo'i in the *'ili* of Maulele, with small *kula*, adjoining the *kula* is not cultivated, being exhausted to the depredations of cattle. Claimant has also a house lot in the village of Kamakahanahana which is surrounded by a fence. No. 1 is bounded...Koloa - *'auwai* [irrigation ditch] of Keoki. No. 2 is *kula* of Kamakahanahana...
>
> LCA 3426 to Pelekane - Foreign Testimony, Vol. 13:156
> ....consists of 4 *lo'i* in the *'ili* of Kapūhala. Claimant has also a house lot near the sea shore, at a place called Kaho...Lot 2 [bounded by]...North - fish pond...
>
> LCA 3371 to Naehu and heirs - Foreign Testimony, Vol. 13:155
> ...consists of 10 *lo'i* and small *kula* adjoining on which Claimants house [is] in the ili of Kapā'ia.
>
> LCA 3647 to Kapuohi - Foreign Testimony, Vol. 13:151
> ...consists of 8 *l'oi* and 23 *lo'i* not now cultivated. These *lo'i* lie in two pieces, being divided by a *kō'ele* [a small land unit farmed by a tenant for the chief]. Lot 1 contains one *lo'i* called Moala, in the *'ili* of Waiea. Lot 2 contains all the other *lo'i*. Lot 3 house lot in Pāpua'a...
>
> LCA 3271 to Lalahilimoku - Foreign Testimony, Vol. 13:161
> ... consists of six *lo'i* in the *'ili* of Kuka. Claimants house lot is in the village of Puako...

> LCA 3423 to Paka - Foreign Testimony, Vol. 13:155
> ...consists of 8 *lo'i* in the *'ili* of Pe'aiki and small *kula* adjoining. Claimant also has a house in Pe'aiki...

The Land Files at the State Archives and the State Survey Office also contain references to the lands of Hanamā'ulu and Kalapakī, describing the land claims of chiefess Kamāmalu (cf. Kalima and Wong Smith IN Walker et al. 1991). Among the records are Document 336 (Governor J. Dominis d. 1891), which includes the survey records for Hanamā'ulu, and the survey of the boundaries of Kalapakī.

Also found in the Land File at the Archives were various references to Hanamā'ulu describing the transition in land ownership and cultivation practices. The following is a summary of the documents at the Archives regarding this *ahupua'a*:

> Interior Dept. Aug. 19, 1862 letter from M. Kekuanaoa to W. Webster, informing that the above land which is claimed as belonging to the King has been surveyed and awarded by the Land Commissioner and a Royal Patent issued to V. Kamamalu, &c.
>
> Interior Dept. Aug. 4, 1863, In letter from H. A. Widemann to Webster, that he had seen his name on a lease to the Lihue Plantation for the above lands, which leads him to think he has something to do with Victoria's lands.
>
> Interior Dept. July 20, 1870, In letter from Paul Isenburg (sic) to J.O. Dominis enclosing a draft for $7250 being the purchase price for the above *ahupua'a* &c.
>
> Interior Dept. Oct. 4, 1870, In letter from Duncan McBryde to C.C. Harris, that Mr. Isenburg has inquired of him if he knew the *mauka* Boundary of the Crown Land of Wailua that part which adjoins the above *ahupua'a* lately sold to Lihue Plantation. Desiring to know whether the said *ahupua'a* was held by the late Princess Victoria by Royal Patent according to survey by Pease, or by the Ancient Boundary, &c.
>
> Interior Dept. July 20, 1871, In letter from E. Krull to the Commissioner of Crown Lands stating that he is holding the Wailua Estate under two leases from the Hawaiian Govt. first from J. Young to Thos. Brown, for 99 years, & second from Kamehamahea IV, to Hoffschlaeger for 50 years; but since a royal patent had been granted to the Lihue Plantation for the above *ahupua'a* containing about 800 acres which is included in his 2 leases & which hampers the pasturage of his cattle, he desires to have said leases cancelled & asking that he be allowed to enter into a new indenture of lease for the same lands, with the exception of the lands granted to said plantation for a term of 25 years, at a yearly rate of not more than $300.
>
> Int dept Bk 15 p. 109 In list of Konohiki lands, showing that V. Kamamalu is owner of the above land & that it has a seacoast frontage of 3.55 miles.
>
> Public Instruction Jan 24, 1891 J., K. Burkett to Min of Public Instruction - Have talked with Mr. Wilcox & Mr. Isenberg in regard to a lot for a school house at the above place, &c.

Public Instruction Feb. 11, 1893, A. S. Wilcox to Min of Pub Instr - Think it best to send a copy of the former survey of the above school lot, as the corner stones have all disappeared & will be difficult to find the exact spot without it &c.

Public Instruction April 3, 1907 Registrar of Conveyances to Supt. of Publ Inst. Submitting Abstract of Title in re a portion of R. P. 4481, Land Claim Award No. 7718, Ap. 2, Part 7, of land situated at the above tract, Kauai, claimed to be owned by the Lihue Plantation Co. Ltd. &c. Notes of Survey of School lot in said tract, attached.

Public Instruction Aug 25, 1909, Supt of Pub Instr to J. K. Farley To assist the Dept in suggesting valuation of 2.03 acres of school lot at the above tract, valued at $300 per acre &c. Doc's relating thereto attached.

Executive Pinkham Aug 4, 1915, Commissioner of Public Lands to Governor Pinkham informing that the Lihue Plantation Co., delivers to the Koloa Sugar Co., waters rising & flowing on the above lands, paying a little over $10,000 a year &c.

In 1866, Princess Kamāmalu died, and her lands were inherited by her father, Mataio Kekūanāo'a. Upon Kekūanāo'a's death, in 1868, Princess Ruth Ke'elikolani inherited Kamāmalu's lands. In 1870, Ke'elikolani sold large portions of Kalapaki and Līhu'e area lands to William Hyde Rice of Līhu'e Plantation.

Sugar Plantations in the Project Area

Kōloa, Kaua'i was home to the first sugar plantation in the islands. A brief history of Līhu'e Plantation Company is presented here, taken from the Pacific Commercial Advertiser's 50th Anniversary Edition, July 2, 1906, pages 60-61:

> Lihue sugar plantation is interesting because of its phenomenal success and the many obstacles which have been encountered and overcome all through its progress, and especially during the early years when the sugar industry in Hawaii was in its experimental stages.
>
> The early records of the plantation show that in 1854 Messrs. Henry Peirce, Wm. L. Lee, Wm. C. Parke, Edwin O. Hall, C. R. Bishop, C. W. Austin, W. H. Bates formed a co-partnership under the name of Henry A. Peirce & Co. whose business should be to plant sugar cane, manufacturing sugar, and all other branches of business theretofore carried on by the proprietors of the said plantation, which indicates that the plantation had been in operation prior to that date. Mr. Rice was the manager. The mill which stood on the present site, was run by water power; the crop amounted to 120 tons of sugar. The plantation store stood near the site of the present manager's residence on the road to Koloa, and was conducted by Mr. Samuel T. Alexander. In front of the store was a large open space surrounded by a grove of koa and kukui trees where natives from all parts of the island congregated on Saturday afternoons, bringing products of all kinds for sale. Waihua produced hau rope; Kapaa was noted for its rush hats and mats, while bullock cart loads of melons were brought from Anahola and Kealia. The taro and sugar cane from Wahiawa was regarded by the natives as especially fine in quality and was in demand for the use of the chiefs not only in Kauai, but in Honolulu as well. The salt produced in the ponds of Makaweli took the color of the soil blown from the land and was regarded as a luxury because of its red tinge. Opihi's from the mountains were then, as today, regarded by Hawaiian epicures as particularly toothsome, and all these staple supplies, foods and delicacies found their way to Lihue market.
>
> It was Mr. Rice who first introduced irrigation on the cane fields in Hawaii. The average yield of sugar per acre was, at that time, one and one-half tons and was insufficient to make the industry a profitable one, and he conceived the idea of bringing the waters of the Kilohana stream on to the plantation for irrigation, and he built a ditch for that propose. Even with irrigation the outlook for the place was evidently dark, for in 1861 a proposition was considered to abandon the planting of sugar cane. Mr. Paul Isenberg was an employee of the plantation at the time and it was due to his advice and efforts that the proposition to abandon was given up, and planting was continued.
>
> In the year 1862 Mr. Rice died. and Mr. Isenberg succeeded to the management of the estate. Mr. Isenberg was a man of strong character, clear foresight and indomitable will and energy, who, by his perseverance and example, not only pulled Lihue plantation through difficulties of extraordinary success, but he inspired his neighbors with pluck to plod along to a successful issue against conditions, at times, most discouraging. So great was his faith in the future of the sugar industry in Hawaii that, when later he had acquired an interest in the plantation, and his proposal to purchase the Hanamaulu lands was opposed by his partners, he entered into an agreement with them whereby any loss which might be incurred in the planting of these lands was to be borne by him individually, whereas any profit arising from the same was to go in as a general realization to the several partners. The tract in question contains 17,000 acres and was bought for $8,500, which price was regarded by some members of the firm as too high.
>
> Men of Mr. Isenberg's discernment rarely err in such matters. It was this purchase which gave to Lihue plantation its present water supply, and added thousands of acres of fine cane land....
>
> The purchase of Hanamaulu lands, referred to above, was effected during the sixties. In 1877 Mr. A. S. Wilcox was given a contract to plant the tract on shares; the mill was erected by Lihue plantation...and in 1899 Mr. A. S. Wilcox, giving up Hanamaulu, the cultivation of that place was taken up by Lihue plantation, since which time the two places have been run in conjunction, although the cane of the respective places have been ground at its own mill...Mr. Wolters (manager) succeeded in increasing the crop of the combined places, Lihue and Hanamaulu, to 18,000 tons.

Planning for the wharf at Ahukini, on the south side of Hanamā'ulu Bay, was begun in the late 1890s (Joesting 1984:263), and the wharf remnants visible today were completed in 1924 and used until 1951, primarily to transport sugar cane (Clark 1990:5). And, as the above entries indicate, Līhu'e Plantation and the cultivation of sugar cane have played a substantial role in development of the Hanamā'ulu - Kalapakī area.

Conclusion

By the 1860s, vast tracks of the flat lands in the Puna District of Kaua'i, were being cleared and turned over to the cultivation of sugar cane. The plantations became the driving force of Kaua'i's economy, and it was only in the 1970s, that sugar's future began to look uncertain. During the 110 years of extensive sugar cultivation the cultural and natural landscapes were greatly modified. As the forests were cleared, plantation and cattle grazing activities increased and the surface of the land changed. Run-off and siltation on the shore increased, and where native trees and shrubs once protected the plains from wind and storm damage, cane and pasture lands could not block winds that blow off of the ocean. Thus, the windswept nature of the land is believed to be quite different from the prehistoric to early-historic landscape. Over the last several years, portions of the project area lands have remained fallow, with no plantation activity at all.

SETTLEMENT PATTERNS

Settlement pattern analysis is an integral component of the conjunctive approach to archaeology. The ultimate goal of such an analysis is to provide a means of summarizing settlement locational and exploitative strategies, and changes in these strategies through time. Such changes are registered as a sequence of changes in the *distribution* of archaeological site types and feature complexes. Consequently, successful settlement pattern analysis requires the development and application of accurate functional typologies, and reliable temporal controls.

A comprehensive discussion of the chronology for settlement on Kaua'i, using the chronology developed by Kirch (1985:293-308), is presented in Henry et al. (1993). In general, radiocarbon dates tend to support that most of the evidence of human occupation of Kaua'i dates to the Expansion period (AD 1100 to 1650) and later. Population density from the earlier Colonization (AD 300 to 600) and Developmental (AD 600 to 1100) periods was considerably lower, and much of the evidence from these periods would have been destroyed by subsequent land use (especially during the historic period). If such sites were to be found in the region, they could occur as lower components of deeply stratified sites—especially at sites situated in optimal locations for resource procurement, such as along the coast.

The development of the *ahupua'a* system took place during the Expansion period, supplanting earlier kinship-based social systems. This period was associated with the construction of many coastal *heiau*, and the intensification of agriculture and aquaculture activities to meet higher population densities. Most of the prehistoric sites found within this region can be expected to date to the Expansion period; hence, a model based on the *ahupua'a* system is appropriate. This model is based on the zonal distribution of resources within a given *ahupua'a* (after Apple 1965:21-23). This settlement model considers topographic and elevation-dependent environmental zones, and how land within these zones was utilized by native Hawaiians. The data base for this model is derived from observations of patterns in archaeological remains (e.g., Neller and Palama 1973) and from historical research (e.g., Wise 1933, Handy and Pukui 1958, Barrere 1961, Handy and Handy 1972). This historical research has been synthesized from tax and property title records, early newspaper articles, oral history, and accounts by early explorers and missionaries.

Kirch (1985:2) notes that "*ahupua'a* were economically self-sufficient to some degree, although differences in the local resource base (agricultural land, water resources, stone for

tools, and so on) resulted in differences in the production patterns of individual land sections." Thus, our settlement pattern model focuses on two aspects of settlement: distribution of resources within *ahupua'a* and differences between *ahupua'a*. First, a regional settlement model will be presented. This will be followed by a more focused look at what we may expect to find within the *ahupua'a* of Kalapakī and Hanamā'ulu.

Regional Settlement Model

The present project area covers two *ahupua'a*: one within the Hanamā'ulu Stream valley and a second, smaller land sandwiched between Hanamā'ulu and Nāwiliwili Streams. The Nāwiliwili and Hulē'ia river valleys lie in lands directly to the south; the important Wailua river valley lies in the *ahupua'a* of Wailua directly to the north. Neller and Palama's (1973) reconnaissance of the Hulē'ia Stream valley area (located in the *ahupua'a* of Nāwiliwili, Niumalu, and Ha'iku) resulted in the identification of habitation structures, ancillary structures (i.e., animal husbandry, agriculture), fishponds, irrigation ditches, taro fields, and trails. While the survey was not intensive, the general patterns in site types and distributions is useful in producing a settlement pattern model for the region. Data from Neller and Palama's c. 9.5 sq km survey area survey were compiled by site function, topography, elevation, and distance to coast. This information is presented in *Table 4*. Four land use zones may be posited from these patterns — Seacoast and Coastal Plain, Stream Valleys and Gulches, Valley Slopes, and the Uplands (Neller and Palama did not survey land in the last zone):

> Seacoast and Coastal Plain Zone — This zone extends up to c. 1 km (0.6 mi) inland in an area of generally low relief—coastal sand and slightly raised plateaus of alluvium from the nearby permanent drainages. Thrum (1907) and Bennett (1931) recorded *heiau* within this zone; Walker et al. (1991) found a habitation site; and Bennett (1931), Cox (1977), Erkelens and Welch (1993), and Beardsley (1994) found dune burials in this zone within the *ahupua'a* of Wailua. Limited agriculture, including the growing of breadfruit, coconut, and dryland taro, probably took place within this zone (Handy and Handy 1972).
>
> Aquaculture was an important subsistence activity in the area, as evidenced by Alekoko (also called "Menehune") Fishpond (Neller and Palama 1973, Ching et al. 1973) and the North Niumalu aquaculture-agriculture complex (Folk and Hammatt 1991), both in Nāwiliwili Bay (near Kalapakī in the *ahupua'a* of Niumalu). Marine resources, including fish, shellfish, and crustaceans, provided the primary protein base for the Hawaiians (Tuggle 1979), and through fish farming, the native Hawaiians were able to maintain a steady supply of readily available fish.
>
> Stream and Gulches Zone — Within the Hulē'ia Stream valley, this zone extends inland c. 5.2 km (3.25 mi) occupying land at c. 60 m (200 ft) elevation and lower. Neller and Palama found both native Hawaiian agriculture and habitation sites within this zone, as well as walls and enclosures that may have served as either historic animal husbandry or boundary functions. The relative density of LCAs occurring in this zone attests to the desirability of this land. Historical data suggests that other stream valleys in the region were used the same way. According to Handy and Handy, because Hanamā'ulu Stream gulch offers a suitable environment for prehistoric agricultural activities, they speculate that the area contained numerous *lo'i* (terraced flats) for wetland taro cultivation. As Bennett notes, all cultivable land was used, extending as far up the valleys as practical.

Table 4. Archaeological Sites Found in Hulēia River Valley Reconnaissance (Compiled from Neller and Palama 1973)

Site	Form	Functional Interpretation	Elev. (ft)	Distance to Coast (km)
Seacoast and Coastal Plain Zone				
98	Alekoko fishpond	Aquaculture	<40	<1
3013	Papaawa fishpond	Aquaculture	<40	<1
3027	Fresh water fishpond	Aquaculture	<40	<1
3028	Fresh water fishpond	Aquaculture	<40	<1
Stream Valleys and Gulches Zone				
3022	Wall	Poss. agriculture	<40	<1
3029	Large Ditch	Agriculture	<40	<1
3030	Small Ditch	Agriculture	<40	<1
3031	Lo'i complex	Agriculture	<40	<1
3032	Lo'i complex	Agriculture	<40	<1
3033	Lo'i complex	Agriculture	<40	<1
3034	Lo'i complex	Agriculture	<40	<1
3025	Walls	Habitation and agriculture/boundary	40	2.2
3012	Enclosures	Animal husbandry/boundary	80	4.0
Valley Slopes Zone				
3000	Enclosure	Habitation	200	0.6
3009	Terraces, ditches, grave	Agriculture-cemetery	200	4.2
3010	Enclosures, bridge	Habitation-agriculture ditch, terrace	200	5.2
3026	Platform	Habitation	240	0.6
3024	Enclosure	Poss. animal husbandry	280	1.4
3001	Cave and terraces	Habitation-agriculture	350	0.6
3011	Platforms	Habitation	360	4.3
3002	Enclosure	Poss. habitation	400	4.6
3004	Kipu Kai Trail	Transportation	400	4.1
3023	Enclosure	Poss. animal husbandry	400	1.4
3005	Wall	Poss. animal husbandry	440	4.0
3003	Complex	Habitation-agriculture	600	4.2
3006	Platform	Habitation	640	4.6
3007	Alaea Pit	Special activity	680	4.7
3008	Terraces, platforms	Habitation-agriculture	680	4.7

Stauder (Stauder 1973) notes that Hulēia Stream basin was farmed extensively in early historic times. During the first half of the 19th century, horses and cattle grazed throughout the valley. Based on testimonies from LCAs, it appears that damage caused by roaming livestock led to a reduction in the amount of agricultural features being used during this period (Stauder 1973:26). Archaeologically, in addition to agricultural features, we can expect to find high stone walls dating to this period. Rice was grown in the valley in historic times as well. Stauder also found from tax records and commercial directories that 60 Chinese farmers were farming in the valley mouth near the sea.

Valley Slopes Zone — This zone occurs from 200 ft. elevation and extends upwards to a maximum elevation of c. 680 ft. This upward figure is based on the elevation of the highest site found in Neller and Palama's survey. Definition of this zone is probably specific to the topography within each stream valley (i.e., based on the extent of slight to moderate slopes above the

valley floor and distance to coast). Neller and Palama found habitation sites located up above the fertile stream valleys. Garden features associated with these habitations (i.e., sweet potato, dryland taro, breadfruit) may be expected, as well as historic animal husbandry features, trails, and special activity areas (i.e., procurement sites).

Upland Zone — Neller and Palama did not survey the higher elevations, although a transition from the inhabited valley slopes to a largely uninhabited forested, upland zone may be hypothesized. While the Upland zone resources would have been greatly valued, the steep slopes would not have been conducive to farming or habitation. The land was probably not used as intensively as the lower slopes. Handy and Handy note "the forested interior was rich in all the trees and other plants treasured by Hawaiians: *koa*, sandalwood, fragrant *maile* and *mokihana* vines, and others" (1972:425). The upland slopes were forested, and contained rich upland resources (e.g., *olonā* for fiber, wood and timber resources, feathers for adornments, stone for quarrying and tool production) that would have greatly valued. Evidence for land use within this zone would be limited to trails, special use features (i.e., procurement sites), and temporary habitation features.

Prehistoric settlement within coastal areas of this general southeastern area of Kaua'i (the *ahupua'a* of Hanamā'ulu, Kalapaki, Nāwiliwili, Niumalu, and Wailua), appears to have been concentrated at Hulēia Valley-Nāwiliwili Bay and Wailua River Valley-Wailua Bay. The Wailua River is the major drainage for the region. According to Joesting (1984), the Wailua area was a highly desirable place of residence and was the principal residence of Kaua'i's high chiefs. The chiefly importance of the Wailua area is further evidenced by the number of *heiau* concentrated within that general area (Malae, Poliahu, Holoholoku, and Hikinaakala are among the many *heiau* named) (Thrum 1907). It was in Wailua that the primary residences and ceremonial centers for the *ali'inui* (greater chiefs) of the island were located, and oral traditions also tend to support the relative importance of Wailua (Damon 1934; I'i 1963; Beckwith 1970 cited IN Cox 1977). Because the Wailua River Valley provides a permanent fresh water source and contains large tracts of fertile alluvial and colluvial soils, it is ideally suited for the cultivation of native crops to sustain a large population. Such a population would provide the labor force which a complex chiefdom would need in order to function. A thorough summary of the historical background of the *ahupua'a* of Wailua is presented in Folk et al. (1994).

Having discussed general settlement patterns within the region, the discussion will now focus on what we may expect to find within the *ahupua'a* of Kalapaki and Hanamā'ulu.

Lands of Hanamā'ulu and Kalapaki

Ethnohistoric research by Ching et al. (1973) has revealed that the boundaries of Hanamā'ulu and Kalapaki have not changed since prehistoric times. The present-day boundaries, then, may be used to extrapolate intra-*ahupua'a* patterns back into the prehistoric past with some confidence. The project area lands lie within the first two zones: Seacoast and Coastal Plain, and Stream Valley and Gulches. Based on existing information for Hanamā'ulu and Kalapaki *ahupua'a*, and the general pattern for Hawaiian settlement, the following expectations for archaeological findings within these lands are proposed.

As noted in the section on previous archaeological research, the *ahupua'a* of Kalapaki and Hanamā'ulu have been moderately well-studied from the coast to c. 2.5 to 4.0 km (1.5 to 2.5

mi) inland. Much of this land, however, has undergone historic and modern disturbance in the forms of sugar cane cultivation and urban development (as noted by Hammatt in coastal Kalapaki and by Henry et al. in the nearby *ahupua'a* of Nāwiliwili, Niumalu, and Ha'iku). Little development has occurred in the inland reaches of Kalapaki and Hanamā'ulu, so our knowledge of these areas is based largely on historical research.

The *ahupua'a* of Kalapaki is a wedge-shaped land that extends 10.1 km (6.3 mi) inland (*Figure 2*). The coastline spans 2.2 mi (3.5 km), and includes good ocean access along a portion of the mouth of Nāwiliwili Bay. Kalapaki's southern border skirts the north side of Nāwiliwili Stream valley for the first 3.2 km (2 mi) inland, then makes a line straight to its terminus on the slope of Kilohana Crater at an elevation of c. 304 m (1000 ft), a short distance below the summit of the crater. The Hanamā'ulu Stream valley forms a portion of its border with the *ahupua'a* of Hanamā'ulu. Kalapaki is notable for its lack of a major permanent drainage, unlike its neighbors on both sides. One tributary of Nāwiliwili Stream does originate in Kalapaki, on the slope of Kilohana, and it is along this tributary that the various LCA with *lo'i* and *kula* plots were located.

While this land was not as rich agriculturally as its neighbors, research on foreign testimony of LCAs revealed that there were at least seven fish ponds along the coast of Kalapaki (LCA claims 3280, 3325, 3425, and 3907; cited IN Hammatt and Creed 1992:68, 69). In addition, Thrum (1907) found three *heiau* in this relatively small *ahupua'a*. Archaeologically, we would expect to find remains of *lo'i*, or agricultural terraces, in the drainages on the slopes of Kilohana crater; low-density dryland agricultural features along the seacoast and coastal plain; evidence of aquacultural features along the shore; and the remains of ceremonial and habitation sites near the coast, unless they have been destroyed by farming and development. Habitation features could also be found in some of the LCA lands, although many of the awards indicate that the awardees had houselots elsewhere (i.e., in the village of Kalapaki).

Hanamā'ulu is a large *ahupua'a* which is roughly rectangular rather than wedge-shaped like Kalapaki (*Figure 2*). It is c. 6.3 times larger than Kalapaki. Hanamā'ulu extends inland to the boundary of the Districts of Līhu'e and Waimea for a total of 18 km (11.2 mi), where its inland boundary runs along the ridge separating Koula Valley and Olokele Canyon in the Waimea District from the windward side of Kaua'i. This inland boundary spans 6 km (3.7 mi); the elevation at this border ranges from 967 m (3173 ft) at the southwest *ahupua'a* corner, rising to the top of Kawaikini peak at 1587 m (5208 ft) in the northwest corner of the *ahupua'a*. Kawaikini, along with Wai'ale'ale, are the twin peaks that once formed the summit of the now extinct volcano that is Kaua'i island. Rainfall at this inland terminus of the *ahupua'a* averages 400 inches a year.

Hanamā'ulu Stream lies entirely within this *ahupua'a*. The border between Kalapaki and Hanamā'ulu bisects Kilohana Crater, a prominent landmark within the mid-portion of the *ahupua'a*. Kalepa ridge runs a parallel course to the coast, connecting Hanamā'ulu Stream to the Wailua River valley to the north. The coastal section of this land spans 3.8 km (2.4 mi), with good coastal access and a natural bay (Hanamā'ulu).

While there is historical evidence of some fish farming in Hanamā'ulu (Appendix B: Walker et al. 1991), aquaculture does not appear to be as important in Hanamā'ulu as in Kalapaki. The shoreline would have had areas suitable for launching canoes, and suitable for shore fishing and shellfish collecting. On the beach area in Hanamā'ulu Bay, burials were placed in sand dunes (Bennett 1931). Activities along the coast and in the coastal plains were

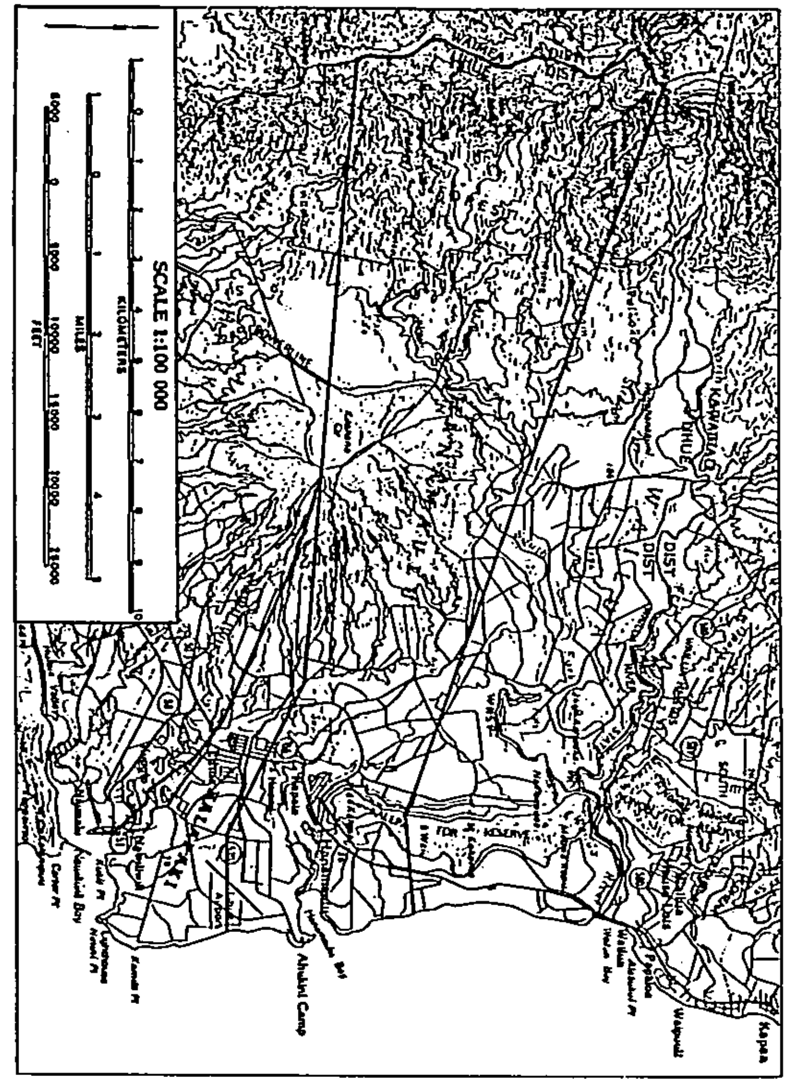

Figure 2. Map Showing Boundary of Ahupua'a of Hanamā'ulu and Kalapaki

likely restricted to marine resource exploitation, small-scale fish farming, and habitation, both temporary and permanent. The coastal plain was probably used for dryland farming, although most farming within this *ahupua'a* would have focused on the valley floor.

Hanamā'ulu Stream valley would have been suitable for wetland taro cultivation, and probably contained an extensive agricultural system comprising of *lo'i* and terraces. The stream flows through a broad gulch that was extensively terraced up to 2-1/2 miles above the delta during historic and probably prehistoric times (Handy and Handy 1972). The valley has, in fact, been assigned a state site number (Site 1847) by Walker et al. (1991). Despite the absence of observable agricultural features on the ground surface, these features may exist intact below the valley sediments. During historic times, walls may have been constructed around these fields to prevent damage caused by roving livestock. We would not expect to find habitation features in the valley floor; LCA claims state that while some houselots were situated near the *lo'i* and *kula* fields, others were located outside of the valley.

The Valley Slopes zone of Hanamā'ulu is not represented within the current project area. Land use within this zone would be expected to reflect the general pattern found in Hulē'ia Stream valley (Neller and Palama 1973), with habitation, limited agriculture, trails, and special activity sites. The extensive Upland zone within Hanamā'ulu may be expected to have evidence of trails, temporary habitation, and special use sites.

Niether Hanamā'ulu or Kalapakī figured in Kaua'i legends; the relative wealth of the lands was likely less than Wailua (this is true more so for Kalapakī); and the population densities were undoubtedly lower. In-kind trade may have existed within these lands, for each has its own richness. Hanamā'ulu may have traded upland resources (i.e., bird feathers) and valley resources (i.e., wetland taro); Kalapakī may have traded fish from its farms.

FIELD PROCEDURES

Sample-coverage surface survey of the Hanamā'ulu parcel (Walker and Rosendahl 1990) was accomplished by way of a series of pedestrian transects oriented both east-west and north-south. Intervals between crew members ranged from 15 to 20 meters. Of the total parcel area, 32.7% was subjected to ground survey. This percentage was deemed adequate due to (a) the absence of surface structural remains in the project area, (b) the paucity of identified portable remains in areas ground surveyed, and (c) past land use patterns and the disturbed nature of the subsurface deposits (cultivated sugar cane land).

Subsequently, subsurface testing by means of mechanical backhoe was conducted within this parcel. Trenches were placed to determine the presence or absence of buried prehistoric agricultural deposits, cultural deposits, and/or features (i.e., firepits), and to recover datable material. Nine backhoe trenches were excavated in the project area; all were numbered sequentially, beginning with BT-1. The backhoe trenches were placed c. 60 to 90.0 m apart, as shown in *Figure 3*.

To aid in the identification of cultural deposits, matrix samples from the trenches were processed through quarter-inch mesh and were examined for ecofactual remains, charcoal, and/or artifacts. Layer descriptions were compiled on PHRI stratigraphy forms through a combination of field examination and laboratory analysis of representative fill samples. All layers were described in accordance with procedures and terminology as set forth in the *Soil Survey Manual* (Soil Survey Staff 1962). All trenches were terminated in sterile soil strata.

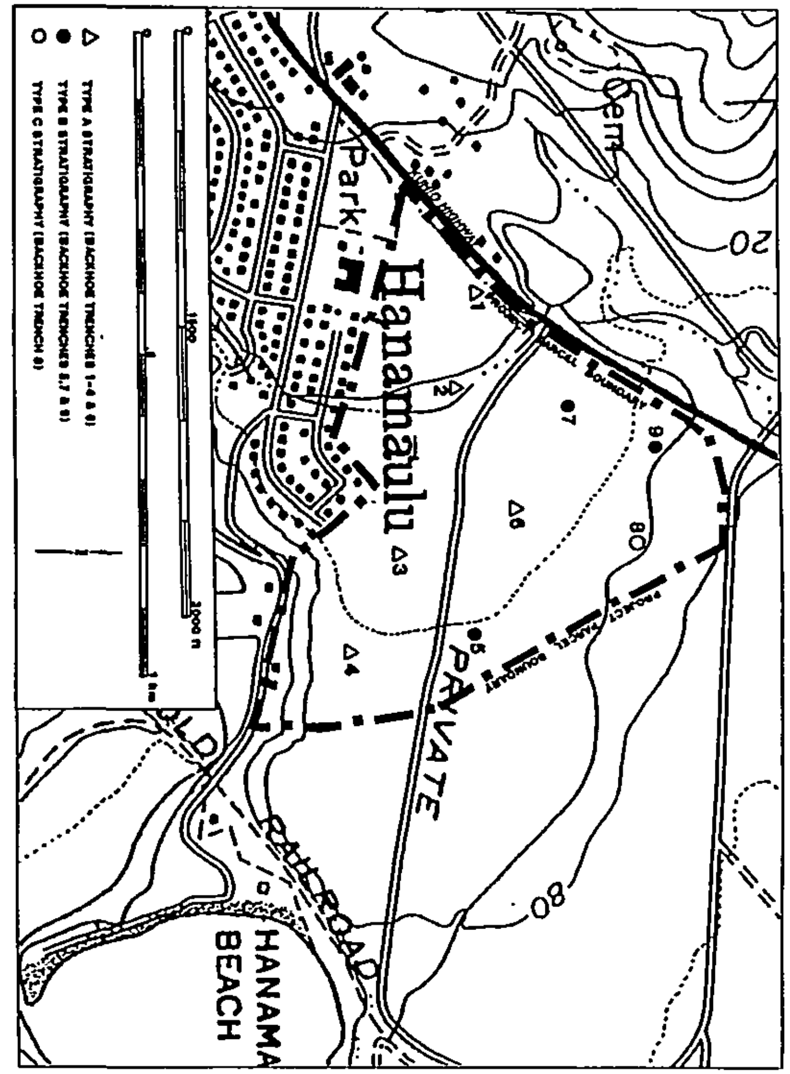

Figure 3. Hanamā'ulu Parcel Showing Backhoe Trench Locations

The surface survey transects and backhoe trench locations were plotted on a USGS 7.5 series quad map ("Kapaa, Hawaii"; 1"=2,000'; 40-ft contours). The general project area was photographed, and at least one 35 mm black-and-white photograph was taken of selected backhoe trenches (PHRI Roll No. 1337).

The ground survey strategy for the Ahukini Mauka, Ahukini Makai, and Molokoa parcels (Walker et al. 1990) considered: (a) past land alteration patterns—specifically, sugar cane cultivation, and (b) prehistoric site distribution patterns indicated by previous archaeological work. Areas deemed likely to contain archaeological sites included coastal areas, stream gulches, and any otherwise unaltered areas. Because areas altered by sugar cane cultivation are not likely to contain archaeological features, and because sugar cane cultivation within the present project area does not occur in low swale or alluvial flat areas that may contain buried cultural deposits, areas in sugar cane cultivation were only sampled. This includes areas adjacent to the highway in the Ahukini Mauka and Ahukini Makai parcels. A 100% ground survey was conducted in all portions of the project area not cultivated in sugar cane. This included all coastal areas, unaltered stream gulches, and drainages within sugar cane fields. *Figure 4* indicates those areas given 100% survey coverage.

The surface survey was conducted in a series of pedestrian transects. The interval between sweeping crew members was 15 to 20 m, depending on vegetation and terrain. To aid in relocating sweep areas and sites, sweeps were numbered sequentially. To ensure complete coverage, the edges of sweep areas were flagged with red- or blue-striped flagging tape. As sites were identified in the Walker et al. survey, they were flagged with pink-and-blue flagging tape and were assigned sequential PHRI temporary numbers prefixed by "T-," beginning with T-1. Subsequently, all identified sites were assigned permanent State Inventory of Historic Places (SIHP) site numbers. The sites were recorded on standard PHRI site record forms and sketch-mapped, with orientation and site dimensions determined using metric tape and compass. The sites was photographed using 35 mm black-and-white film, and tagged with an aluminum strip bearing the site number, PHRI project number (90-894), the letters PHRI, and the date. This information was also written on a piece of flagging tape that was wrapped around a stone and placed in a protected area on the site. The sites were plotted on a blueline topographic map (1"=600' scale) provided by Helber, Hastert & Kimura. Site plotting was aided by 1"=1000' scale, black-and-white, aerial photos (R.M. Towill Corp. Photo Nos. 1165-1 through -3, dated November 26, 1989, and Photo No. 8437-43 dated February 27, 1986).

Although ten sites (T-1 through T-10) were located within the Walker et al. project area, only one site is situated within or near the present project area. This was temporary site "T-5," which was subsequently given the SIHP Site Number 1842. This site was photographed on PHRI Roll No. 1566.

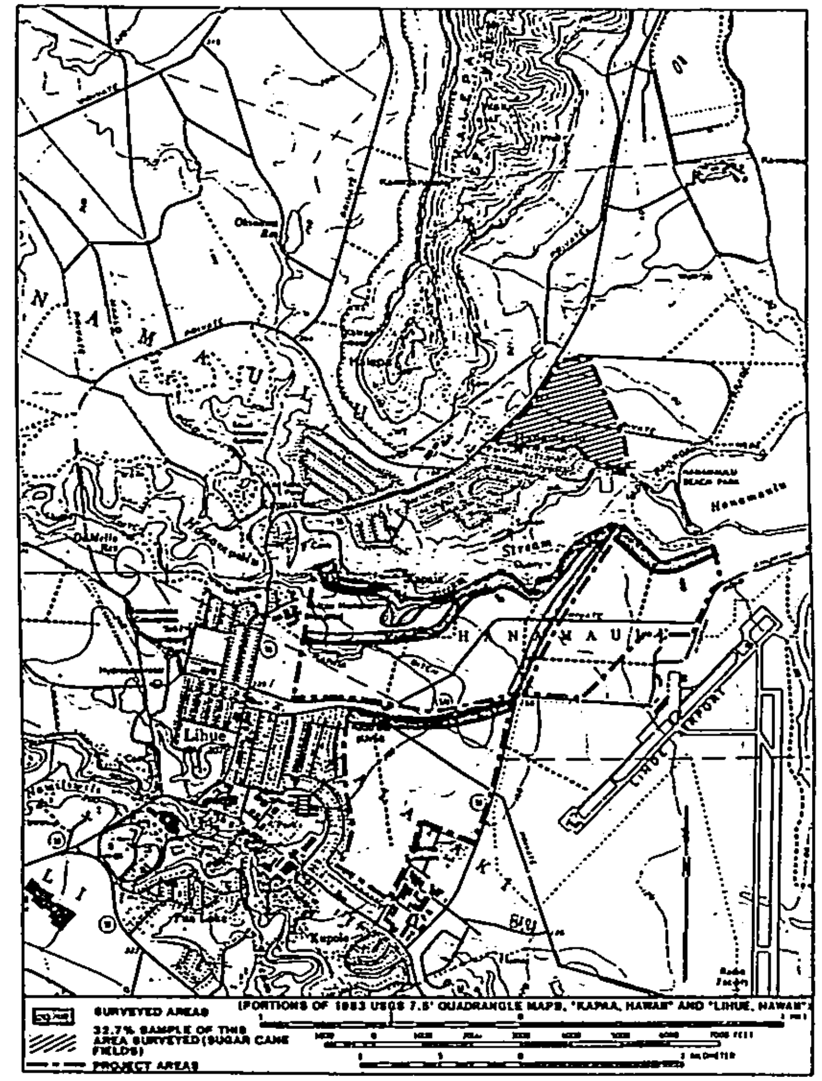

Figure 4. Survey Coverage Map

FINDINGS

SURFACE SURVEY

Only one site, a wall (SIHP Site 1842), was identified within or immediately adjacent to the project area. This site lies along the edge of the Ahukini Mauka parcel. The location of this site is shown on *Figure 1*. Its value mode assessments and recommended field work tasks are summarized in *Table 5*. No significant archaeological remains of any kind were encountered in the surface or subsurface surveys of the Hanamā'ulu parcel. The only cultural remains encountered in this parcel were several small isolated coral pebbles.

Site 1842 is a historic wall with low research, interpretive, and cultural value. The wall is straight, running NW-SE along a ridge at the top edge of the sloping side of a sugar cane road. The slope below the wall descends down to a small stream that is surrounded by dense hau. Principal vegetation species near the wall consist of Java plum, hau, and vines. The wall measures 30 m long by 1.40m wide, ranging from 0.80 to 1.25 m high. Construction is of mostly waterworn medium-sized basalt boulders and large cobbles stacked five to six courses high and two to three courses wide (*Figure 5*). Where the wall extends above the soil, it is roughly faced on both sides. This wall appears to have been built to help retain soil from eroding into the gulch that lies to the northeast. Preservation of the wall is fair, and its integrity is partially altered by post-abandonment modifications. An extension of the wall (c. 30 m long) may have previously existed, as indicated by a bulldozed berm/alignment at the edge of the slope alongside the road.

Table 5. Summary of Identified Sites and Features

*SIHP Site No.	Formal Site/Feature Type	Functional Interpretation	§ CRM Value Mode Assess.			# Field Work Tasks		
			R	I	C	DR	SC	EX
1842	Wall	Boundary/Agriculture	L	L	L	-	-	-

* State Inventory of Historic Places (SIHP) numbers. SIHP numbers are five-digit numbers prefixed by 50-30-11 - (50=State of Hawai'i; 30=Island of Kaua'i; 11=USGS 7.5' series quad map ["Lihue, Hawai'i"]).

§ Cultural Resource Management
Value Mode Assessment—Nature:
R = scientific research
I = interpretive
C = cultural
—Degree:
H = high
M = moderate
L = low

# Recommended further data collection field work tasks:
DR = detailed recording (scaled drawings, photographs, and written descriptions)
SC = surface collections
EX = limited excavations

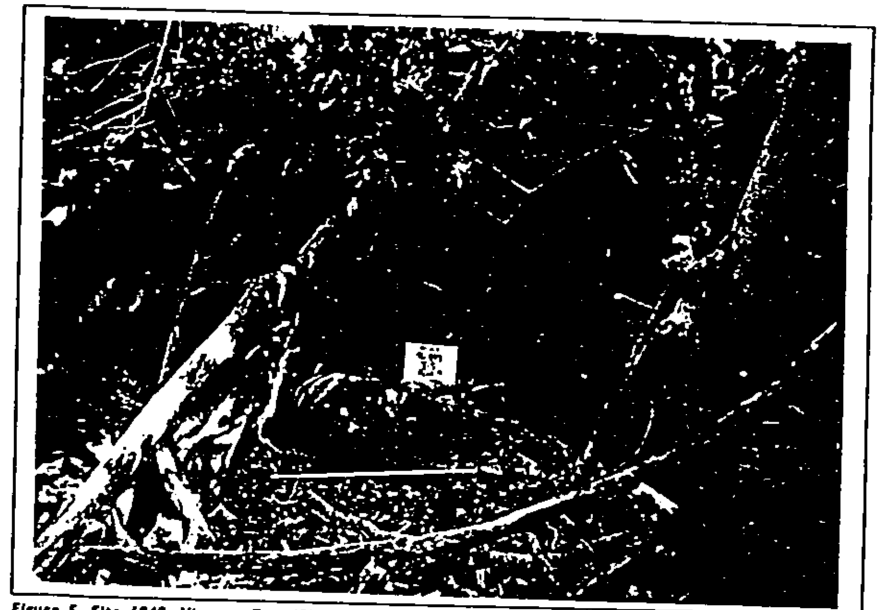

Figure 5. Site 1842, View to East (PHRI Neg. 1566-19)

SUBSURFACE TESTING

The backhoe trenching took place during the Walker and Rosendahl (1990) survey and entailed excavating c. 29 sq m of surface area (c. 70 cu m) in nine trenches within the Hanamā'ulu parcel (Figure 3). During trenching, no cultural matrices, buried pondfields, subsurface horizontal features, portable cultural remains, or datable materials were observed. Detailed soil descriptions for backhoe trenches are presented in *Table 6*. The trenches displayed three general stratigraphies (Types A-C). The stratigraphies all contained dark reddish-brown silty clay (Layer I) and red silty clay (II) matrices. Type A consisted solely of these two clay matrices; Type B displayed a Layer III, a yellowish-red silty clay; and Type C contained a variation of Layer II (a strong brown silty clay). Stratigraphy Types A, B, and C are apparently slight variations of representative subsoil profiles of Lihue silty clay described in Foote et al. (1972).

Layer I (found in all trenches) is the most recent plow zone layer. *Table 7*, the summary of backhoe trench excavations, indicates that the depth of this layer ranges from 0.15 m to 0.50 m, with a median depth of 0.23 m. It is widely accepted that reddish clayey soils found in land that has been planted in sugar cane are created by agricultural activity. Hence, the stratigraphies throughout all trenches showing Type A and Type B profiles (see *Figure 5*) indicate that these areas have been affected by historic and modern sugar cane cultivation down to the depth of the bottom of the trenches. The Layer II (a strong brown silty clay) present in the single trench showing a Type C stratigraphy (BT-8), is the only soil observed within this parcel that could have been laid down by non-agricultural colluvial processes.

The findings of the subsurface testing illustrate that, due to the depth and pervasiveness of historic disturbance within this parcel (specifically—disturbance resulting from mechanical means), there is little chance of any intact subsurface cultural deposits occurring within this parcel.

Table 6. Backhoe Trench Stratigraphy

Trench	Layer	Description
BT-1	I	20 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
	II	200+ cm thick; red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slightly sticky, and of plastic consistence; few fine roots
BT-2	I	15 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
	II	185+ cm thick; red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slightly sticky, and of plastic consistence; few fine roots
BT-3	I	23 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
	II	177+ cm thick; red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slightly sticky, and of plastic consistence; few fine roots
BT-4	I	30 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
	II	190+ cm thick; red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slightly sticky, and of plastic consistence; few fine roots
BT-5	I	25 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
	II	150+ cm thick; clear, smooth lower boundary red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slightly sticky, and of plastic consistence; few fine roots
	III	100+ cm thick; yellowish-red (5 YR 4/6 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, firm, slightly sticky, and of slightly plastic consistence; very few fine roots
BT-6	I	22 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
	II	218+ cm thick; red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slightly sticky and of plastic consistence; few fine roots
BT-7	I	22 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong; fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots

Table 6. (cont.)

Trench	Layer	Description
BT-7 (cont.)	II	148+ cm thick; clear, smooth lower boundary; red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slightly sticky and of plastic consistence; few fine roots
	III	120+ cm thick; yellowish-red (5 YR 4/6 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, firm, slightly sticky, and of slightly plastic consistence; very few fine roots
BT-8	I	50 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
	II	190+ cm thick; strong brown (7.5 YR 5/6 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, firm, sticky, and of plastic consistence; very few fine roots
BT-9	I	30 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
	II	160 cm thick; clear, smooth lower boundary red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slightly sticky, and of plastic consistence; few fine roots
	III	70+ cm thick; yellowish-red (5 YR 4/6 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, firm, slightly sticky, and of slightly plastic consistence; very few fine roots

Table 7. Backhoe Excavation Results

Trench	Length (m)	Width (m)	Layers	Stratigraphy Type	Max. Depth (m)	Depth of Layer I (m)
BT-1	3.20	1.20	I, II	A	2.20	0.20
BT-2	2.70	1.15	I, II	A	2.00	0.15
BT-3	3.05	0.96	I, II	A	2.00	0.23
BT-4	2.87	1.15	I, II	A	2.20	0.30
BT-5	3.30	1.20	I-III	B	2.75	0.25
BT-6	3.25	1.00	I, II	A	2.40	0.22
BT-7	3.70	0.80	I-III	B	2.90	0.22
BT-8	3.70	0.90	I, II	C	2.40	0.50
BT-9	3.35	0.75	I-III	B	2.60	0.30

CONCLUSION

SUMMARY AND DISCUSSION

The archaeological survey of the project area consisted of inventory-level investigations. As part of the inventory survey, a program of subsurface backhoe trenching was also undertaken. The inventory-level survey consisted of 100% ground survey of all areas not planted in sugar cane, and limited surface survey in sugar cane fields. This was justified because surface archaeological features are not likely to have survived in areas that have undergone the substantial surface and subsurface modification involved in sugar cane cultivation.

Given the extensive Historic period modifications within the present project area, it is not surprising that the present survey confirmed that only one archaeological site is present in the project area. This site appears to have served a historic agriculture function—specifically, it was built as a retaining wall to control erosion. This site was probably associated with Lihue Plantation. Lihue Plantation developed the sugar cane industry in this part of Kaua'i during the early historic period. Its history is described in more detail in the Historical Documentary Research section of this report. Cultivation of sugar cane within most of the project area has continued to the present.

In the Hanamā'ulu parcel, settlement was either non-existent or very limited, or the lack of cultural remains could be due to the intense land modification caused by sugar cane cultivation.

GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

As shown in *Table 8*, the single site identified within the project area (Site 1842) is assessed as no longer significant (NLS). Significant data has been collected from this site; the site is important for information content only and no further data collection is necessary. This site lacks associated cultural deposits and portable remains. It has been measured, described, photographed, and its location plotted.

Significance categories used in the site evaluation process were based on the National Register criteria for evaluation, as outlined in the Code of Federal Regulations (36 CFR Part 60). The DLNR-SHPD uses these criteria for evaluating cultural resources. Sites determined to be potentially significant for information content fall under Criterion D, which defines significant resources as ones that "...have yielded, or may be likely to yield, information important in prehistory or history." Sites potentially significant as representative examples of site types are evaluated under Criterion C, which defines significant resources as those which "...embody the distinctive characteristics of a type, period, or method of construction...or that represent a significant and distinguishable entity whose components may lack individual distinction.

Sites with potential cultural significance are evaluated under guidelines prepared by the Advisory Council on Historic Preservation (ACHP) entitled "Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review" (Draft Report, August 1985). The guidelines define cultural value as "...the contribution made by an historic property to an ongoing society or cultural system. A traditional cultural value is a cultural value that has historical depth." The guidelines further specify that "[a] property need not have been in consistent use since antiquity by a cultural system in order to have traditional cultural value."

The evaluations and recommendations presented within this final report have been based on a variable-coverage surface and limited subsurface inventory survey of the project area. Due to the limitations of such a survey, there is always the possibility, however remote, that potentially significant, unidentified surface or subsurface cultural remains will be encountered in the course of future archaeological investigations or subsequent development activities. In such situations, archaeological consultation should be sought immediately.

Table 8. Summary of General Significance Assessments and Recommended General Treatments

*SIHP Site No.	Significance Category A	B	C	D	E	NLS	Recommended Treatment FDC	NFW	PID	PAI
1842	-	-	-	-	-	+	-	+	-	-
Total:	0	0	0	0	0	1	0	1	0	0

* *State Inventory of Historic Places (SIHP) numbers. Prefixed by 50-30-11 - (50=State of Hawai'i; 30=Island of Kaua'i; 11=USGS 7.5' series quad map ["Lihue, Hawai'i"], 1983).*

General Significance Categories:
- *A = Important for historical contribution to significant events and/or broad patterns of history;*
- *B = Important for association with the lives of important individuals in history;*
- *C = Excellent example of site type at local, region, island, State, or National level (PHRI=interpretive value);*
- *D = Important for information content, further data collection necessary (PHRI=research value);*
- *E = Culturally significant (PHRI=cultural value); and*
- *NLS = No longer significant, significant data collected, important for information content only, no further data collection necessary (PHRI=research value, SHPO=no longer significant); and*

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

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ADDENDUM

The Department of Land and Natural Resources - State Historic Preservation Division (DLNR-SHPD) reviewed this report, less this addendum, in June of 1994, and subsequently sent PHRI a review letter (dated 18 July 1994, from D. Hibbard to P. Rosendahl) addressing two concerns: (1) the DLNR-SHPD noted that Site 9402 was mentioned in the background section of the report, but was not mentioned in the findings or conclusions; they asked that PHRI send "replacement pages covering the site," so that they could finalize their review; and (2) the DLNR-SHPD asked for a copy of a report by Walker, Kalima and Rosendahl (1991), noting that it was referenced, but they did not have a copy.

PHRI has prepared this addendum in response to the DLNR-SHPD review letter. Concerning Item 2, above, PHRI searched the report for the Walker, Kalima and Rosendahl (1991) reference, but the reference was not found. References to Walker, Kalima and Goodfellow (1991) and Walker et al. (1991) were found; we believe the DLNR-SHPD already has copies of these reports.

The following is additional information on Site 9402. This site was initially identified by McMahon in February of 1990, during a field check of three parcels (McMahon 1990). At the time, the site was photographed, was given an SIHP site number, and was located on a USGS map, but the site was not measured or described in detail. In McMahon's report, the site is described briefly: "One historic building...TMK:3-6-02:4...the building is in bad repair. It is owned by AMFAC. Apparently the radio station KTOH was using it for some time...." Based on her findings, McMahon assessed Site 9402 as significant solely for information content (Criterion d, 36 CFR Part 60).

PHRI recently obtained the following, more detailed information on the site:

> Site 9402 is a historic building that is currently uninhabited (see Figure 1; building is in the Molokoa Parcel at the site of Radio Station KIVM). The building is in a generally flat area; vegetation in the immediate vicinity of the building is overgrown and consists of grasses, banana, *milo*, and bougainvillea. The building is on an L-shaped concrete-slab foundation 60 feet long by 25.5-45.5 feet wide. The walls of the building are made of wood and hollow concrete tile and are finished with plaster. The roof is shingled with wood and is in the "cut-up" style. The building is in poor condition. There are large holes in the roof, and large areas of the roof are missing shingles. The exterior paint is faded and peeling, especially on the window sashes. The interior of the building is in extremely poor condition; the walls are heavily marked and rutted, and huge portions of the ceiling have been torn out.
>
> The building was constructed in the late 1930s and was owned by Lihu'e Plantation Company, Ltd. It originally was built to house Kauai's first radio station, KTOH, which began broadcasting on May 8, 1940. The architect of the building was Guy Rothwell, and the interior designer was Sascha Petry of New York. G. Hiranaka was the building contractor. Accompanying the building was a 150-ft radio station tower constructed by Kauai Electric Company; the tower was completed the week of February 19, 1940. The building was used as a radio station though the early 1980s (the last radio station to use it was KIVM). In 1982 the building was damaged by Hurricane 'Iwa. After the hurricane the building was repaired only minimally. From 1983-1992 several small businesses worked out of the building or used it for storage. Most recently, Jack Harder Helicopters worked out of an addition adjoining the original building. In 1992 Hurricane 'Iniki damaged the building further. After 'Iniki, the building was not repaired.

Based on the above information, PHRI confirms McMahon's earlier assessment of Site 9402 as significant solely for information content (Criterion d, 36 CFR). Since all necessary information on the site has been recorded (in addition to the above information, PHRI has photographs of the building, a floor plan, and tax records), the site is recommended for no further archaeological work.

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N

Acoustic Study
for the Lihue-Hanamaulu Master Plan

ACOUSTIC STUDY
FOR THE
LIHUE – HANAMAULU MASTER PLAN
LIHUE, KAUAI, HAWAII

Prepared for:

AMFAC/JMB HAWAII, INC.

Prepared by:

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SEPTEMBER 1994

TABLE OF CONTENTS

CHAPTER	CHAPTER TITLE	PAGE NO.
	LIST OF FIGURES	ii
	LIST OF TABLES	iv
I.	SUMMARY	I-1
II.	PURPOSE	II-1
III.	NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY	III-1
IV.	GENERAL STUDY METHODOLOGY	IV-1
V.	EXISTING NOISE ENVIRONMENT	
	Traffic Noise	V-1
	Aircraft Noise	V-4
	Asphalt Concrete Batch Plant Noise	V-17
VI.	FUTURE NOISE ENVIRONMENT	
	Traffic Noise	VI-1
	Aircraft Noise	VI-3
VII.	DISCUSSION OF PROJECT RELATED NOISE IMPACTS AND POSSIBLE NOISE MITIGATION MEASURES	
	Traffic Noise Impacts	VII-1
	Aircraft Noise Impacts	VII-3
	Combined Traffic and Aircraft Noise	VII-4
	Asphalt Concrete Batch Plant Noise	VII-5
	Construction Noise	VII-6
APPENDICES		
A.	REFERENCES	A-1
B.	EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE	B-1

LIST OF FIGURES

NUMBER	FIGURE TITLE	PAGE NO.
1	LAND USE COMPATIBILITY WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVEL AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED	III-3
2	LOCATIONS OF NOISE MEASUREMENT SITES	IV-2
3	HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF HANAMAULU-AHUKINI CUTOFF ROAD AT AHUKINI ROAD (NOVEMBER 3, 1993)	IV-6
4	HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF AHUKINI ROAD (WEST LEG) AT KAPULE HIGHWAY (NOVEMBER 1, 1993)	IV-7
5	HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF KAPULE HIGHWAY AT AHUKINI ROAD (NOVEMBER 3, 1993)	IV-8
6	HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF AHUKINI ROAD (EAST LEG) AT KAPULE HIGHWAY (NOVEMBER 1, 1993)	IV-9
7	HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF KUHIO HIGHWAY AT HANAMAULU ROAD (NOVEMBER 2, 1993)	IV-10
8	LOCATIONS OF EXISTING AND FUTURE AIRCRAFT FLIGHT TRACKS IN PROJECT ENVIRONS	V-5
9	LOCATIONS OF CY 1994 AIRCRAFT NOISE CONTOURS IN PROJECT ENVIRONS	V-6
10	LOCATIONS OF CY 1995 AIRCRAFT NOISE CONTOURS FROM FAR PART 150 REPORT	V-7
11	LOCATIONS OF CY 1994 HELICOPTER NOISE CONTOURS IN PROJECT ENVIRONS	V-18
12	LOCATIONS OF CY 2010 AIRCRAFT NOISE CONTOURS FROM CURRENT STUDY EFFORT	VI-4
13	LOCATIONS OF CY 2010 HELICOPTER NOISE CONTOURS IN PROJECT ENVIRONS	VI-6

LIST OF FIGURES (CONTINUED)

NUMBER	FIGURE TITLE	PAGE NO.
14	CONSTRUCTION NOISE LEVELS VS. DISTANCE	VII-7

LIST OF TABLES

NUMBER	TABLE TITLE	PAGE NO.
1	EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)	III-2
2	STATE DEPARTMENT OF TRANSPORTATION RECOMMENDATIONS FOR LOCAL LAND USE COMPATIBILITY EXPRESSED IN YEARLY DAY-NIGHT AVERAGE SOUND LEVELS (Ldn)	II-5
3	TRAFFIC NOISE MEASUREMENT RESULTS	IV-3
4A	COMPARISONS OF CY 1994 AND CY 2016 TRAFFIC NOISE LEVELS ALONG ROADWAYS IN THE PROJECT ENVIRONS (PM PEAK HOUR AND 100 FT FROM ROADWAY CENTERLINES)	V-2
4B	EXISTING AND CY 2016 DISTANCES TO 60, 65, AND 70 LDN CONTOURS	V-3
5A	SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "A"	V-8
5B	SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "B"	V-9
5C	SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "C"	V-10
5D	SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "E"	V-11
5E	SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "F"	V-12
5F	SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "J"	V-13
5G	SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "K"	V-14
5H	SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "L"	V-15
5I	SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "M"	V-16
6	CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 2016)	VI-2

LIST OF TABLES (CONTINUED)

NUMBER	TABLE TITLE	PAGE NO.
7	AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE	VII-8

CHAPTER I. SUMMARY

The existing and future traffic noise levels in the vicinity of the proposed Lihue-Hanamaulu Master Plan Project on the island of Kauai, Hawaii were evaluated for their potential impact on present and future noise sensitive areas. The future traffic noise levels along the primary access roadways to the project were calculated for the Year 2016.

Along the existing roadways which are expected to service the project traffic, noise levels are expected to increase by 0.4 to 5.7 Ldn between CY 1994 and CY 2016 as a result of project traffic. These increases in traffic noise levels associated with project traffic range from the insignificant to the significant. Traffic noise increases due to project traffic are predicted to be less than the increases caused by non-project traffic on all roadways except Hoolako Street, and are expected to range from 2.5 to 3.1 Ldn. These increases in traffic noise levels associated with non-project traffic are considered to be significant. With or without the project, future traffic noise levels are expected to increase significantly along the roadways servicing the project, and traffic noise mitigation measures will be required.

Based on previously published FAR Part 150 aircraft noise contours for Lihue Airport, only non-residential portions of the project site are located inside of the 60 Ldn noise contour. More recently developed airport noise contours for CY 1994 and CY 2010, also indicate that planned residential or other noise sensitive uses within the petition area are located outside the airport's existing and forecasted 60 Ldn contours, and are in conformance with local planning guidelines for the siting of noise sensitive land uses in the vicinity of airports. Special aircraft noise attenuation measures should not be required for this project. The implementation of the airport noise disclosure provisions of Section 467-31, Hawaii Revised Statutes, 1988 will be necessary over the project areas which are contained within the FAR Part 150

noise contours which were developed for forecasted CY 1995 operations.

Special mitigation measures related to the noise from the existing asphalt concrete batch plant near the north end of the petition area may be required. Although industrial uses are planned in the immediate vicinity of the asphalt plant at the north end of the petition area, the low frequency noise emissions from the source may cause complaints from tenants of neighboring properties.

Unavoidable, but temporary, noise impacts may occur during the construction of the proposed project. Because construction activities are predicted to be audible at adjoining properties, the quality of the acoustic environment may be degraded to unacceptable levels during periods of construction. Mitigation measures to reduce construction noise to inaudible levels will not be practical in all cases. For this reason, the use of quiet equipment and construction curfew periods as required under the State Department of Health noise regulations are recommended to minimize construction noise impacts.

CHAPTER II. PURPOSE

The objectives of this study were to describe the existing and future noise environment in the environs of the proposed Lihue-Hanamaulu Master Plan Project on the island of Kauai, Hawaii. Traffic noise level increases and impacts associated with the proposed development were to be determined within the project site as well as along the public roadways expected to service the project traffic. A specific objective was to determine future traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases. Assessments of possible impacts from noise resulting from fixed and rotary wing aircraft operations at nearby Lihue Airport, from a nearby asphalt concrete plant, and from short term construction noise at the project site were also included in the noise study objectives. Recommendations for minimizing these noise impacts were also to be provided as required.

CHAPTER III. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

The noise descriptor currently used by federal agencies to assess environmental noise is the Day-Night Average Sound Level (Ldn). This descriptor incorporates a 24-hour average of instantaneous A-Weighted Sound Levels as read on a standard Sound Level Meter. By definition, the minimum averaging period for the Ldn descriptor is 24 hours. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the Ldn descriptor. A more complete list of noise descriptors is provided in **APPENDIX B** to this report.

TABLE 1, derived from **Reference 1**, presents current federal noise standards and acceptability criteria for residential land uses. Land use compatibility guidelines for various levels of environmental noise as measured by the Ldn descriptor system are shown in **FIGURE 1**. As a general rule, noise levels of 55 Ldn or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, Ldn levels generally range from 55 to 65 Ldn, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 Ldn, and as high as 75 Ldn when the roadway is a high speed freeway. Due to noise shielding effects from intervening structures, interior lots are usually exposed to 3 to 10 Ldn lower noise levels than the front lots which are not shielded from the traffic noise.

For the purposes of determining noise acceptability for funding assistance from federal agencies (FHA/HUD and VA), an exterior noise level of 65 Ldn or lower is considered acceptable. This standard is applied nationally (**Reference 2**), including Hawaii. Because of our open-living conditions, the predominant use of naturally ventilated dwellings, and the relatively low exterior-to-

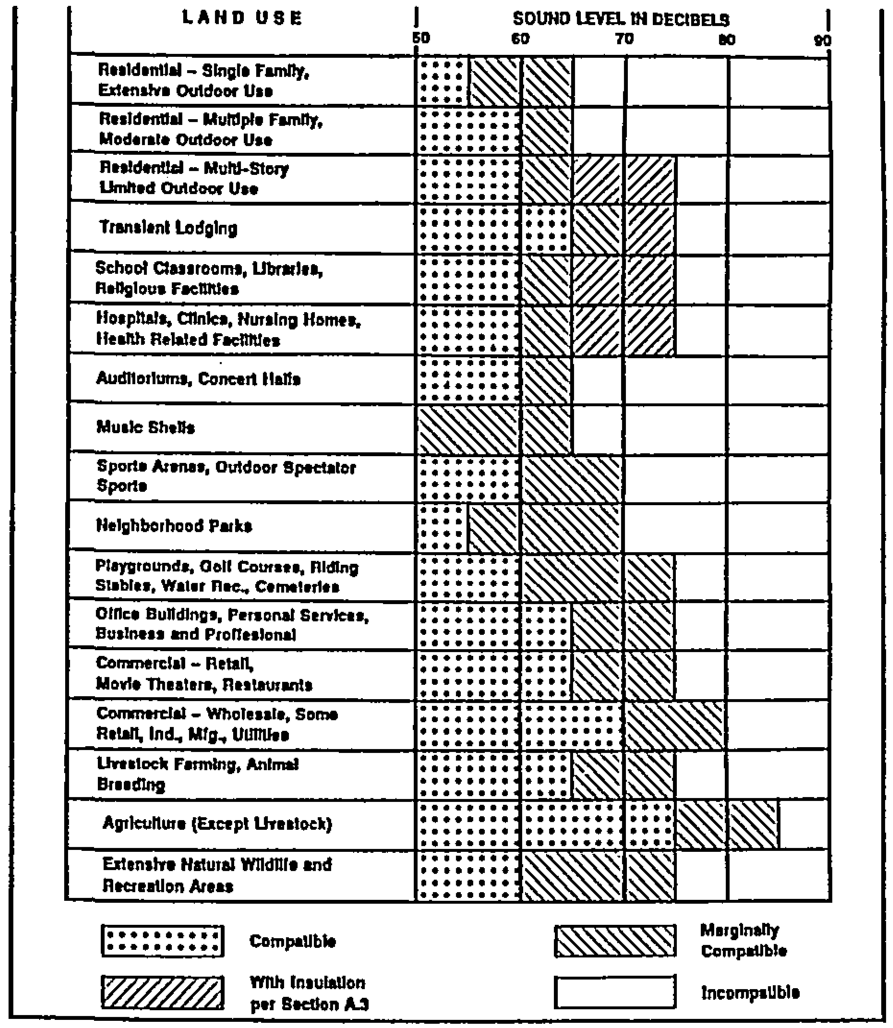
TABLE 1

EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

NOISE EXPOSURE CLASS	DAY-NIGHT SOUND LEVEL	EQUIVALENT SOUND LEVEL	FEDERAL[1] STANDARD
Minimal Exposure	Not Exceeding 55 L_{dn}	Not Exceeding 55 L_{eq}	Unconditionally Acceptable
Moderate Exposure	Above 55 L_{dn} But Not Above 65 L_{dn}	Above 55 L_{eq} But Not Above 65 L_{eq}	Acceptable[2]
Significant Exposure	Above 65 L_{dn} But Not Above 75 L_{dn}	Above 65 L_{eq} But Not Above 75 L_{eq}	Normally Unacceptable
Severe Exposure	Above 75 L_{dn}	Above 75 L_{eq}	Unacceptable

Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

(2) FHWA uses the L_{eq} instead of the L_{dn} descriptor. For planning purposes, both are equivalent if: (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours, and (b) traffic between 10:00 PM and 7:00 AM does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours. The noise mitigation threshold used by FHWA for residences is 67 L_{eq}.



LAND USE COMPATIBILITY
WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVEL
AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED
(Source: American National Standards Institute S3.23-1980)

FIGURE 1

interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 Ldn does not eliminate all risks of noise impacts. Because of these factors, and as recommended in **Reference 3**, a lower level of 55 Ldn is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise. However, after considering the cost and feasibility of applying the lower level of 55 Ldn, government agencies such as FHA/HUD and VA have selected 65 Ldn as a more appropriate regulatory standard.

For aircraft noise, the State Department of Transportation, Airports Division, has recommended that 60 Ldn be used as the common level for determining land use compatibility in respect to noise sensitive uses near its airports. **TABLE 2** presents the current land use compatibility guidelines which have been recommended for use around the Hawaii State airports. It should be noted that for residential and certain public uses (schools, day-care centers, libraries, and churches), aircraft noise levels less than 60 Ldn are considered to be compatible in **TABLE 2**. In order to further reduce risks of adverse noise impacts from airport noise in the State of Hawaii, **Reference 4** requires that disclosure of the airport noise levels be provided prior to real property transactions concerning properties located within Air Installation Compatibility Use Zones (AICUZ) or located within airport noise maps developed under Federal Aviation Regulation Part 150 - Airport Noise Compatibility Planning (14 CFR Part 150).

Table 2 State Department of Transportation Recommendations for Local Land Use Compatibility Expressed in Yearly Day-Night Average Sound Levels (Ldn).

TYPE OF LAND USE	Yearly Day-Night Average Sound Level					
	≤ 60	60-65	65-70	70-75	75-80	80-85
RESIDENTIAL:						
Low density residential, resorts, and hotels (outdoor facil.)	Y(a)	N(b)	N	N	N	N
Low density apartment with moderate outdoor use	Y	N(b)	N	N	N	N
High density apartment with limited outdoor use	Y	N(b)	N(b)	N	N	N
Transient lodgings with limited outdoor use	Y	N(b)	N(b)	N	N	N
PUBLIC USE:						
Schools, day-care centers, libraries, and churches	Y	N(c)	N(c)	N(c)	N	N
Hospitals, nursing homes, clinics, and health facilities	Y	Y(d)	Y(d)	Y(d)	N	N
Indoor auditoriums and concert halls	Y(c)	Y(c)	N	N	N	N
Government services and office buildings serving the public	Y	Y	Y(d)	Y(d)	N	N
Transportation and Parking	Y	Y	Y(d)	Y(d)	Y(d)	Y(d)
COMMERCIAL AND GOVERNMENT USE:						
Offices - government, business, and professional	Y	Y	Y(d)	Y(d)	N	N
Wholesale and retail - bldg.mater., hardware, & heavy equip..	Y	Y	Y(d)	Y(d)	Y(d)	Y(d)
Airport businesses - car rental, lei stands, ticketing, etc..	Y	Y	Y(d)	Y(d)	N	N
Retail, restaurants, shopping centers, financial inst., etc..	Y	Y	Y(d)	Y(d)	N	N
Power plants, sewage treatment plants, and base yards	Y	Y	Y(d)	Y(d)	Y(d)	N
Studios without outdoor sets, broadcasting, prod. facilities.	Y(c)	Y(c)	N	N	N	N
MANUFACTURING, PRODUCTION AND STORAGE:						
Manufacturing, general	Y	Y	Y(d)	Y(d)	Y(d)	N
Photographic and optical	Y	Y	Y(d)	Y(d)	N	N
Agriculture (except livestock) and forestry	Y	Y(e)	Y(e)	Y(e)	Y(e)	Y(e)
Livestock farming and breeding	Y	Y(e)	Y(e)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL USE:						
Outdoor sports arenas and spectator sports	Y	Y(f)	Y(f)	N	N	N
Outdoor music shells, amphitheaters	Y(f)	N	N	N	N	N
Nature exhibits and zoos, neighborhood parks	Y	Y	Y	N	N	N
Amusements, beach parks, active playgrounds, etc.	Y	Y	Y	Y	N	N
Public golf courses, riding stables, cemeteries, gardens, etc.	Y	Y	N	N	N	N
Professional/resort sport facilities, media event fac., etc..	Y(f)	N	N	N	N	N
Extensive natural wildlife and recreation areas	Y(f)	N	N	N	N	N

Numbers in parentheses refer to notes.

KEY TO TABLE 2

Y(Yes) = Land Use and related structures compatible without restrictions.
N(No) = Land Use and related structures are not compatible and should be prohibited.

Table 2 (Continued). State Department of Transportation Recommendations for Local Land Use Compatibility Expressed in Yearly Day-Night Average Sound Levels (Ldn).

NOTES FOR TABLE 2

(a) A noise level of 60 Ldn does not eliminate all risks of adverse noise impacts from aircraft noise. However, the 60 Ldn planning level has been selected by the State Airports Division as an appropriate compromise between the minimal risk level of 55 Ldn and the significant risk level of 65 Ldn.

(b) Where the community determines that these uses must be allowed, Noise Level Reduction (NLR) measures to achieve interior levels of 45 Ldn or less should be incorporated into building codes and be considered in individual approvals. Normal local construction employing natural ventilation can be expected to provide an average NLR of approximately 9 dB. Total closure plus air conditioning may be required to provide additional outdoor to indoor NLR, and will not eliminate outdoor noise problems.

(c) Because the Ldn noise descriptor system represents a 24-hour average of individual aircraft noise events, each of which can be unique in respect to amplitude, duration, and tonal content, the NLR requirements should be evaluated for the specific land use, interior acoustical requirements, and properties of the aircraft noise events. NLR requirements should not be based solely upon the exterior Ldn exposure level.

(d) Measures to achieve required NLR must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

(e) Residential buildings require NLR. Residential buildings should not be located where noise is greater than 65 Ldn.

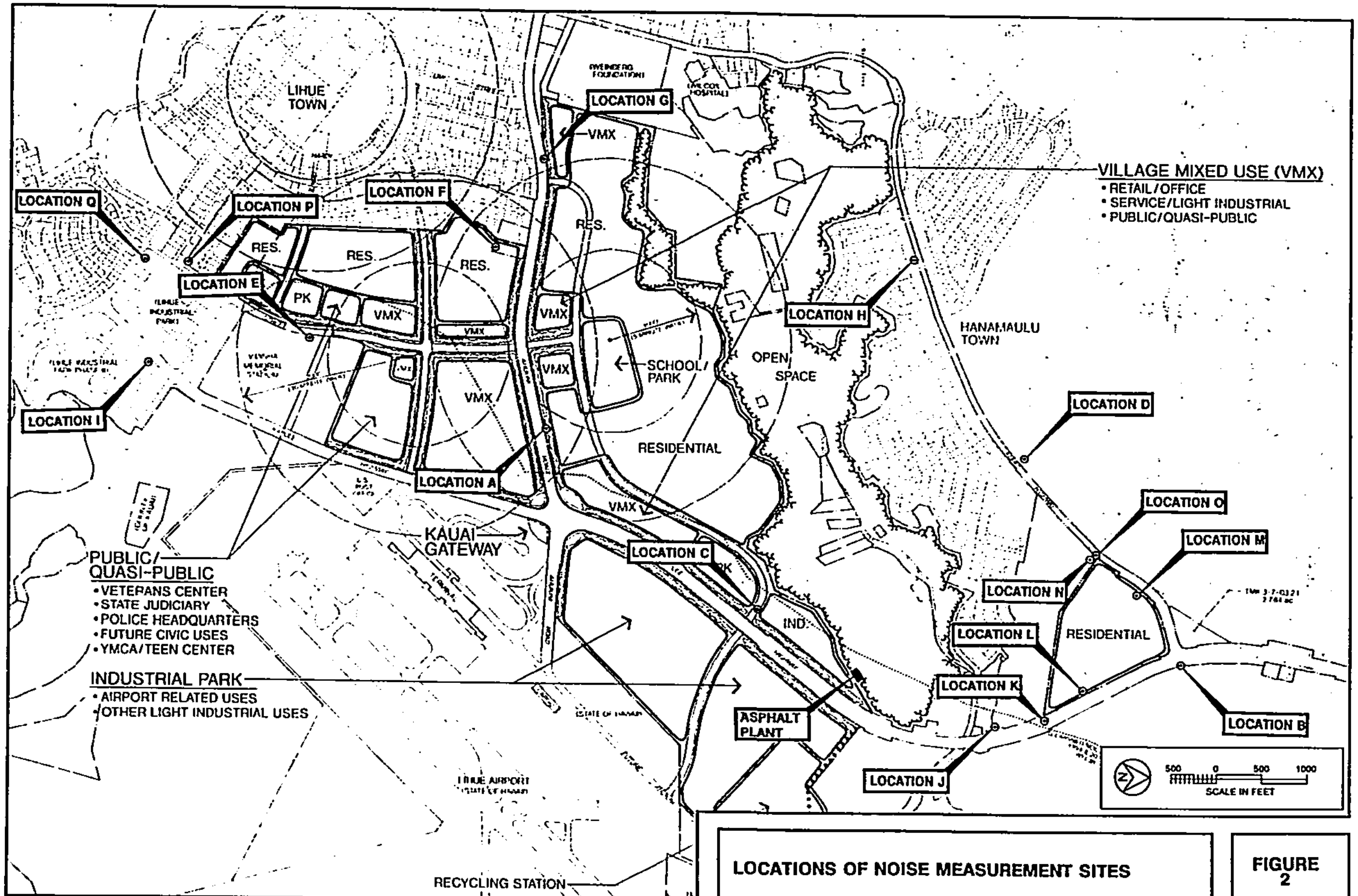
(f) Impact of amplitude, duration, frequency, and tonal content of aircraft noise events should be evaluated.

CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing traffic and aircraft noise levels were measured at various locations in the project environs to provide a basis for developing the traffic noise contours along the roadways which will service the proposed development: Ahukini Road, Kapule Highway, Hanamaulu-Ahukini Cutoff Road, Rice Street, Hoolako Street, and Kuhio Highway; and for validating and updating the aircraft noise contours previously developed during the FAR Part 150 Noise Compatibility Program for Lihue Airport (Reference 5).

The locations of the measurement sites are shown in FIGURE 2. Noise measurements were performed during the latter parts of CY 1989 and 1990 (prior to Hurricane Iniki) and during the months of May and August 1994. The traffic noise measurement results, and their comparisons with computer model predictions of existing traffic noise levels are summarized in TABLE 3. The results of the traffic noise measurements were compared with calculations of existing traffic noise levels to validate the computer model used.

Traffic noise calculations for the existing conditions as well as noise predictions for the future conditions with and without the project were performed using the Federal Highway Administration (FHWA) Noise Prediction Model (Reference 6). Traffic data entered into the noise prediction model were: hourly traffic volumes, average vehicle speeds, estimates of traffic mix, and soft ground propagation loss factor. The traffic study for the project (Reference 7) and Hawaii State Department of Transportation counts (References 8 and 9) were the primary sources of data inputs to the model. For existing and future traffic, it was assumed that the average noise levels, or Leq(h), during the PM peak hour were 0.5 dB less than the 24-hour Ldn along each roadway segment. These assumptions were based on computations of both the hourly Leq and the 24-hour Ldn of traffic noise on Ahukini Road, Kapule Highway, Kuhio Highway, and Hanamaulu-Ahukini Cutoff Road (see FIGURES 3 thru 7).



LOCATIONS OF NOISE MEASUREMENT SITES

FIGURE 2

TABLE 3

TRAFFIC NOISE MEASUREMENT RESULTS

LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	--Hourly Traffic Volume-- AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
A. 50 FT from the center-line of Ahukini Rd. (5/17/94)	1600 TO 1700	41	957	46	14	64.8	64.6
C. 50 FT from the center-line of Hanamaulu-Ahukini Cutoff Rd. (5/17/94)	1600 TO 1700	47	1,543	19	31	66.9 *	67.4
C. 50 FT from the center-line of Hanamaulu-Ahukini Cutoff Rd. (5/19/94)	1345 TO 1445	47	1,209	31	64	67.2 *	68.4
D. 50 FT from the center-line of Kuhio Hwy. (5/19/94)	1100 TO 1200	40	954	19	12	63.9	63.3
G. 50 FT from the center-line of Ahukini Rd. at Palai St. (10/10/90)	1515 TO 1615	47	714	38	12	65.9	65.6
H. 50 FT from the center-line of Kuhio Hwy. at Nuku St. (10/8/90)	1630 TO 1730	44	1,296	28	6	65.4	65.2
I. 50 FT from the center-line of Kapule Hwy. at Stadium. (10/10/90)	1630 TO 1730	55	864	44	20	69.2	69.0
K. 55 FT from the center-line of Hanamaulu-Ahukini Cutoff Rd. (12/22/89)	1550 TO 1700	50	1,199	12	5	65.2	65.5
L. 105 FT from the center-line of Hanamaulu-Ahukini Cutoff Rd. (12/21/89)	1420 TO 1555	47	1,151	23	20	60.0 *	61.4
N. 100 FT from the center-line of Kuhio Hwy. (12/21/89)	1607 TO 1630	40	1,220	8	4	60.5	60.1
O. 50 FT from the center-line of Kuhio Hwy. (12/21/89)	1630 TO 1707	45	1,040	4	4	65.7	65.7
P. 50 FT from the center-line of Hoolako Street. (8/10/94)	1455 TO 1555	30	273	7	6	58.9	59.0
Q. 55 FT from the center-line of Rice Street. (8/10/94)	1600 TO 1700	35	1,019	5	7	62.4	62.2

NOTE:
* Partial shielding of road noise was present at measurement Location.

FIGURE 3

HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF HANAMAULU-AHUKINI CUTOFF ROAD AT AHUKINI ROAD (NOVEMBER 3, 1993)

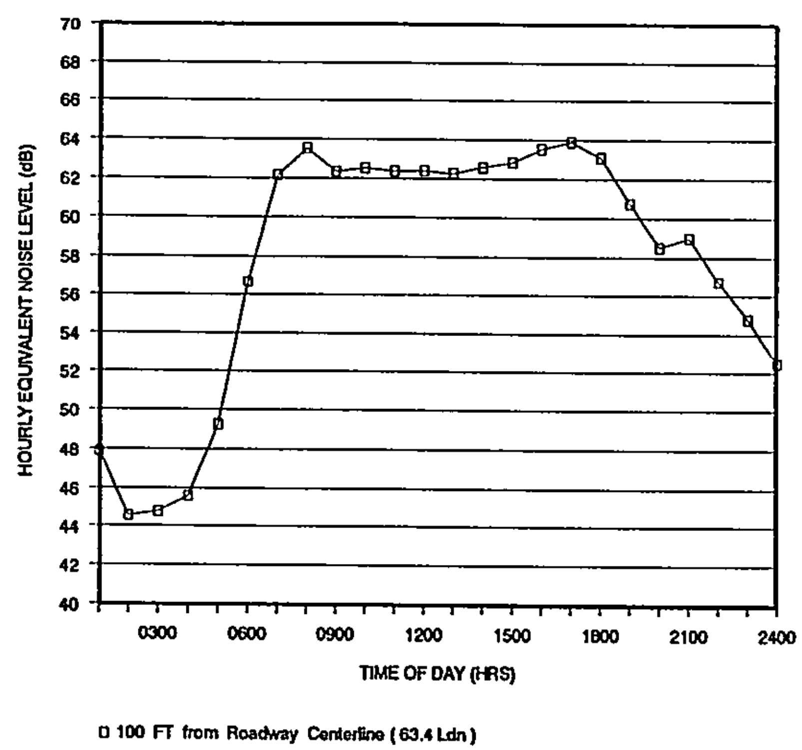


FIGURE 4

HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF AHUKINI ROAD (WEST LEG) AT KAPULE HIGHWAY (NOVEMBER 1, 1993)

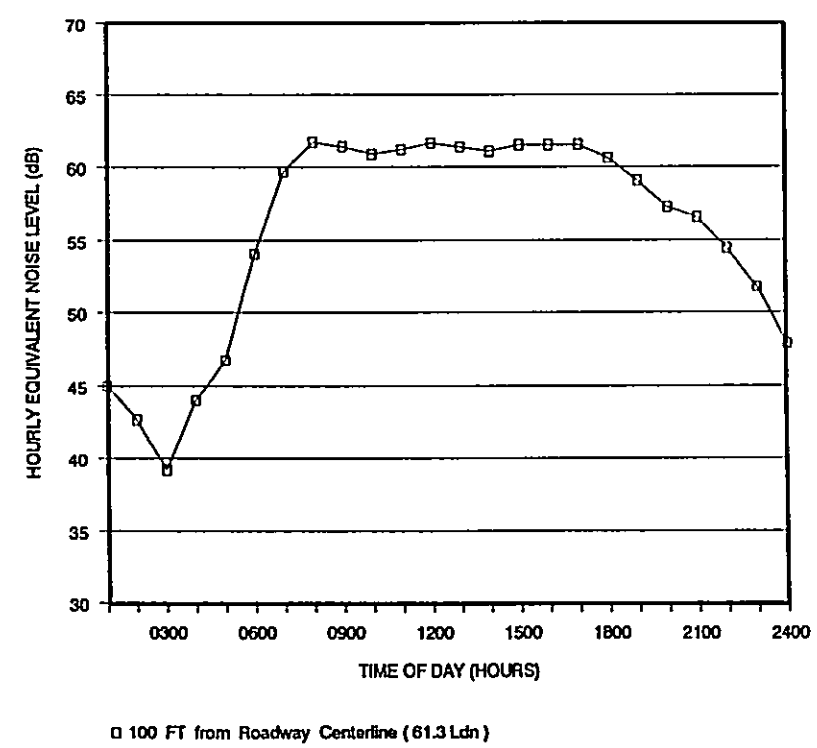


FIGURE 5

HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF KAPULE HIGHWAY AT AHUKINI ROAD (NOVEMBER 3, 1993)

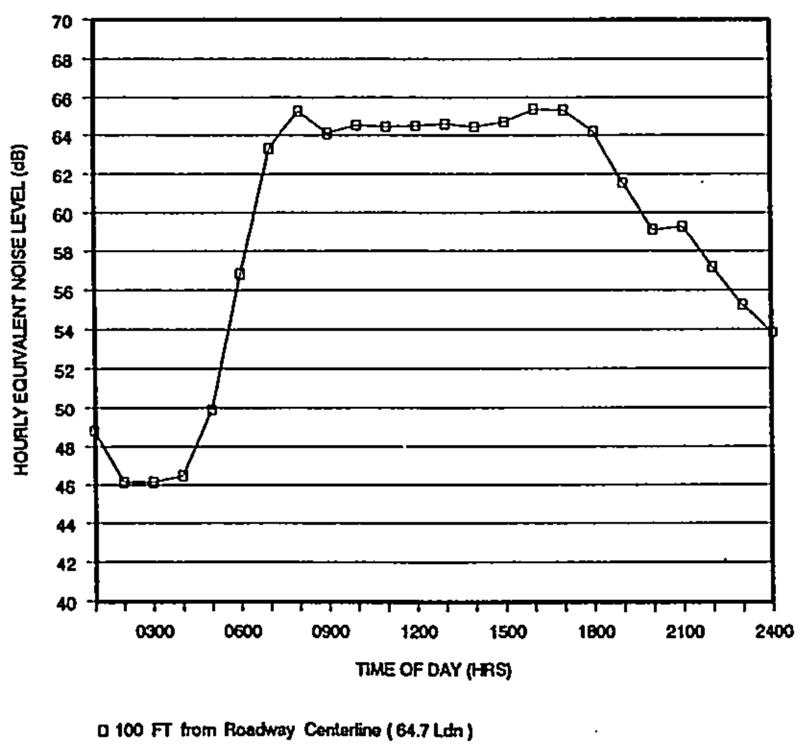


FIGURE 6

HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF AHUKINI ROAD (EAST LEG) AT KAPULE HIGHWAY (NOVEMBER 1, 1993)

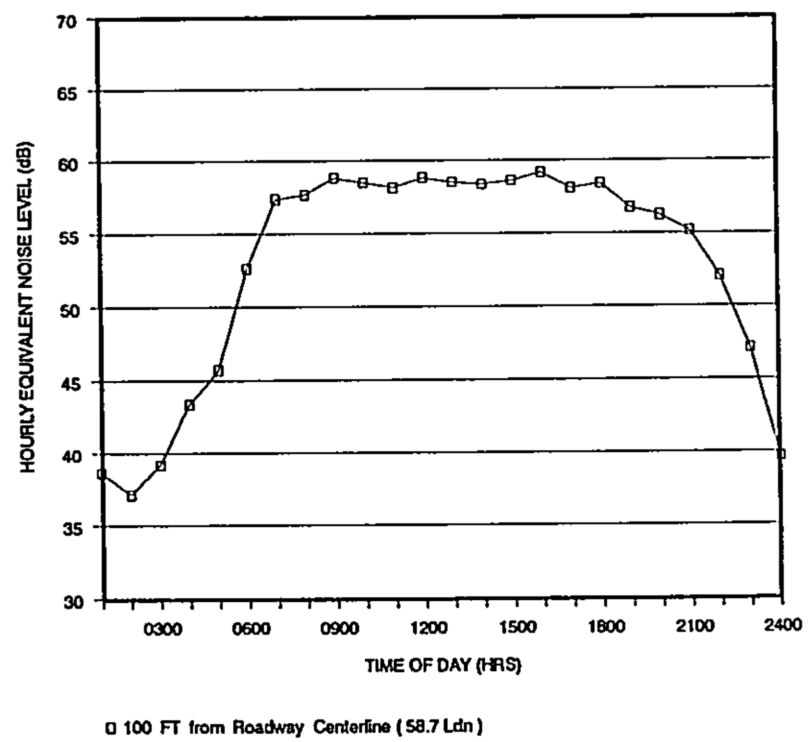
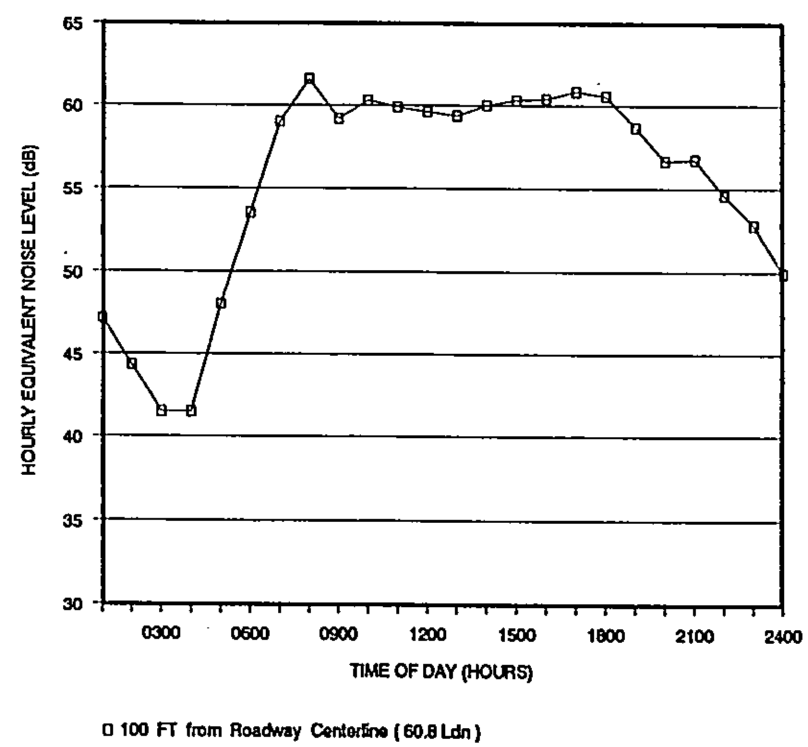


FIGURE 7

HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF KUHIO HIGHWAY AT HANAMAULU ROAD (NOVEMBER 2, 1993)



Traffic noise calculations for both the existing and future conditions in the project environs were developed for ground level receptors without the benefit of shielding effects. Traffic assignments with and without the project were obtained from the project's traffic study (**Reference 7**). The forecasted increases in traffic noise levels over existing levels were calculated for both scenarios, and noise impact risks evaluated. The relative contributions of non-project and project related traffic to the total noise levels were also calculated, and an evaluation was made of possible traffic noise impacts resulting from the project.

Aircraft noise measurements were obtained at Sites "A," "B," "C," "E," "F," "J," "K," and "L" (see **FIGURE 2**). Aircraft noise measurements were made to confirm that single event noise levels associated with fixed and rotary wing aircraft operations at Lihue Airport were consistent with the noise data and contours for Lihue Airport which were developed during the FAR Part 150 Program for CY 1995, as well as those aircraft noise contours developed this study. The recently released Federal Aviation Administration Integrated Noise Model, Version 4.11 (FAA INM) was used to develop aircraft and helicopter noise contours over the project site. The on-site measurements were also performed to confirm helicopter and light aircraft flight tracks in the project environs, which were originally reported in **Reference 5**. In addition, 1994 airline passenger and cargo flight schedules were also used to obtain the best estimate of the aircraft operations at Lihue Airport during CY 1994. The CY 1994 operations by jet and helicopter aircraft at Lihue Airport were estimated to be 55,480 and 51,504, respectively. The percentage of quieter Stage 3 jet aircraft was estimated to be 16 percent of the total jet aircraft operations in CY 1994.

The CY 2010 passenger and aircraft operations forecasts for Lihue Airport (**Reference 10**) were used to develop the future aircraft noise contours in the project environs. By CY 2010, it was assumed that the existing seaward airport Runway 35-17 would be extended by 3,500 FT to a total length of 10,000 FT as has been proposed by the State Department of Transportation, Airports Division. The CY 1994 operations by jet and helicopter aircraft at Lihue Airport were estimated to be 60,730 and 80,000, respectively. The percentage of quieter Stage 3 jet aircraft was assumed to be 80 percent of the total jet aircraft operations by CY 2010.

Airport noise contours with and without the existing Interim Helicopter Facility were developed with the FAA INM for CY 2010. In addition, helicopter noise contours for CY 1994 and CY 2010 were also developed for completeness. Potential impacts of fixed and rotary wing aircraft noise on the planned land uses of the proposed project were evaluated and mitigation measures recommended.

CHAPTER V. EXISTING NOISE ENVIRONMENT

Traffic Noise. The existing traffic noise levels in the project environs vary from levels of approximately 67 Ldn along Rice Street, Kapule Highway, and Kuhio Highway, to less than 55 Ldn at the interior locations of the project site which are removed from the high volume roadways. Existing traffic noise levels along the Rights-of-Way of Ahukini Road and Hoolako Street are approximately 65 Ldn or less. Traffic noise levels along the Hanamaulu-Ahukini Cutoff Road's Right-of-Way are approximately 65 Ldn.

Calculations of existing traffic noise levels during the PM peak traffic hour are presented in **TABLE 4A**. The hourly Leq (or Equivalent Sound Level) contribution from each roadway section in the project environs was calculated for comparison with forecasted traffic noise levels with and without the project. The existing setback distances from the roadways' centerlines to their associated 60, 65, and 70 Ldn contours were also calculated as shown in **TABLE 4B**. The contour line setback distances do not take into account noise shielding effects or the additive contributions of traffic noise from intersecting street sections. Based on the results of **TABLE 4B**, it was concluded that the existing 65 Ldn traffic noise contours do not extend into the residential areas of the proposed Lihue-Hanamaulu Master Plan, except at the Hanamaulu Triangle area along Kuhio Highway.

Existing traffic noise levels at the interior portions of the project site are low (less than 55 Ldn) due to their large setback distances from the high volume roadways which cross through the project area. At these interior locations on the project site, aircraft noise is the dominant noise source. A discussion of existing aircraft noise levels on the project site is provided in the following section. Between aircraft noise events, background ambient noise levels drop to a range of 40 to 45 dB. During calm wind periods, background ambient noise levels decrease to levels

TABLE 4A

COMPARISONS OF CY 1994 AND CY 2016 TRAFFIC NOISE LEVELS ALONG ROADWAYS IN THE PROJECT ENVIRONS (PM PEAK HOUR AND 100 FT FROM ROADWAY CENTERLINES)

LOCATION	SPEED (MPH)	VPH	****** HOURLY LEQ IN dB ****** AUTO	MT	HT	ALL VEH
EXISTING (CY 1994) PM PEAK HOUR:						
Kapule Highway (South End)	55	1,081	61.5	59.2	60.6	65.3
Kapule Highway (North End)	55	1,106	61.6	59.3	60.7	65.4
Hanamaulu–Ahukini Cutoff Rd (S)	47	1,468	60.3	54.7	59.8	63.7
Hanamaulu–Ahukini Cutoff Rd (N)	47	1,477	60.4	54.7	59.8	63.7
Ahukini Rd. West of Kapule Hwy.	47	927	58.3	56.7	54.3	61.5
Ahukini Rd. East of Kuhio Hwy.	47	790	57.6	56.0	53.6	60.8
Kuhio Hwy. SW of Cutoff Road	40	1,082	58.4	53.0	57.0	61.5
Hoolako Street	30	278	49.8	44.9	51.3	54.2
Rice St. West of Hoolako St.	30	1,171	54.6	46.6	53.0	57.3
Rice St. West of Kapule Hwy.	35	1,024	56.6	48.3	54.1	58.9
Rice St. East of Kapule Hwy.	35	1,016	56.4	51.3	57.1	60.4
FUTURE (CY 2016) PM PEAK HOUR WITH PROJECT:						
Kapule Highway (South End)	55	2,993	66.0	63.6	65.1	69.8
Kapule Highway (North End)	55	3,136	66.2	63.8	65.3	70.0
Hanamaulu–Ahukini Cutoff Rd (S)	47	4,271	65.0	59.3	64.4	68.3
Hanamaulu–Ahukini Cutoff Rd (N)	47	4,396	65.1	59.5	64.5	68.4
Ahukini Rd. West of Kapule Hwy.	47	3,012	63.4	61.8	59.4	66.6
Ahukini Rd. East of Kuhio Hwy.	47	3,152	63.6	62.0	59.6	66.8
Kuhio Hwy. SW of Cutoff Road	40	2,386	61.9	56.4	60.5	64.9
Hoolako Street	30	1,839	58.0	53.1	59.5	62.4
Rice St. West of Hoolako St.	30	3,405	59.2	51.2	57.7	61.9
Rice St. West of Kapule Hwy.	35	2,349	60.2	51.9	57.7	62.5
Rice St. East of Kapule Hwy.	35	2,810	60.9	55.7	61.5	64.8

Note:

The following assumed traffic mixes of autos, medium trucks, and heavy vehicles were used for existing and future conditions:

(a) Kapule Highway: 93.0% Autos; 4.5% Medium Trucks; and 2.5% Heavy Trucks and Buses.
(b) Ahukini Road: 94.0% Autos; 5.0% Medium Trucks; and 1.0% Heavy Trucks and Buses.
(c) Kuhio Highway: 96.5% Autos; 2.0% Medium Trucks; and 1.5% Heavy Trucks and Buses.
(d) Hanamaulu–Ahukini Bypass Road: 94.5% Autos; 2.0% Medium Trucks; and 3.5% Heavy Trucks and Buses.
(e) Rice Street (West End): 98.0% Autos; 1.0% Medium Trucks; and 1.0% Heavy Trucks and Buses.
(f) Rice Street (East End): 96.0% Autos; 2.0% Medium Trucks; and 2.0% Heavy Trucks and Buses.
(g) Hoolako Street: 96.0% Autos; 2.0% Medium Trucks; and 2.0% Heavy Trucks and Buses.

TABLE 4B

EXISTING AND CY 2016 DISTANCES TO 60, 65, AND 70 Ldn CONTOURS

STREET SECTION	60 Ldn SETBACK (FT) EXISTING	CY 2016	65 Ldn SETBACK (FT) EXISTING	CY 2016	70 Ldn SETBACK (FT) EXISTING	CY 2016
Kapule Highway (South End)	245	483	114	224	53	104
Kapule Highway (North End)	249	498	115	231	54	107
Hanamaulu–Ahukini Cutoff Rd (S)	189	386	88	179	41	83
Hanamaulu–Ahukini Cutoff Rd (N)	190	393	88	182	41	85
Ahukini Rd. West of Kapule Hwy.	136	298	63	139	29	64
Ahukini Rd. East of Kuhio Hwy.	122	308	57	143	26	66
Kuhio Hwy. SW of Cutoff Road	135	229	63	106	29	49
Hoolako Street	44	155	20	72	9	33
Rice St. West of Hoolako St.	71	145	33	67	15	31
Rice St. West of Kapule Hwy.	91	159	42	74	20	34
Rice St. East of Kapule Hwy.	114	224	53	104	25	48

Notes:

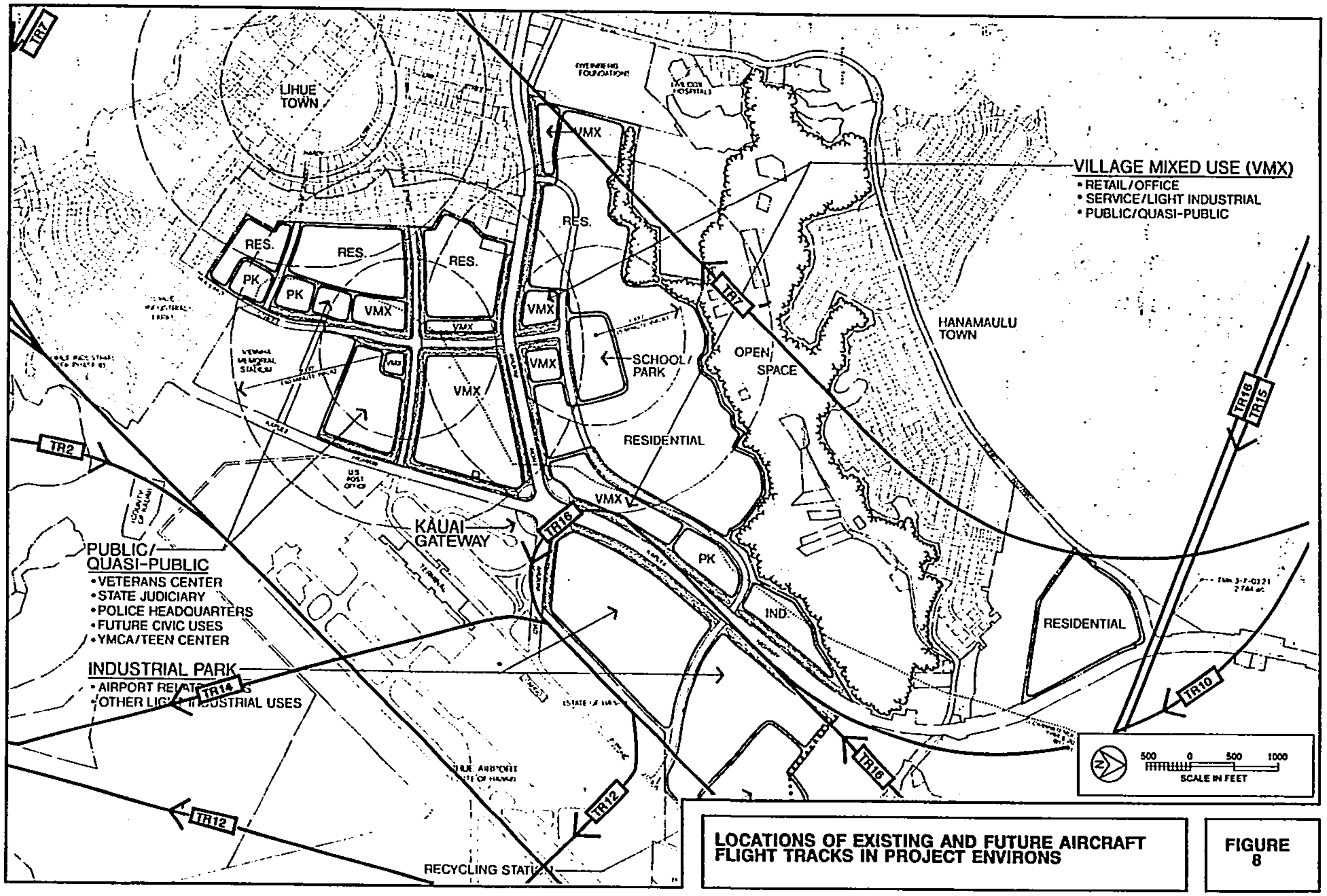
(1) All setback distances are from the roadways' centerlines.
(2) See TABLE 4A for traffic volume, speed, and mix assumptions.
(3) Ldn assumed to be equal to PM Peak Hour Leq plus 0.5 dB along all roadways.
(4) Setback distances are for unobstructed line–of–sight conditions.
(5) Soft ground conditions assumed along all roadways.

less than 40 dB. The minimum background ambient noise levels at these interior locations are controlled by distant traffic and wind noise.

Aircraft Noise. Aircraft noise sources in the project environs are associated with fixed and rotary wing aircraft operations at Lihue Airport. FIGURE 8 depicts aircraft flight tracks in the project environs, which were similar to those reported in Reference 5. Helicopter arrival tracks to the Interim Helicopter Facility are shown as Tracks TR10, TR15, and TR16. Helicopter departure tracks to the southeast are shown as Tracks TR12 and TR14. Track TR7 is used primarily by fixed wing, propeller aircraft which arrive from the northwest. The noisier jet aircraft flight tracks remain east of the project site and are aligned with Lihue Airport's two runways (Runway 03-21 and Runway 35-17).

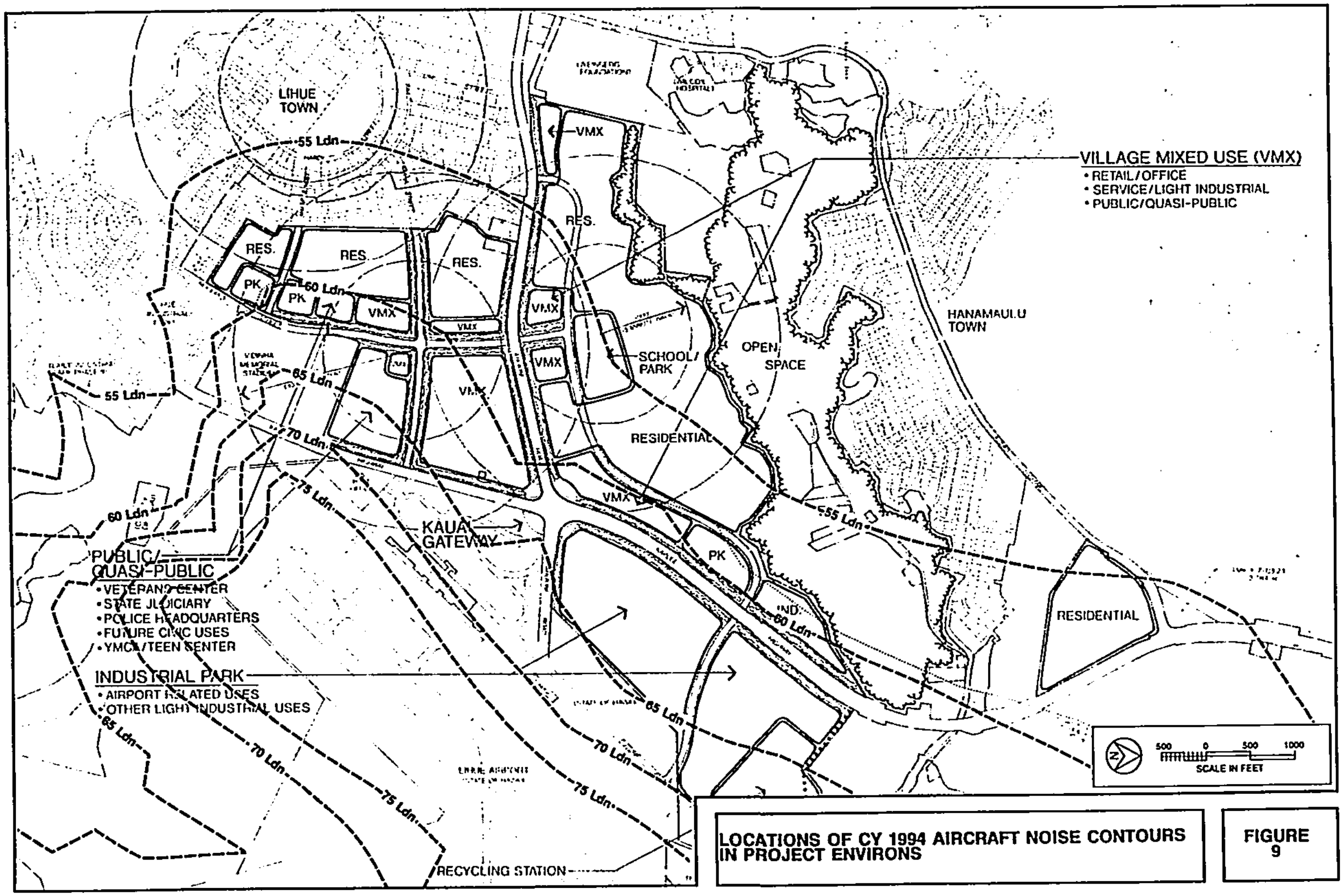
FIGURE 9 depicts the locations of the existing 55 thru 75 Ldn aircraft noise contours for the CY 1994 period. These noise contours were developed using current airline flight schedules, and are approximately 3 to 4 Ldn larger than the CY 1995 noise contours (FIGURE 10) developed during the Lihue Airport FAR Part 150 effort (Reference 5). Although the CY 1994 noise contours of FIGURE 9 are slightly larger than those contained within the FAR Part 150 Study Report, existing aircraft noise levels do not exceed 60 Ldn at planned residential or other noise sensitive areas of the project site, and as such, are considered to be in the "Acceptable" category for the planned land uses on the project site.

TABLES 5A thru 5I summarize the results of the aircraft noise measurements obtained at locations on or adjacent to planned noise sensitive uses of the project. These aircraft noise measurements were used to validate the FAA Integrated Noise Model, Version 4.11, which was used in this study to develop the aircraft noise contours for Lihue Airport. The comparisons between the measured and predicted aircraft noise levels are shown in the "Sound Expo-



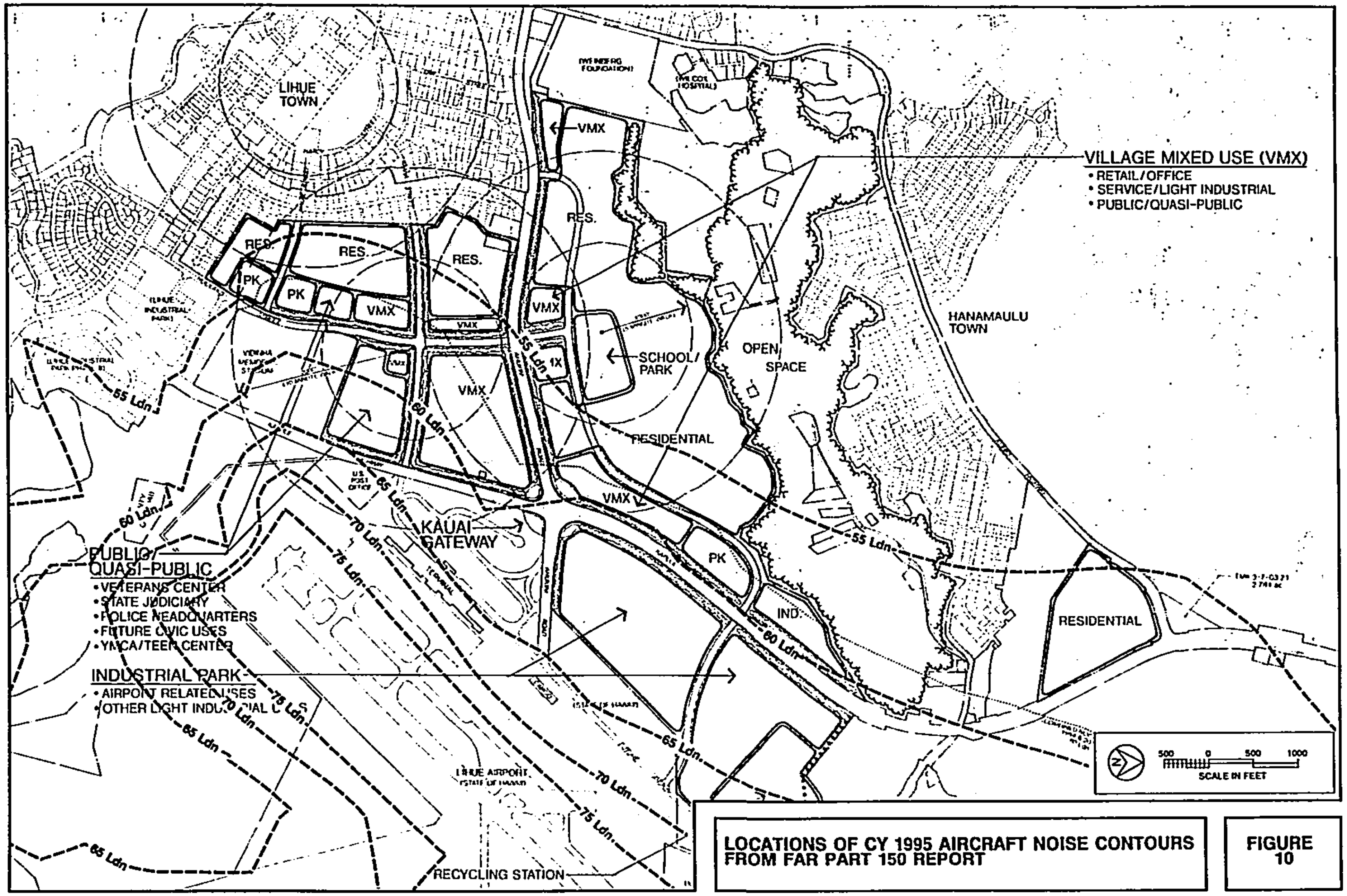
LOCATIONS OF EXISTING AND FUTURE AIRCRAFT FLIGHT TRACKS IN PROJECT ENVIRONS

FIGURE 8



LOCATIONS OF CY 1994 AIRCRAFT NOISE CONTOURS IN PROJECT ENVIRONS

FIGURE 9



LOCATIONS OF CY 1995 AIRCRAFT NOISE CONTOURS FROM FAR PART 150 REPORT

FIGURE 10

TABLE 5A

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "A"

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200)	74.3; 78.4; 77.7; 80.7; 77.8; 73.6; 76.5; 81.1 (AVG.=77.5)	83.5; 83.8; 87.6; 86.5; 85.0; 83.7; 82.0; 89.1 (AVG.=85.8) (PRED.=86.3)
B-737(300)	69.9; 69.1 (AVG.=69.5)	76.0; 76.5 (AVG.=76.3) (PRED.=72.3)
DC-9(50)	81.5; 79.4; 81.1; 81.9; 82.4; 83.8; 80.1 (AVG.=81.5)	89.2; 87.5; 90.0; 89.8; 87.9; 90.1; 88.6 (AVG.=89.1) (PRED.=89.7)
HELICOPTER	67.3; 73.1; 78.7; 67.8; 68.4; 68.0; 67.9; 75.8; 70.3; 69.1; 72.0; 67.7; 68.0; 68.4; 68.5; 69.5; 65.9; 72.3; 66.4; 66.7; 67.5; 65.4; 69.8; 68.2; 68.0; 66.1; 68.4; 67.6; 68.4; 70.1; 66.6; 71.3; 69.0; 66.6; 70.9; 69.7; 66.0; 64.4; 67.7; 72.8; 67.9; 72.9; 71.4; 67.7; 65.1; 69.0 (AVG.=68.9)	74.7; 77.4; 73.9; 71.4; 74.3; 75.6; 74.1; 83.7; 72.5; 74.2; 76.8; 72.6; 74.2; 73.1; 72.7; 71.4; 73.0; 77.6; 71.9; 72.9; 71.7; 74.5; 76.7; 71.8; 76.9; 74.7; 71.1; 69.3; 72.7; 72.7; 71.0; 75.3; 73.4; 75.0; 76.1; 75.8; 74.8; 72.6; 71.8; 76.7; 70.5; 74.9; 76.2; 74.8; 71.8; 75.6 (AVG.=75.0) (PRED.=76.1)

TABLE 5B

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "B"

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200)	75.9	81.4 (PRED.=83.1)
B-737(300)	69.9	78.7 (PRED.=68.8)
DC-9(50)	81.6; 77.7 (AVG.=79.7)	86.5; 83.8 (AVG.=85.4) (PRED.=86.2)
HELICOPTER	74.8; 73.9; 74.2; 74.6; 72.6; 74.4; 75.6; 75.6; 72.7; 75.9; 69.2; 68.6; 76.9 (AVG.=73.8)	81.2; 82.2; 81.2; 81.5; 81.2; 81.3; 84.0; 83.6; 81.5; 82.6; 79.7; 76.5; 82.7 (AVG.=81.8) (PRED.=82.2)

TABLE 5C

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "C"

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200)	76.5; 81.2; 78.7; 81.0 (AVG.79.4)	85.5; 86.9; 87.4; 85.3 (AVG.=86.4) (PRED.=86.4)
B-737(300)	67.6; 74.4 (AVG.=71.0)	76.5; 80.5 (AVG.=78.9) (PRED.=71.7)
DC-9(50)	81.9; 79.3; 81.7; 84.0; 79.8 (AVG.=81.3)	85.9; 87.6; 88.7; 89.9; 88.1 (AVG.=88.2) (PRED.=88.3)
HELICOPTER	85.8; 77.8; 86.6; 78.7; 78.3; 73.2; 76.6; 78.0; 75.7; 73.9; 83.1; 79.4; 73.2; 81.2; 77.3; 82.0; 90.6; 79.9; 76.7; 82.9; 76.1; 77.5; 73.6; 79.9; 79.9; 83.0; 78.6; 83.0; 80.3; 82.8; 78.2; 80.1; 75.8; 73.7; 77.3; 78.3; 88.1; 80.6; 79.2; 81.2; 75.2; 75.6; 77.7; 77.7; 80.5; 74.3; 74.9; 79.6; 78.3 (AVG.=79.0)	89.4; 85.2; 92.6; 87.8; 85.5; 78.5; 82.0; 83.9; 82.9; 77.6; 88.9; 85.4; 82.0; 88.1; 83.6; 88.4; 93.8; 86.3; 84.3; 88.8; 83.3; 84.8; 80.5; 85.8; 86.0; 89.6; 84.6; 86.6; 86.3; 88.3; 84.4; 86.2; 84.2; 80.0; 84.3; 85.5; 91.0; 84.6; 84.8; 87.8; 84.0; 82.9; 84.1; 84.6; 85.1; 81.7; 83.2; 86.6; 83.3 (AVG.=86.5) (PRED.=88.7)

TABLE 5D

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "E"

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200)	83.2; 79.8; 82.2; 89.1; 85.9; 87.3; 89.4; 87.5 (AVG.=85.6)	91.5; 88.9; 89.2; 93.2; 95.2; 93.5; 95.1; 96.1 (AVG.=93.5) (PRED.=92.2)
B-737(300)	70.8	79.2 (PRED.=78.5)
DC-9(50)	93.0; 84.9; 84.4; 89.3; 90.3; 86.0 (AVG.=88.0)	97.5; 89.8; 94.3; 97.2; 97.5; 96.2 (AVG.=96.1) (PRED.=95.0)

TABLE 5E

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS
AT SITE "F"

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200)	77.1; 78.7; 74.7; 72.0; 75.5; 74.7; 77.9; 78.2 (AVG.=76.1)	84.3; 84.5; 81.9; 81.1; 84.8; 82.4; 84.2; 86.7 (AVG.=84.1) (PRED.=86.4)
B-737(300)	66.2	74.5 (PRED.=72.7)
DC-9(50)	83.5; 78.0; 78.0; 74.3; 80.9; 77.3 (AVG.=78.7)	90.3; 85.1; 86.5; 85.2; 86.3; 85.7 (AVG.=87.0) (PRED.=89.4)

TABLE 5F

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS
AT SITE "J"

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200)	78; 77; 79 (AVG.=78.0)	
DC-9(50)	81; 78; 81 (AVG.=80.0)	
HELICOPTER	68; 71; 65; 69; 68; 69; 69; 76 (AVG.=69.4)	

TABLE 5G

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "K"

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200)	78; 82; 76 (AVG.=78.7)	
DC-9(50)	86; 80 (AVG.=83.0)	
HELICOPTER	68; 63; 68; 69; 68; 72; 66; 68; 70; 65; 66; 67; 67; 72 (AVG.=67.8)	

TABLE 5H

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "L"

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200)	79; 79; 76 (AVG.=78.0)	
DC-9(50)	74; 81 (AVG.=77.5)	
HELICOPTER	73; 62; 67; 68; 64; 69; 63; 69; 66; 72 (AVG.=67.3)	

sure Level" column of the tables. The results of the comparisons indicated that the use of the FAA Model for developing the aircraft noise contours should provide reasonably accurate results.

Comparisons of measured and predicted helicopter noise levels are presented in TABLES 5A thru 5C, which also verified the relative accuracy of the FAA INM in modeling the helicopter noise contours shown in FIGURE 11. The helicopter noise levels are typically less than the jet aircraft noise levels, and do not exceed 60 Ldn over the noise sensitive areas of the project. In addition, when the helicopter noise contours are combined with the noisier fixed wing aircraft noise contours (see FIGURE 9), the existing 60 Ldn contour does not extend into the planned residential areas west of the Hanamaulu-Ahukini Cutoff Road.

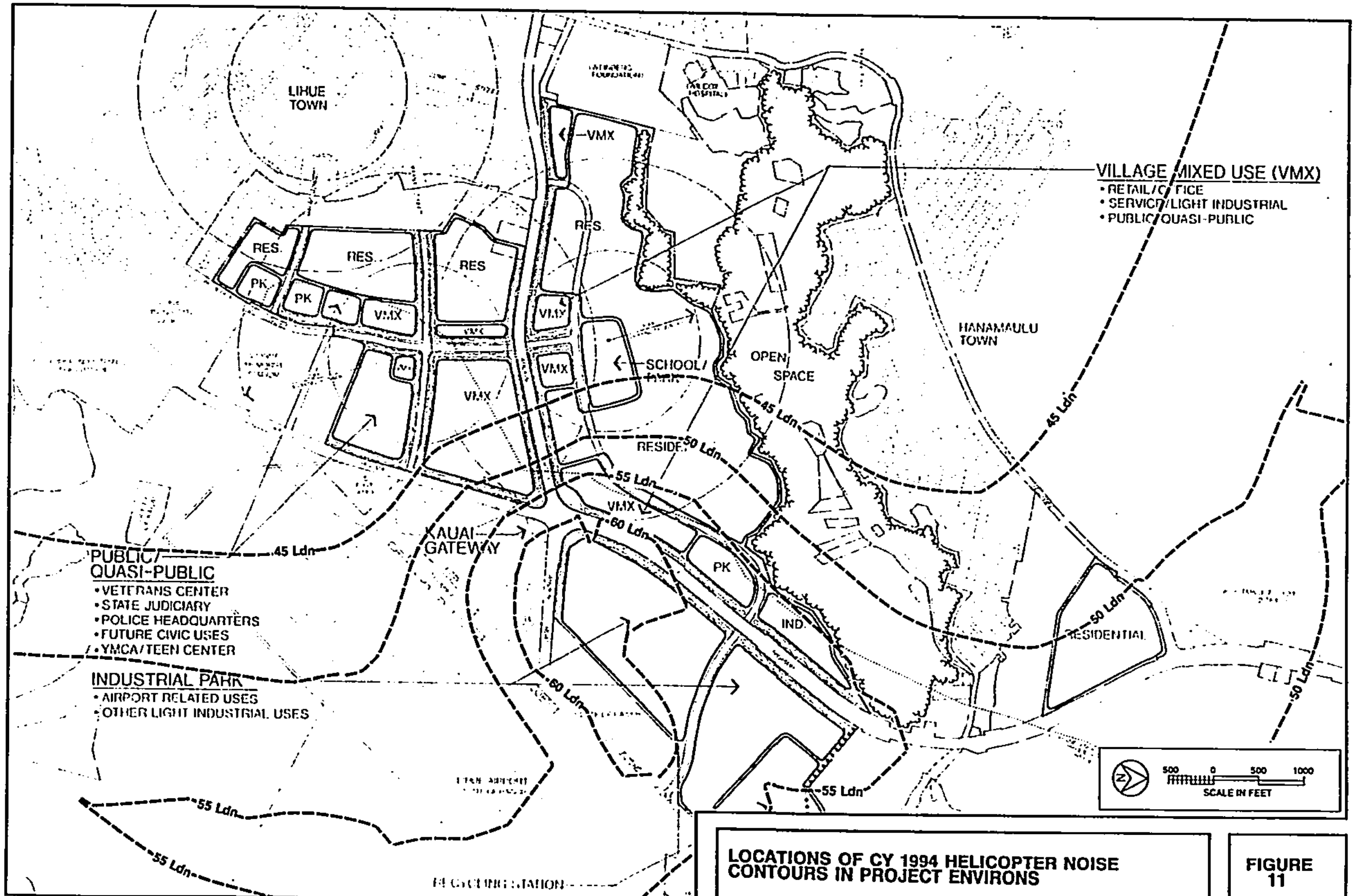
It was concluded that the existing 60 Ldn aircraft noise contour does not enclose the planned noise sensitive areas of the project. Based on these updated aircraft noise contours in the project environs, it was concluded that special aircraft noise mitigation measures will not be required since the noise sensitive uses are planned to be developed outside the 60 Ldn contour of Lihue Airport.

Asphalt Concrete Batch Plant Noise. An additional noise source in the project environs is the Asphalt Concrete Batch Plant which is operated by Niu Construction, Inc. The location of the Asphalt Plant is at the northern end of the petition area where shown in FIGURE 2. The dominant noise sources from the plant are the 1 megawatt diesel generator and the asphalt plant's furnace, which operate intermittently during the daytime hours. Measured noise levels from the plant at the northern end of the petition area ranged from 67 to 73 dBA without the benefit of noise shielding effects from the cliff between the Asphalt Plant and project site. At approximately 120 and 210 FT south of the cliff edge and on the project site, plant noise levels were reduced to the range of 60 to 55 dBA due to the beneficial shielding effects of the

TABLE 5I

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "M"

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200)	80; 81 (AVG.=80.5)	
DC-9(50)	82; 80 (AVG.=81.0)	
HELICOPTER	66; 72; 69; 73; 69; 80 (AVG.=71.5)	



LOCATIONS OF CY 1994 HELICOPTER NOISE CONTOURS IN PROJECT ENVIRONS

FIGURE 11

cliff plus the increased distance from the plant. Existing noise levels from the plant are audible at the northern end of the petition area, and could exceed 70 dBA along the common property boundary between the asphalt plant and the petition area. In the planned residential areas of the project approximately 1,800 FT from the asphalt plant, the plant noise levels decrease to the range of 50 to 55 dBA. Although the plant noise levels may be audible at the planned residential areas of the project, they should be compatible with the planned residential uses.

CHAPTER VI. FUTURE NOISE ENVIRONMENT

Traffic Noise. Predictions of future traffic noise levels were made using the traffic volume assignments of Reference 7 for CY 2016 with and without the proposed project. The future assignments of project plus non-project traffic on the roadway sections which would service the project are shown in TABLE 4A for the PM peak hour of traffic. As indicated in TABLE 4A, by CY 2016 and following complete project build-out, traffic noise levels on the roadways servicing the project are predicted to increase by 3.4 to 8.2 Ldn. This range of increase in traffic noise levels is considered to be significant, and reflects the large growth of forecasted project and non-project traffic in the project environs by CY 2016.

TABLE 4B summarizes the predicted increases in the future setback distances to the 60, 65, and 70 Ldn traffic noise contour lines along the roadways in the project environs and attributable to both project plus non-project traffic in CY 2016. The setback distances in TABLE 4B do not include the beneficial effects of noise shielding from terrain features and highway cuts, or the detrimental effects of additive contributions of noise from intersecting streets. As indicated in TABLE 4B, the setback distances to the 65 Ldn contour are predicted to range from 139 to 143 FT from the centerline of Ahukini Road following project build-out in CY 2016. Along the Hanamaulu-Ahukini Cutoff Road, setback distances to the 65 Ldn contour are predicted to range from 179 to 182 FT from the roadway's centerline. Along Kapule Highway, setback distances to the 65 Ldn contour are expected to range from 224 to 231 FT. Setback distances to the 65 Ldn contour are expected to range from 67 to 106 FT from the centerlines of Kuhio Highway (near the Hanamaulu Triangle), Hoolako Street, and Rice Street.

TABLE 6 presents the predicted increases in traffic noise levels associated with non-project and project traffic by CY 2016,

TABLE 6

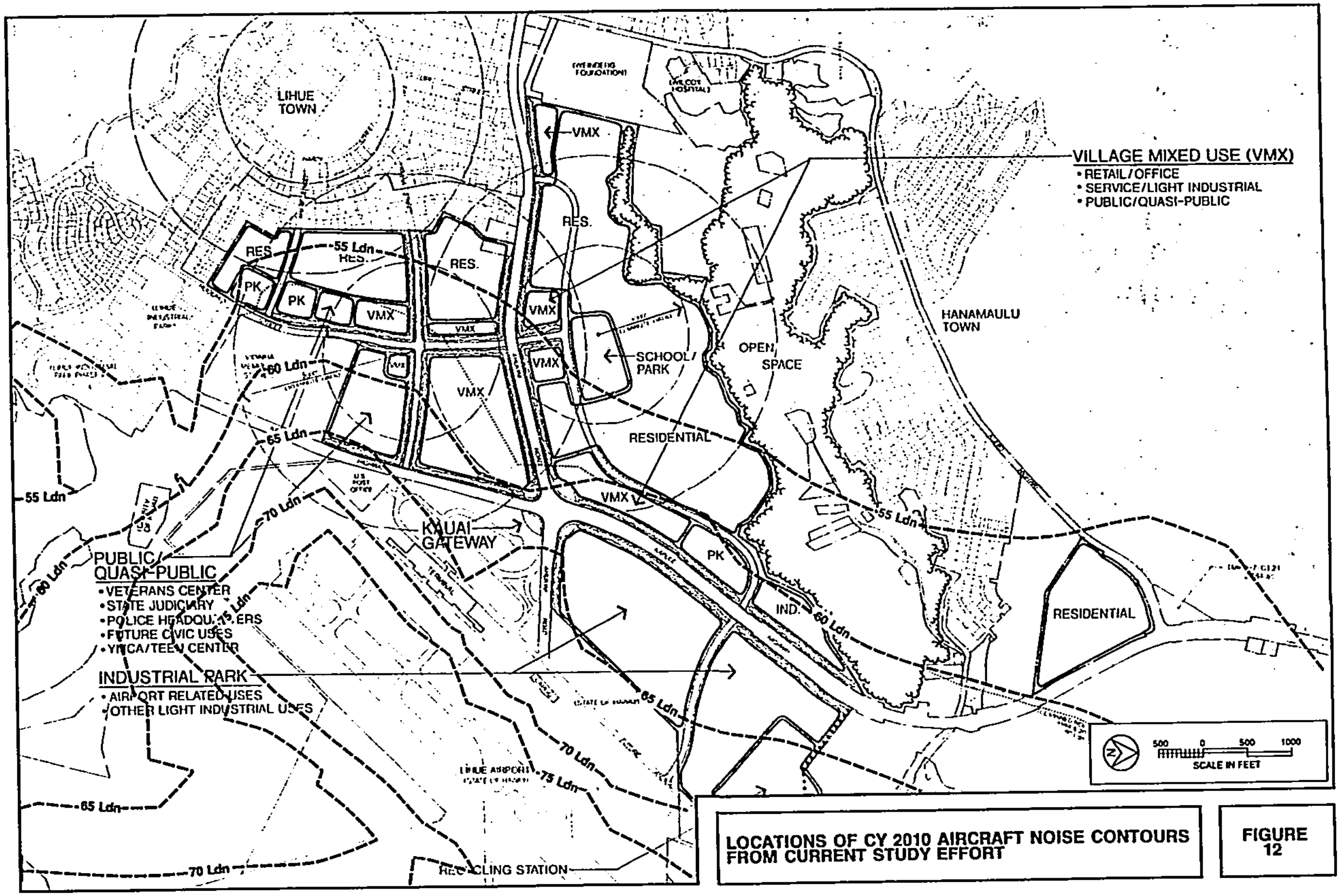
CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 2016)

STREET SECTION	NOISE LEVEL INCREASE (Ldn) DUE TO NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Kapule Highway (South End)	3.0	1.4
Kapule Highway (North End)	2.7	1.8
Hanamaulu-Ahukini Cutoff Rd (S)	3.0	1.7
Hanamaulu-Ahukini Cutoff Rd (N)	3.0	1.8
Ahukini Rd. West of Kapule Hwy.	3.1	2.0
Ahukini Rd. East of Kuhio Hwy.	3.1	2.9
Kuhio Hwy. SW of Cutoff Road	3.1	0.4
Hoolako Street	2.5	5.7
Rice St. West of Hoolako St.	2.7	1.9
Rice St. West of Kapule Hwy.	3.0	0.7
Rice St. East of Kapule Hwy.	3.0	1.5

and as measured by the Ldn descriptor system. As indicated in TABLE 6, non-project traffic is expected to cause the larger increases in traffic noise along the roadways servicing the project, except along Hoolako Street and Ahukini Road. Except for future conditions along Hoolako Street, traffic noise increases due to project traffic are less than those resulting from non-project traffic. The largest increases in traffic noise levels attributable to project traffic are expected to occur along Hoolako Street, and along the section of Ahukini Road near the Kuhio Avenue intersection. The smallest increase in traffic noise levels attributable to project traffic is expected to occur along the section of Kuhio Highway north of the Hanamaulu Triangle at the intersection with the Hanamaulu-Ahukini Cutoff Road.

Aircraft Noise. The aircraft noise contours in the project environs for the CY 2010 period were developed using the most recently available State DOT forecasts for Lihue Airport (Reference 10). The proposed extension of Runway 35-17 from 6,500 to 10,000 FT length was included in the modeling of the CY 2010 noise contours for Lihue Airport. It should be noted that the State DOT operations forecasts assumed that three interisland air carriers would be flying to Lihue Airport by CY 2010. It was assumed that only 80 percent of the interisland B-737 and DC-9 fleet would be quieted from Stage 2 to Stage 3 noise levels by CY 2010. The quieter Stage 3 aircraft, which are approximately 10 to 15 dB quieter than the older Stage 2 aircraft, and could include brand new aircraft such as the B-737(300) and B-737(400), or older aircraft which are outfitted with hush kits or which are reengined with high bypass ratio engines.

The relationship of the CY 2010 aircraft noise contours to the project site are shown in FIGURE 12. The CY 2010 contours developed during the current study indicate reduced aircraft noise levels in the Molokoa residential area primarily due to the expected conversion of noisier Stage 2 interisland jet aircraft to



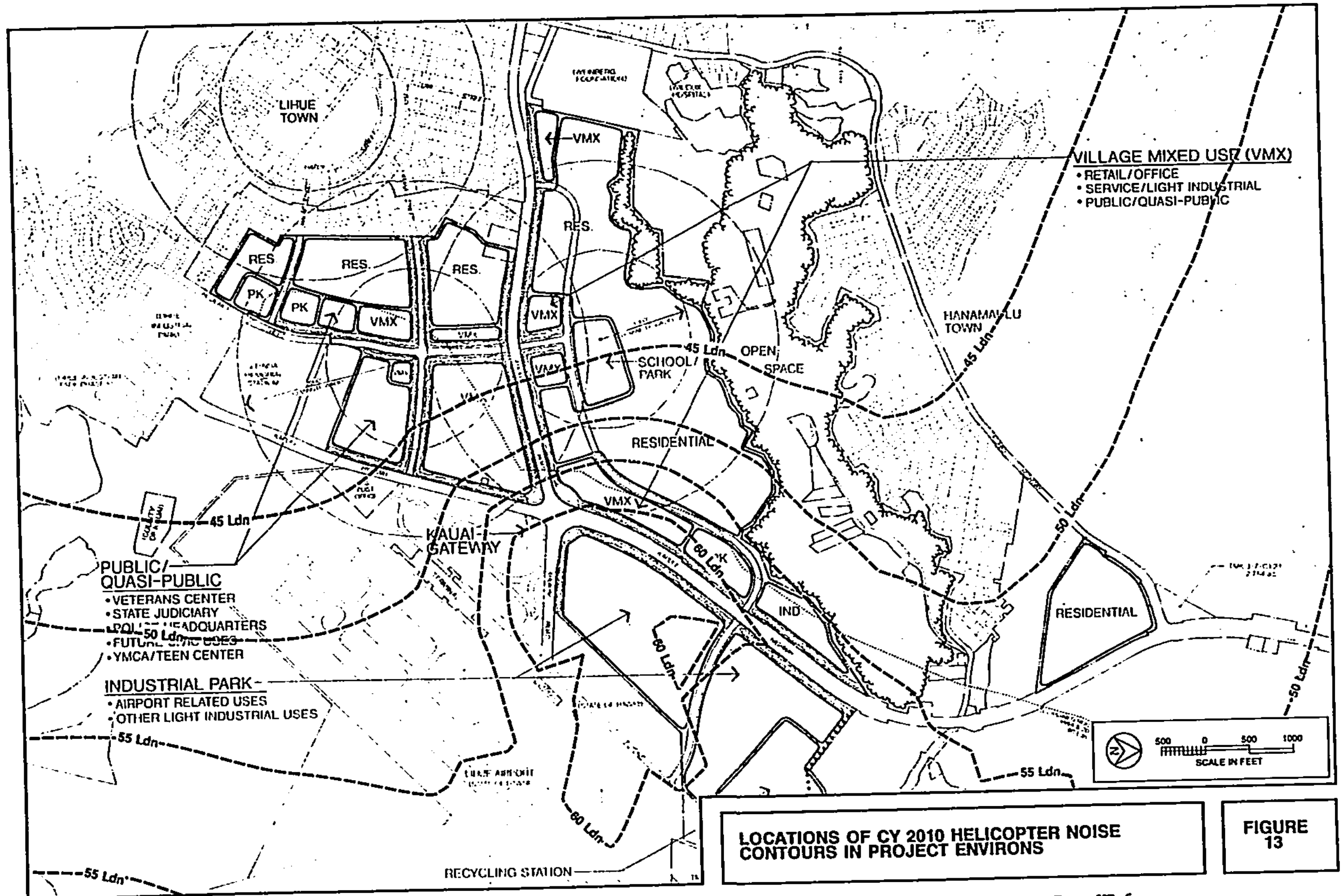
LOCATIONS OF CY 2010 AIRCRAFT NOISE CONTOURS FROM CURRENT STUDY EFFORT

FIGURE 12

the quieter Stage 3 aircraft. In the proposed industrial area mauka (west) of Hanamaulu-Ahukini Cutoff Road, aircraft noise levels are expected to increase slightly from current levels, primarily as a result of increased helicopter operations at Lihue Airport. The helicopter noise component of the CY 2010 airport noise contours shown in **FIGURE 12** are shown in **FIGURE 13**. As indicated in **FIGURE 13**, the helicopter noise tends to be concentrated along the Cutoff Road which is directly below the arrival flight track of the helicopters to the Lihue Heliport Facility. The existing heliport facility is not expected to be replaced or relocated in the foreseeable future, and its future status is planned to be changed from an interim to a permanent facility.

A possible secondary effect from the proposed extension of Lihue Airport's seaward Runway 35-17 to 10,000 FT is an increase in military and civil jet aircraft training operations on the extended runway. An increase in these jet aircraft training operations at Lihue Airport over the forecasted levels would tend to expand the noise contours in the Hanamaulu Triangle Area. The State DOT forecasts for military operations at Lihue Airport indicated a constant level of 8,000 operations per year between CY 1995 and 2010. However, for this study, the number of military training operations were doubled to reflect the worst case secondary effects which could be anticipated from the seaward runway's extension.

The available CY 2010 forecasts for aircraft noise over the project site indicate that the 60 Ldn contour will expand slightly and continue to extend into the project site alongside the Hanamaulu-Ahukini Cutoff Road (see **FIGURE 12**). The Molokoa residential area is expected to remain clear of the 60 Ldn contour by CY 2010. The Public/Quasi-Public Use and VMX areas along Kapule Highway are expected to experience reduced aircraft noise levels by CY 2010. Planned noise sensitive uses of the project have been located outside the 60 Ldn contour for CY 2010 in recognition of the existing planning guidelines shown in **TABLE 2**.



LOCATIONS OF CY 2010 HELICOPTER NOISE CONTOURS IN PROJECT ENVIRONS

FIGURE 13

CHAPTER VII. DISCUSSION OF PROJECT RELATED NOISE IMPACTS AND POSSIBLE NOISE MITIGATION MEASURES

Traffic Noise Impacts. The increases in traffic noise levels attributable to the project from the present to CY 2016 are predicted to range from 0.4 to 5.7 Ldn along the roadways in the immediate vicinity of the project. Traffic noise level increases of 0 to 1.0 Ldn are considered to be insignificant and will be difficult to detect, particularly if the increase occurs over a long period of time. Traffic noise level increases along Kuhio Highway near the Hanamaulu Triangle and along Rice Street between Kapule Highway and Hoolako Street are expected to be insignificant, with essentially no traffic noise impacts expected from the proposed project.

Increases in traffic noise levels attributable to project traffic along the sections of Rice Street east of Kapule Highway and west of Hoolako Street, along the Hanamaulu-Ahukini Cutoff Road, along Kapule Highway, and along the section of Ahukini Road near Kapule Highway are considered to be in the moderate category, and range between 1.4 and 2.0 Ldn. Traffic noise increases expected as a result of non-project traffic along these roadways will be greater than those associated with project traffic, and will range from 2.7 to 3.1 Ldn.

Along Ahukini Road toward Kuhio Highway, traffic noise increases from project traffic are expected to be in the significant category at 3.0 Ldn. Non-project traffic will also cause similar increases in traffic noise levels of 3.1 Ldn along this section of Ahukini Road.

Only along Hoolako Street are project traffic noise increases expected to be greater than those resulting from non-project traffic. Existing traffic noise levels along the south section of Hoolako Street near Rice Street are relatively low at approximately 60 Ldn at 50 FT setback distance from the street's centerline. The north section of Hoolako Street is expected to be extended to

Ahukini Road in conjunction with this project. Two or three existing residences near the Rice Street intersection are expected to be affected by the increased traffic volumes along Hoolako Street. The construction of sound attenuation walls along Hoolako Street and fronting these existing homes is a possible traffic noise mitigation measure.

Potential noise impacts from project and non-project traffic are possible in the project environs, both in respect to existing and planned noise sensitive receptors along these roadways. Existing and future residences which are located along essentially all of the major roadways in the Lihue-Hanamaulu area may be impacted by the future traffic noise along these roadways if their setback distances from the roadway centerlines are less than those shown for the 65 Ldn contour in TABLE 4B. The setbacks of existing homes from Rice Street and Ahukini Road are not adequate for avoiding future adverse noise impacts from traffic by CY 2016, with or without the project. For this reason, existing homes which front these two roadways are expected to be impacted by traffic noise in the future.

Because traffic noise along public roadways such as those listed in the table are generated by non-project as well as project traffic, mitigation of off-site traffic noise impacts are generally performed by individual property owners along the roadways' Rights-of-Way or by public agencies during roadway improvement projects. These mitigation measures generally take the form of increased setbacks, sound attenuating walls and/or berms, total closure and air conditioning, or the use of sound attenuating windows. Where adequate setbacks beyond the 65 Ldn noise contour are not available, the construction of 6 FT high sound walls is generally effective for attenuating traffic noise at single story structures, or at the ground floors of multistory structures. If 6 FT high walls and/or berms are utilized to reduce traffic noise, at least 5 Ldn units of reduction should be possible at ground level units. The reduced setback distances to the 65 Ldn contour behind the 6 FT high walls or berms can be estimated from the setback distances indicated under the 70 Ldn column in **TABLE 4B**. Whenever mitigation of traffic noise at the upper floors are required, the use of closure and air conditioning, or the use of sound attenuating windows are the more appropriate sound attenuation measures.

Aircraft Noise Impacts. The siting of future noise sensitive developments within the 60 Ldn airport noise contour is not recommended by the State DOT, Airports Division as well as by Lihue Airport's FAR Part 150 Noise Compatibility Plan. Residences, schools, churches, health centers, day-care centers, and hotels are included within the noise sensitive land use category. The rationale for selection of the 60 Ldn threshold is more fully discussed in **Reference 5**.

The siting of industrial and commercial uses within the 60 Ldn contour is acceptable, since closure and air conditioning of industrial and commercial office spaces is the rule rather than an exception. The siting of these types of uses within the high noise areas around an airport is usually encouraged, since it tends to preclude future development of noise sensitive uses on the same lands.

By siting planned noise sensitive uses outside the existing and forecasted 60 Ldn noise contours for Lihue Airport, risks of adverse aircraft noise impacts have been reduced to acceptable levels. The noise contour disclosure provisions of Section 467-31, Hawaii Revised Statutes must be applied over all project lands which are located within the aircraft noise contours developed by the State DOT during a FAR Part 150 Noise Compatibility Program. The FAR Part 150 CY 1995 contours (see **FIGURE 10**) are the applicable contours for disclosure purposes. These disclosure provisions are intended to further reduce risks of occupant dissatisfaction with the aircraft noise levels in the project environs. Additional aircraft noise mitigation measures should not be

required.

Combined Traffic and Aircraft Noise. When applying for FHA/HUD financial assistance on residential developments, sound attenuation measures are normally required if total exterior noise levels exceed 65 Ldn. Traffic noise levels may exceed 65 Ldn along the highway corridors and major thoroughfares which service the project. If the traffic noise level equals 65 Ldn and the aircraft noise level equals 60 Ldn at a project dwelling, the total noise level will be 66 Ldn, which exceeds the FHA/HUD standard of 65 Ldn. Where existing and forecasted aircraft noise levels over the project site do not exceed 55 Ldn, combined traffic and aircraft noise levels should not exceed 65 Ldn when traffic noise levels are less than 65 Ldn. Where traffic noise levels exceed 65 Ldn, the combined noise levels will be identical to the traffic noise levels and will not be dependent upon the levels of aircraft noise, as long as aircraft noise levels remain at least 10 Ldn units below the traffic noise levels.

Aircraft noise contours for CY 2016 (the same year as the traffic noise predictions) were not constructed because aircraft operations forecasts for Lihue Airport were not available. However, if the CY 2010 aircraft noise contours are combined with the CY 2016 traffic noise contours, the following changes to the CY 2016 setback distances to the 65 Ldn contours shown in **TABLE 4B** are predicted:

a. Kapule Highway (South End): Increase from 224 FT to 250 FT.

b. Kapule Highway (North End): Increase from 231 FT to 300 FT.

c. Hanamaulu-Ahukini Cutoff Road (South End): Increase from 179 FT to 250 FT.

d. Hanamaulu-Ahukini Cutoff Road (North End): Increase from 182

FT to 200 FT.

e. Ahukini Road West of Kapule Highway: Increase from 140 FT to 180 FT.

f. Ahukini Road East of Kuhio Highway: No Change.

g. Kuhio Highway SW of Cutoff Road: Increase from 106 FT to 120 FT.

h. Hoolako Street: Increase from 72 FT to 90 FT.

i. Rice Street: No Change.

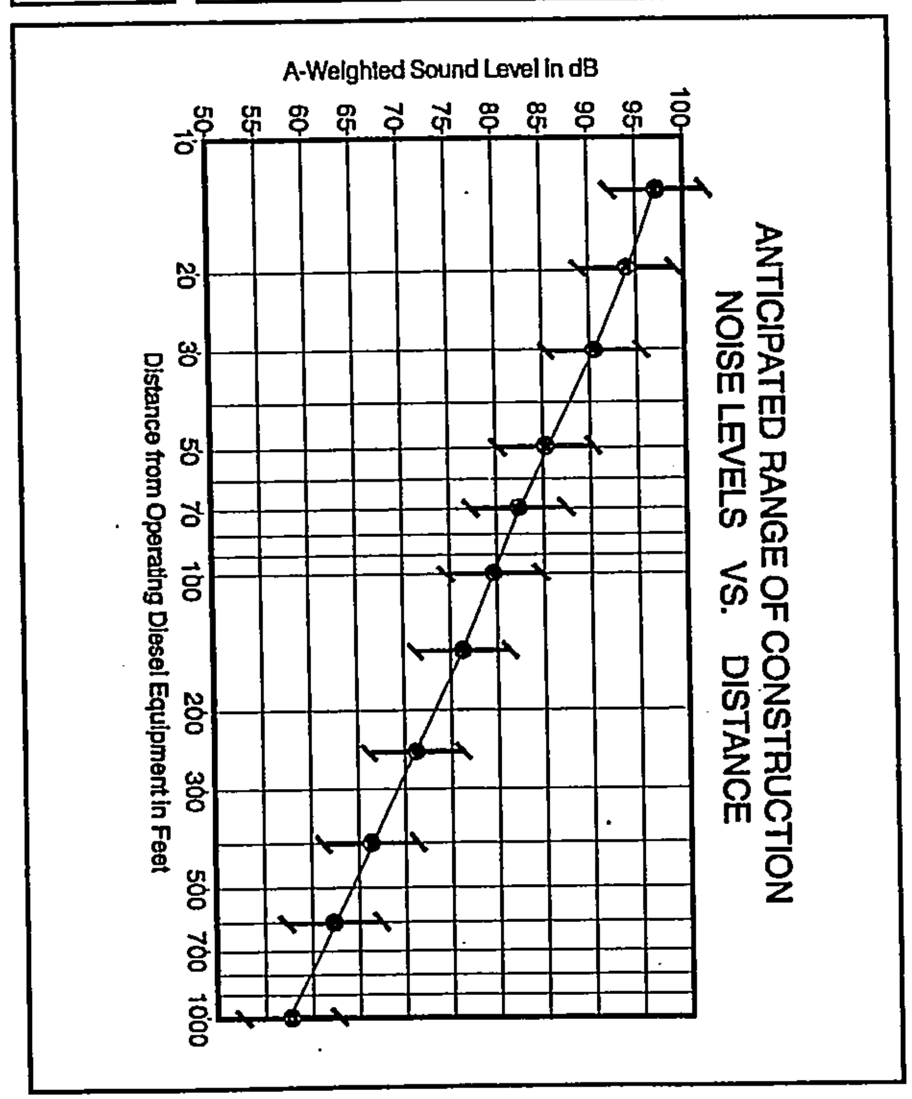
Asphalt Concrete Batch Plant Noise. In order to avoid potential noise conflicts between the asphalt plant and its future neighbors, mitigation measures are recommended prior to development of any industrial lots which are exposed to asphalt plant noise levels greater than 70 dBA. The 70 dBA limit is anticipated to become the State Department of Health (DOH) limit for machinery noise sources along industrial property boundaries on Kauai, as it is presently on the island of Oahu. Because industrial uses are planned on the project site in areas immediately adjacent to the asphalt plant, the potential for future noise conflicts from the asphalt plant should be minimized.

Noise mitigation measures in the form of enclosing the asphalt plant's furnace opening, as well as providing silencers at the air openings, may be required to reduce plant noise levels to the State DOH limit of 70 dBA at the project's industrial property boundary. In addition, if the State DOH noise limits do become effective on Kauai in the near future as anticipated, additional mitigation of asphalt plant noise levels along the plant's other property boundaries may be required. It these noise mitigation measures are not cost effective or impair operations at the plant,

the next best alternative measure is to provide an alternate site for relocating the asphalt plant.

Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. During periods of construction, it is anticipated that the actual work will be moving from one location on the project site to another during that period. Actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of noise from construction activity (excluding pile driving activity) are shown in FIGURE 14. The noise sensitive properties which are predicted to experience the highest noise levels during construction activities on the project site are the existing residences in the Holokoa, Lihue, and Hanamaulu areas adjacent to the project site. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 FT distance), and due to the exterior nature of the work (grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. The incorporation of State Department of Health construction noise limits and curfew times, which are applicable on the island of Oahu (Reference 11), is another noise mitigation measure which can be applied to this project. TABLE 7 depicts the allowed hours of construction for normal construction noise (levels which do not exceed 95 dB at the project's property line) and for construction



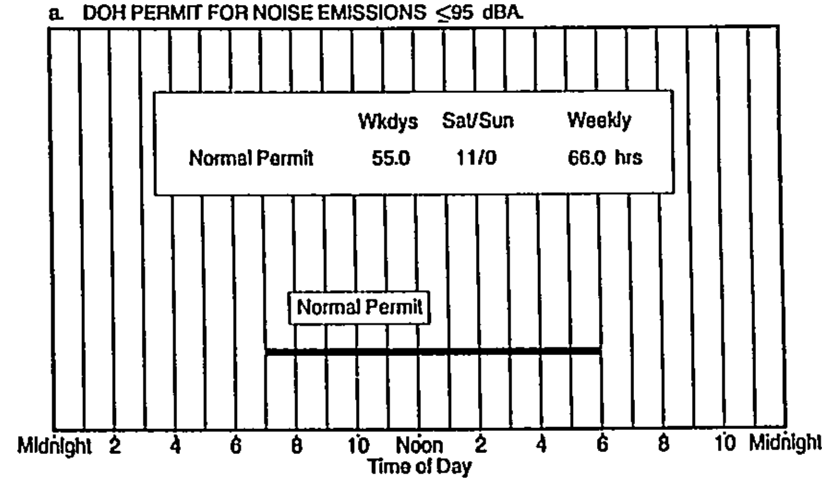
CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 14

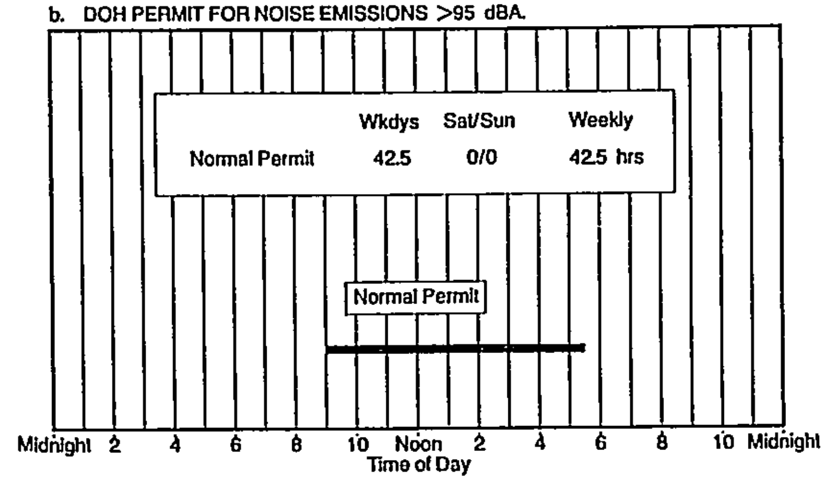
TABLE 7

AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

a. DOH PERMIT FOR NOISE EMISSIONS ≤95 dBA.



b. DOH PERMIT FOR NOISE EMISSIONS >95 dBA.



noise which exceeds 95 dB at the project's property line. Noisy construction activities are not allowed on holidays under the DOH permit procedures.

APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control;" Federal Interagency Committee on Urban Noise; June 1980.

(2) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B;" U.S. Department of Housing and Urban Development; July 12, 1979.

(3) "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety;" Environmental Protection Agency (EPA 550/9-74-004); March 1974.

(4) Section 467-31, Hawaii Revised Statutes, 1988.

(5) "Volume II - Noise Compatibility Program Report; Lihue Airport, Hawaii;" Hawaii State Department of Transportation, Airports Division; December 1989.

(6) Barry, T. and J. Reagan, "FHWA Highway Traffic Noise Prediction Model;" FHWA-RD-77-108, Federal Highway Administration; Washington, D.C.; December 1978.

(7) Traffic projections for the Lihue-Hanamaulu Master Plan Project; Austin, Tsutsumi & Associates, Inc.; August 9, 1994.

(8) 24-Hour Traffic Counts; Station 22-C, Kapule Highway at Ahukini Road; Hawaii State Department of Transportation; November 1 and 3, 1993.

(9) 24-Hour Traffic Counts; Station 22, Kuhio Highway at Hanamaulu Road; Hawaii State Department of Transportation; November 2, 1993.

(10) "Update of the Statewide Airport System Plan Forecasts;" Aries Consultants Ltd.; April 20, 1990.

(11) "Title 11, Administrative Rules, Chapter 43, Community Noise Control for Oahu;" Hawaii State Department of Health; November 6, 1981.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "LepN" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PHL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

TERM	SYMBOL
1. A-Weighted Sound Level	L_A
2. A-Weighted Sound Power Level	L_{WA}
3. Maximum A-Weighted Sound Level	L_{max}
4. Peak A-Weighted Sound Level	L_{Apk}
5. Level Exceeded x% of the Time	L_x
6. Equivalent Sound Level	L_{eq}
7. Equivalent Sound Level over Time (T) [1]	$L_{eq(T)}$
8. Day Sound Level	L_d
9. Night Sound Level	L_n
10. Day-Night Sound Level	L_{dn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$
12. Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78, NOISE REGULATION REPORTER.

APPENDIX B (CONTINUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

TERM	A-WEIGHTING	ALTERNATIVE[1] A-WEIGHTING	OTHER[2] WEIGHTING	UNWEIGHTED
1. Sound (Pressure) [3] Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2. Sound Power Level	L_{WA}		L_{WB}	L_W
3. Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4. Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5. Level Exceeded x% of the time	L_x	L_{Ax}	L_{Bx}	L_{px}
6. Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7. Equivalent Sound Level [4] Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8. Day Sound Level	L_d	L_{Ad}	L_{Bd}	L_{pd}
9. Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10. Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12. Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13. Energy Average value over (non-time domain) set of observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14. Level exceeded x% of the total set of (non-time domain) observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15. Average L_x value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,.....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

O

Air Quality Impact Analysis

AIR QUALITY IMPACT ANALYSIS
Lihue-Hanamaulu Lands Development
Project No. 3-1262-0000

Prepared For
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September 1994

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AIR QUALITY IMPACT ANALYSIS
Lihue-Hanamaulu Lands Development
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September 1994

TABLE OF CONTENTS

SECTION	TITLE	PAGE
1	INTRODUCTION	1-1
2	ENVIRONMENTAL BACKGROUND	2-1
2.1	Regulatory Setting	2-1
2.2	Ambient Air Quality Levels	2-1
2.3	Meteorology and Climatology	2-3
2.4	Topography	2-8
3	ENVIRONMENTAL IMPACTS	3-1
3.1	Short-Term Pollutant Impacts	3-1
3.2	Long-Term Pollutant Impacts	3-2
3.3	Indirect Pollutant Impacts	3-8
4	MITIGATION MEASURES	4-1
4.1	Short-Term Measures	4-1
4.2	Long-Term Measures	4-1
4.3	Indirect Measures	4-2
5	CONCLUSION	5-1
6	REFERENCES	6-1

LIST OF FIGURES

NUMBER	TITLE	PAGE
1-1	Project Location, Lihue - Hanamaulu Lands Development	1-2
2-1	Lihue Airport Windrose	2-6
3-1	Schematic Diagram of CAL3QHC Modeling Analysis at the Kapule Highway and Rice Street Intersection	3-5

TABLE OF CONTENTS (Continued)

LIST OF TABLES

NUMBER	TITLE	PAGE
2-1	Summary of State of Hawaii and Federal Ambient Air Quality Standards	2-2
2-2	PM_{10} Concentrations in the Lihue Area 24-Hour Monitoring Samples	2-4
2-3	1991 Climatic Normals, Means, and Highs for Lihue Airport	2-7
3-1	Maximum Predicted CO Concentrations	3-6

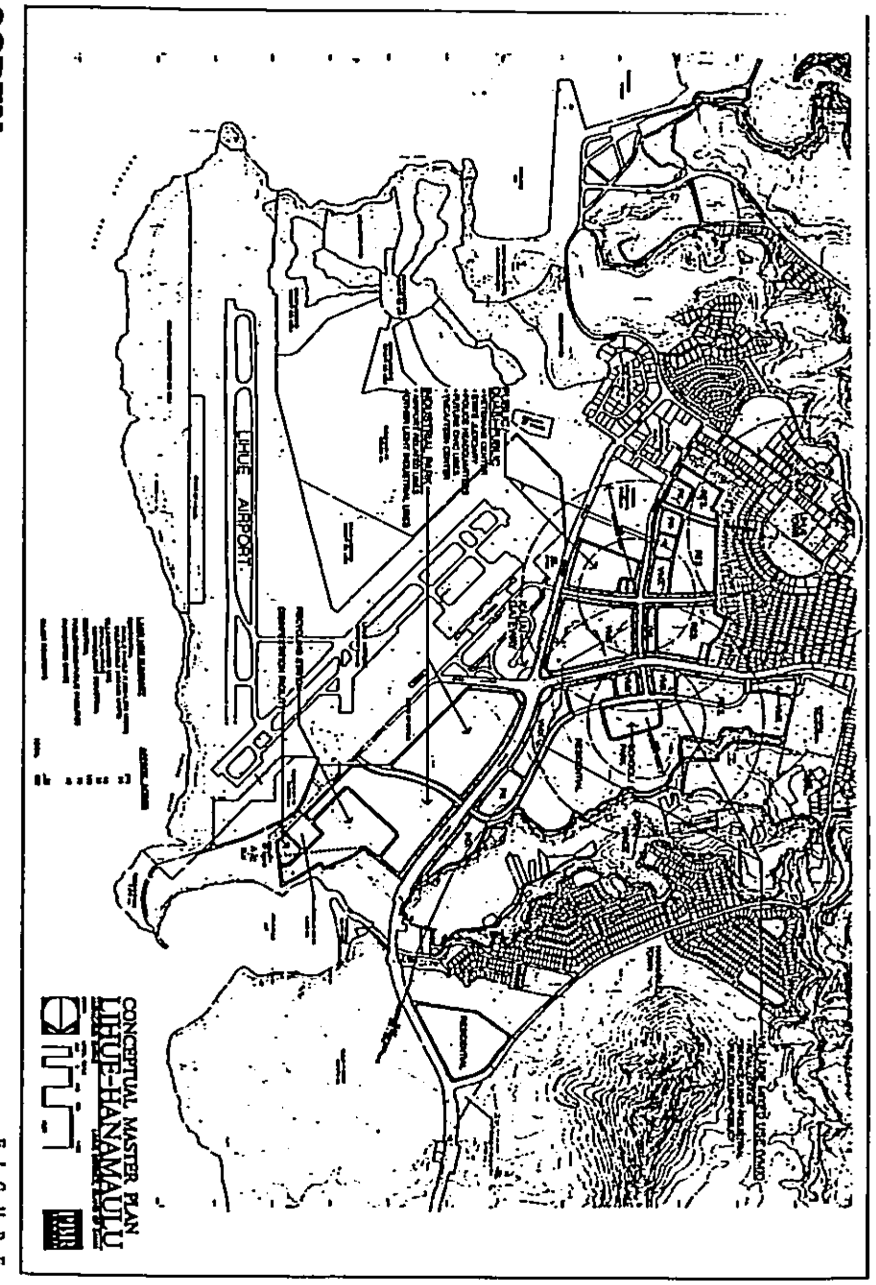
SECTION 1
INTRODUCTION

The Lihue Plantation Company, Limited, a subsidiary of Amfac/JMB Hawaii, Inc. plans to develop the lands of Molokoa, Ahukini Mauka, Ahukini Makai and Hanamaulu. Development is projected to take place over a 15 to 20 year period and covers 552 acres of land located at Lihue and Hanamaulu, Kauai (see Figure 1-1). Currently, the project area is under cultivation for sugar production by Lihue Plantation Company, Limited. The primary development of the project will consist of housing units for residential purposes, industrial/commercial uses to stimulate employment opportunities and public and quasi-public uses.

This report assesses the impact of the proposed development on air quality both on a local and regional basis. Potential air quality impacts that exceed National or State ambient air quality standards (NAAQS/SAAQS) would constitute a significant effect. Potential air quality impacts that do not exceed NAAQS or SAAQS would be insignificant.

The overall project is an "indirect source" of air pollution as defined in the Federal Clean Air Act because its primary association with air pollution is due to motor vehicle traffic that will be generated by residential and industrial/commercial activities. Thus, the focus of this analysis is on the project's potential to reduce or enhance the impact of the surrounding air quality as a result of the new development. Additionally, this report addresses short-term impacts due to construction activities.

The following sections describe the environmental setting, the impacts of the proposed project, and potential mitigation measures when deemed necessary.



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PROJECT LOCATION, LIHUE - HANAMAULU LANDS DEVELOPMENT

FIGURE 1-1

SECTION 2
ENVIRONMENTAL BACKGROUND

This section identifies the regulations governing NAAQS and SAAQS. A summary of the existing air quality and physical conditions (i.e., meteorology, climate, and topography) affecting air pollution dispersion at the proposed development site and surrounding area is also provided.

2.1 Regulatory Setting

The Federal *Clean Air Act* (amended November 15, 1990) set forth NAAQS with States retaining the option to develop more stringent standards. These standards represent the maximum levels of pollution considered safe, with an adequate margin of safety, to protect the public health and welfare. The six pollutants for which NAAQS have been established (criteria pollutants) are sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), particulate matter less than 10 microns in diameter (PM_{10}), and lead (Pb). SAAQS were established for these same pollutants in Chapter 11-59 of the Hawaii Administrative Rules, *Ambient Air Quality Standards* (amended November 26, 1993). In the amendment of Chapter 11-59, the State standard for particulate matter (PM) was removed and a new standard for PM_{10} was implemented to match the National PM_{10} standard. Both NAAQS and SAAQS are summarized in Table 2-1.

2.2 Ambient Air Quality Levels

In evaluating the compliance of a new source with applicable standards, ambient background concentrations of the criteria pollutants are added to the maximum predicted concentrations resulting from implementation of the proposed project, and compared with existing NAAQS and SAAQS. Typically, the maximum background concentrations

Table 2-1
SUMMARY OF STATE OF HAWAII AND FEDERAL
AMBIENT AIR QUALITY STANDARDS
(µg/m3)

Pollutant	Hawaii State	Federal Primary Standard[a]	Federal Secondary Standard[b]
Carbon Monoxide			
1 hour	10,000	40,000	40,000
8 hour	5,000	10,000	10,000
Nitrogen Dioxide			
1 hour	--	--	--
24 hour	--	--	--
Annual (Arithmetic)	70	100	100
Particulate Matter-10[c]			
24 hour	150	150	150
Annual (Arithmetic)	50	50	50
Ozone			
1 hour	100	235	235
Sulfur Dioxide			
3 hour	1300	--	1300
24 hour	365	365	--
Annual (Arithmetic)	80	80	--
Lead			
3 months (Arithmetic)	1.5	1.5	1.5
Hydrogen Sulfide	35	--	--

a Designed to prevent adverse effects on public health.
b Designed to prevent adverse effects on public welfare including effects on comfort, visibility, vegetation, animals, aesthetics values, and soiling and deterioration of materials.
c Particulate Matter which is 10 microns or less in diameter.

recorded within the previous three years are used to represent baseline conditions for the air quality analysis. As for the project area under consideration, ambient concentrations have not been monitored regularly by the Department of Health (DOH) Clean Air Branch. To date, 24-hour averaging sampling data exist only for PM_{10} in the Lihue area (Hawaii State Department of Health, 1991). Table 2-2 provides the ambient PM_{10} concentrations in the Lihue area. No other pollutants were monitored by DOH, and the Lihue monitoring station has not operated since October 1985. While there is no background data available for SO_2, NO_2, CO, O_3, or Pb, it is safe to assume that the air quality relative to these pollutants is good. This assumption is based on the fact that the State of Hawaii is presently considered by the U.S. Environmental Protection Agency (USEPA) to be in attainment for all criteria pollutants (i.e., not violating the State or Federal air quality standards) as codified in the Code of Federal Regulations (CFR) Title 40 §81.312.

2.3 Meteorology and Climatology

The meteorological and climatological data presented below is based on a compilation of reports prepared by the United States Department of Commerce - National Oceanic and Atmospheric Administration - Climatic Data Center, and the Hawaii State Department of Land and Natural Resources - Division of Water Resource Management (Hawaii State Department of Business, Economic Development & Tourism, 1993).

The climate in Lihue can be characterized as semi-tropical and is influenced by Hawaii's location southwest of the Pacific High, anticyclone. The climate is characterized by equable temperature conditions from day to day and season to season by the persistent trade winds from the northeast and by the marked variation in rainfall between wet and dry seasons.

Table 2-2
PM_{10} CONCENTRATIONS IN THE LIHUE AREA
24-HOUR MONITORING SAMPLES ($\mu g/m^3$)

Lihue Sampling Station (Year)	PM_{10} Concentrations (Annual range)
1988	9-25
1989	10-33
1990	8-36
1991	9-41

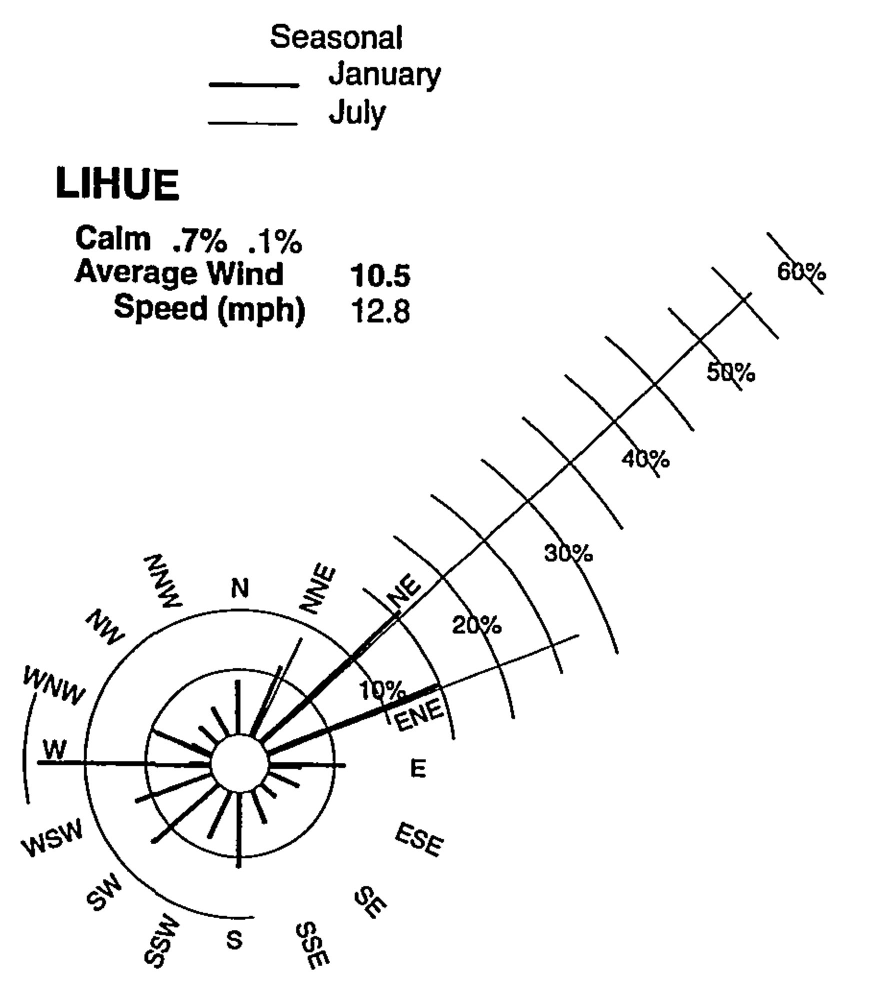
Sources: 1) Hawaii State Department of Health, *Hawaii Air Quality Data: January 1989-1990.*
2) Hawaii State Department of Business, Economic Development & Tourism, *The State of Hawaii Data Book 1992: A Statistical Abstract.*

The predominant wind direction is from the northeast, although there is a shift to the west and southwest during the winter months (December through March). The strongest winds are from the northeast and are fairly consistent throughout the year. Figure 2-1 is a windrose that shows the percentage of winds arriving in Lihue Airport during the year from various directions. Daily variations include diurnal effects of winds from the southwest quadrant during the night and morning hours, shifting to the northeast during the day.

Surface winds are generally around twelve miles per hour from the northeast. There are some seasonal changes in prevailing direction to the southwest with the Kona winds in winter. Strong winds do occur at times in connection with storm systems moving through the area. Wind velocities and directions are influenced to an important extent by the mountainous terrain to the south and west.

Trade wind showers are relatively common and although heavy rains occur at times, most of the showers are light and of short duration. Normal annual rainfall is greater than 40 inches, three-fourths of which occurs during the wet season from October through April. Normal precipitation in January, the wettest month, is over 6 inches, and in June, the driest month, averages one and one-half inches. In 1991, the maximum monthly precipitation was 22.91 inches and the minimum monthly was considered to be at trace amounts.

The average annual temperature recorded in 1991 ranged between a high of 81.1°F and a low of 69.3°F at the Lihue Airport. The range in normal temperature between the coolest month (February) to the warmest month (August) averaged less than 8°F. Table 2-3 presents the 1991 climatic normals, means, and highs for Lihue Airport.



Source: National Weather Service, Pacific Region 1972

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LIHUE AIRPORT WINDROSE

FIGURE 2-1

Table 2-3
1991 CLIMATIC NORMALS, MEANS, AND EXTREMES FOR LIHUE AIRPORT

Subject	Lihue
Normal temperatures (°F):	
Daily maximum	81.1
Daily minimum	69.3
Monthly:	
Coolest month	71.3
Warmest month	79.1
Annual	75.2
Extreme temperatures (°F):	
Record highest	90
Record lowest	50
Precipitation (inches):	
Normal (annual average)	44.02
Maximum monthly	22.91
Minimum monthly	trace
Relative humidity (percent):	
8 am	78
2 pm	67
Wind speed (miles per hour):	
Mean	12.3
Fastest observed, 1 minute	65
Mean number of days:	
Clear	54.3
Partly cloudy	182.5
Cloudy	128.5
Precipitation 0.01 inch or more	201.4
Percent of possible sunshine	57

Source: Hawaii State Department of Economic and Business Development, *Statistics*, 1993.

2.4 Topography

The proposed site is located windward of the Kalepa Ridge. The Kalepa Ridge represents an erosional remnant of lava of the original volcanic dome on Kauai. It also forms (with the Nonou Ridge) the eastern boundary of the Lihue Depression, a collapsed caldera.

The rocks of the Kalepa Ridge are part of the Napali formation of the Waimea Canyon volcanic series of Pliocene age. The Napali formation rocks are gently dipping, thin flows of olivine basalt. Dikes are present in the Napali formation of Kalepa Ridge but their effect on ground water is unknown. In general, these rocks are highly permeable and form an excellent source of ground water (PBR Hawaii, 1994).

Overlying the Napali formation and separated by an erosional unconformity are the rocks of the Koloa volcanic series. These volcanic flows and ash deposits floor much of the Lihue Depression. The areas of the project are located on the lava flows of the Koloa volcanic series. The Koloa volcanic series consists of materials that are dense to moderately dense. Lava flows are pahoehoe and a'a, the latter being more abundant. A slope analysis of the topography of the areas of application reveals slopes ranging from 0 to 8 percent. Elevations at the development project site range from 80 to 160 feet.

SECTION 3
ENVIRONMENTAL IMPACTS

This section describes the environmental impacts of the proposed project. Impacts have been broken down into three groups: short-term, long-term, and indirect. Each of these groups is discussed below.

3.1 SHORT-TERM POLLUTANT IMPACTS

Short-term pollutant impacts of the proposed development project are considered to be those associated with construction activities. Emission sources primarily include tailpipe emissions from heavy-duty construction equipment and workers' vehicles and fugitive dust generated during demolition and construction activities, particularly site clearing and land grading.

During the construction of the project, various types of equipment (i.e., scrapers, dozers, water trucks) will be utilized. The operation of the heavy-duty construction equipment will cause the emission of SO_2, oxides of nitrogen (NO_x), hydrocarbons (HC), CO, and PM_{10}. Typically, diesel-powered equipment will emit more NO_x, SO_2, and PM_{10} than will gasoline-powered equipment. The latter, however, will emit more HC and CO. In addition, exhaust emissions from workers' vehicles will add to the total pollutants emitted. While localized increases of these pollutants are expected to occur, they are not considered significant.

Fugitive dust generated (i.e., PM) from clearing vegetation and other heavy-duty construction operations is estimated at the rate of 1.2 tons per acre per month of activity (USEPA 1985). According to the Lihue Plantation Company, approximately 552 acres will be disturbed over the 15 to 20 year project lifetime. With an estimated 27.6 acres of land being disturbed per year, the amount of fugitive dust generated per month is expected to be less than three tons per month. The potential for significant fugitive dust

generation during the vegetation clearing will exist. However, these air quality impacts will be localized and temporary and can be mitigated.

Sugar cane plantation land will be relocated several miles north of the project site. This relocation will occur in phases over the same 15 to 20 year project lifetime as the development site progresses. As a result of this relocation, there will be a reduction in the amount of particulate air pollution, such as dust and smoke due to sugar cane burning at the project site and surrounding areas. The net result will be an improvement in air quality (i.e., less particulates, better visibility, etc.) for the development site and surrounding areas, such as the nearby hospital, existing urban community, and the airport.

3.2 LONG-TERM POLLUTANT IMPACTS

Long-term pollutant impacts of the proposed development project are considered to be those associated with everyday use of the development. The most significant long-term emission sources are motor vehicles, with the most significant tailpipe emission being CO.

High short-term concentrations of CO, known as "hot spots", can occur at locations where traffic is congested, such as at intersections and along highways. For this project, the intersection of Kapule Highway and Rice Street was modeled because this location is the only intersection currently operating at a Level of Service (LOS) "F" rating. Consequently, if no base improvements are constructed, this LOS rating at Kapule Highway/Rice Street is expected to continue in the year 2006 and 2016 with and without the development project.

The intersection is currently controlled by a stop sign and has a high traffic volume moving through it in terms of vehicles per peak hour (Austin, Tsutsumi & Asssoc., 1994). Consequently, traffic at this intersection was modeled for both morning and evening peak hour traffic volumes using the existing 1994 traffic data. Impacts for the projected buildout year 2006 and 2016 were predicted assuming the "with" and "without" project development. These modeling results provide the worst-case scenario of CO concentration levels to be produced with or without the development project at this intersection.

Based on the base improvements and mitigation measures recommended by the traffic consultants, this modeled intersection will improve to a below capacity LOS rating only if the mitigation measures recommended with project development are provided. The CO concentrations produced by other intersections along the development are expected to be equivalent too or less than the CO concentrations at the modeled intersection due to their equivalent or smaller traffic volumes. As the base improvements and mitigation measures are implemented during project development, the LOS ratings will improve and CO concentrations reduced.

The CAL3QHC air quality model developed by the USEPA was used to analyze the potential air quality impacts at specific receptors surrounding the intersection. CAL3QHC is presently listed in Supplement B to the USEPA *Guideline on Air Quality Models (Revised)* as the preferred air quality model to use for mobile air pollution emissions (USEPA 1987, USEPA 1990a).

Vehicle emissions were generated for 1994, 2006 and 2016 using MOBILE 5.0 emission factors, assuming the national average vehicle mix (USEPA 1993a). The idle emission factors were generated by the MOBILE 4.1 model, as recommended in CAL3QHC documentation and were adjusted for site-specific conditions (USEPA 1992, USEPA 1993b). The DOH has indicated that the average miles traveled per gallon per vehicle in the State of Hawaii is higher than the national average. This higher average is due to a higher number of fuel efficient vehicles (most likely rental cars) in operation. Therefore, using the national vehicle mix emission rates is conservative. Different emission factors were used for the various estimated speeds approaching the intersections (i.e., 45 miles

per hour (mph) along Kapule Highway and 30 mph along Rice Street). The MOBILE emission rates were used as input into CAL3QHC.

The CAL3QHC model is designed to calculate CO concentrations at signalized intersections. Because the intersection of concern is currently a stop sign, not a signalized intersection, some adjustments to the modeling approach were made. According to Braverman and Wholley (Personal Communication, 1992), a stop sign can be simulated by CAL3QHC by modeling queue lengths with an arbitrary signal time of 100 seconds of which 70 seconds are set as red time. Using this scenario, the model will generate the number of vehicles per hour that need to pass along the queue to generate an appropriate emission rate for the intersection. Wholley suggested running the model first as a signalized intersection to obtain the vehicles per hour at 100 emission factor. The CAL3QHC number of vehicles determined by the model were then used to represent the queuing vehicles going through the stop sign assuming no queues.

The maximum 1-hour average concentration of CO was estimated based on the worst-case meteorological conditions of a wind speed of 1.0 meters per second (mps) and a stability class of D. This stability class is considered appropriate for the study involved.

Receptors (i.e., locations where the ambient CO concentrations are calculated) were placed outside of the mixing zone 10-ft from the roadways. Figure 3-1 shows the roadway and locations of receptors used in the CAL3QHC model.

A typical ambient 1-hour average CO concentration is 2 ppm. As mentioned earlier, high concentrations of CO, known as "hot spots," can occur at locations where traffic is congested, such as at intersections and along highways. For this scenario, we have modeled an intersection consisting of a highway and side street. The modeling results show typical CO concentration levels that are found at these locations. Table 3-1 summarizes the maximum model predicted 1-hour and 8-hour CO concentrations for the existing conditions, the future without the project, and the future with the project.

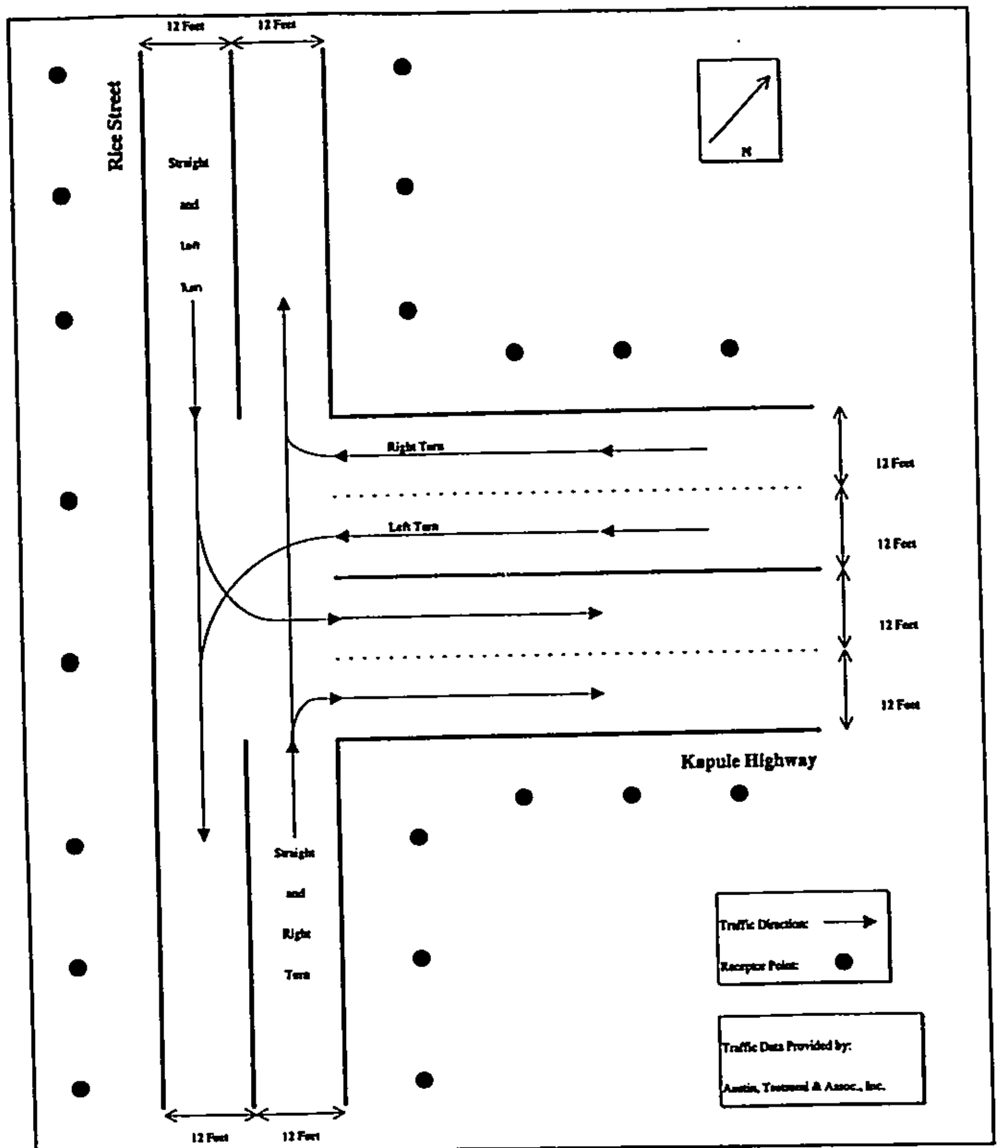

FIGURE 3-1

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SCEMATIC DIAGRAM OF CAL3QHC MODELING ANALYSIS AT THE KAPULE HIGHWAY AND RICE STREET INTERSECTION

Table 3-1
MAXIMUM PREDICTED CO CONCENTRATIONS
(ppm)

		Maximum Predicted 1-hour CO concentrations					
Year	Time	Ambient	Base No Project	With Project	Total Concentration	SAAQS	NAAQS
1994	am	2.00	3.60		5.60	9	35
1994	pm	2.00	3.60		5.60	9	35
2006	am	2.00		4.20	6.20	9	35
2006	pm	2.00		3.90	5.90	9	35
2006	am	2.00	3.50		5.50	9	35
2006	pm	2.00	3.60		5.60	9	35
2016	am	2.00		5.00	7.00	9	35
2016	pm	2.00		5.50	7.50	9	35
2016	am	2.00	4.20		6.20	9	35
2016	pm	2.00	4.30		6.30	9	35

Note: 1-hour CO SAAQS of 10,000 µg/m3 is equivalent to 9 ppm.
1-hour CO NAAQS of 40,000 µg/m3 is equivalent to 35 ppm.

Table 3-1 (Continued)
MAXIMUM PREDICTED CO CONCENTRATIONS
(ppm)

		Maximum Predicted 8-hour CO concentrations					
			Base	With	Total		
Year	Time	Ambient	No Project	Project	Concentration	SAAQS	NAAQS
1994	am	1.40	2.52		3.92	4	9
1994	pm	1.40	2.52		3.92	4	9
2006	am	1.40		2.94	4.34	4	9
2006	pm	1.40		2.73	4.13	4	9
2006	am	1.40	2.45		3.85	4	9
2006	pm	1.40	2.52		3.92	4	9
2016	am	1.40		3.50	4.90	4	9
2016	pm	1.40		3.85	5.25	4	9
2016	am	1.40	2.94		4.34	4	9
2016	pm	1.40	3.01		4.41	4	9

Note:. 8-hour CO SAAQS of 5,000 μg/m3 is equivalent to 4 ppm.
8 -hour CO NAAQS of 10,000 μg/m3 is equivalent to 9 ppm.

One-hour modeling results

For the 1-hour modeling scenarios, there are no potential violations of the SAAQS or NAAQS. For the years 2006 and 2016, with or without the development project, the modeling results indicate that there will be no anticipated exceedances of the Federal or State CO standards. The results shown in Table 3-1 lists the maximum predicted CO concentrations for the wind direction that caused the highest overall concentration.

Eight-hour modeling results

Based on USEPA guidelines, a persistence factor of 0.7 was used to estimate the 8-hour average CO concentration from the predicted 1-hour values. For the 8-hour modeling scenarios, there are no potential violations of the NAAQS, but there are potential violations of the SAAQS for the years 2006 and 2016 with the development project if no mitigation measures are taken. Mitigation measures are discussed in Section 4 of this report. The results shown in Table 3-1 lists the maximum predicted CO concentrations for the wind direction that caused the highest overall concentration.

3.3 INDIRECT POLLUTANT IMPACTS

The project will have additional air quality impacts beyond those associated with construction and traffic. For example, street lights have no direct emissions of air pollutants. However, these lighting fixtures will increase energy demand from power generating facilities. This increased demand though minimal will also contribute to the regional air pollution background, yet total air pollution generated will have little impact in the area and will remain below the SAAQS. Therefore, impacts beyond those associated with construction and traffic are considered to be insignificant.

As the population on the Island of Kauai grows, increased demand will dictate that Kauai Electric be able to provide additional electricity. Though Kauai Electric is presently investigating increasing electrical output on Kauai, currently the majority of the island's electricity is generated by burning fuel oil which emits SO_2, NO_x, PM, and HC. The impact from these emissions will be external to the proposed development site, but because additional electrical demands will be generated by the project, a portion of these emissions are attributable to it. This increase in electrical demand as a result of the project will have little impact in the area and pollutant concentrations are expected to remain below the SAAQS. Therefore, impacts associated with electrical demand are considered to be insignificant.

Other potential indirect sources of air pollution include pesticide use. Impacts associated with indirect pollution sources are not expected to significantly impact the regional air quality, and are therefore, considered insignificant as well.

The only stationary pollutant sources in the vicinity of the project are Niu Construction Inc., which is an asphalt concrete batch plant and the Lihue Airport. PM_{10} emissions from these sources have been accounted for in the existing ambient concentration levels as measured by DOH monitoring stations in Lihue. Increased contributions of PM_{10} from these sources resulting from the development project are negligible.

SECTION 4
MITIGATION MEASURES

This section describes the mitigation measures that can be employed to minimize or reduce the potentially adverse environmental impacts from the proposed development. The mitigation measures vary according to impact type. The following subsections discuss mitigation measures for short-term, long-term, and indirect pollutant impacts.

4.1 Short-Term Measures

Fugitive dust and heavy equipment use are the primary short-term emission sources. Fugitive dust emissions can be mitigated by ensuring that appropriate brush clearing and construction operations are practiced. These include: minimizing the number of concurrent brush clearing and construction activities, and watering, which can minimize fugitive dust emissions by fifty percent. Onsite personnel should determine the locations and application times for watering based on construction activities and local meteorological conditions.

The following measures can be taken to reduce potential impacts due to exhaust emissions from construction equipment. These measures include utilizing electrical equipment and/or fuel burning equipment with air pollution control technologies applied (i.e., source catalytic converter, and fuel injection timing retard).

4.2 Long-Term Measures

The development project, without consideration for ambient CO concentrations, is not expected to raise CO concentrations above the significance level. When ambient concentrations are added to the project, CO concentration levels in the year 2006 and 2016 exceed the SAAQS during an 8-hour period if not mitigated. However, the development project has incorporated into the project strategy mitigation measures designed to reduce overall motor vehicle emissions. Implementation of these measures listed below will aid in reducing pollutant emissions associated with the large number of vehicles traveling to and from the development site.

- Implement traffic flow improvement measures, such as proper signalization and road widening for intersections with poor LOS ratings
- Encourage ride-sharing/car pooling or use of public transportation by employees
- Limit the number of passenger parking spaces to promote the use of shuttle services and public transportation
- Discourage idling vehicles at drop-off points
- Implement bicycle lanes for bicycling
- Encourage walking

4.3 INDIRECT MEASURES

Indirect pollutant impacts are not considered to be significant. Due to the negligible impact of these sources, no additional reduction measures are warranted.

SECTION 5
CONCLUSION

The air quality impact analysis for the development project reveals potential short-term significant impacts. The potential for significant fugitive dust generation during the construction phase will exist. However, there are mitigation measures that can be taken to reduce the air quality impact, which will be localized and temporary. Mitigation measures include: minimizing the number of concurrent brush clearing and construction activities, and watering, which can minimize fugitive dust emissions by fifty percent.

Modeling results indicate that the long-term air quality impact of project intersections would be significant for 8-hour SAAQS in the years 2006 and 2016 if the traffic consultant's base improvements and project mitigation measures are not implemented. However, emissions should become significantly less as the proposed transportation improvements are developed and the LOS ratings of project intersections are improved to "D" or better. Mitigation measures designed to reduce overall motor vehicle emissions can be incorporated into the project strategy. Mitigation measures that can be taken include public access to alternate forms of transportation, such as public transportation, car pooling, bicycling and walking. Impacts associated with indirect pollution sources are not expected to significantly impact the regional air quality, and are therefore, considered insignificant.

As a result of the new development project site, there will be no agricultural sugar cane burning in this area. Hence, there will be a decrease in emissions of particulate matter into the environment. This will be a positive net result. Additional positive impacts of the project will be reductions in: pesticide use, and travel time and distance to jobs for the residents.

SECTION 6
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Lihue-Hanamaulu Master Plan
Social Impact Assessment

Lihue - Hanama'ulu Master Plan

Social Impact Assessment

Prepared for Amfac/JMB Hawaii

by Earthplan

September 1994

Contents

1. Background and Introduction 1

- 1.1 Report Purpose and Preparation 1
- 1.2 Report Organization 2
- 1.3 Description of the Proposed Plan 3

2. Profile of the Existing Community 6

- 2.1 Historic Perspective 6
- 2.2 Population Trends 9
- 2.3 Demographic Characteristics 12
- 2.4 Education and Labor Force 14
- 2.5 Household and Family Characteristics 17
- 2.6 1990 Housing Unit Characteristics 21
- 2.7 Economic Profile 24
- 2.8 Effects of Hurricane Iniki 26

3. Major Forces for Change 29

- 3.1 County-wide Projections 29
- 3.2 Public Policies 31
  - 3.2.1 State Land Use Boundary Review ... 31
  - 3.2.2 Kaua'i General Plan 33
  - 3.2.3 Lihu'e Development Plan 34
- 3.3 Possible Changes Independent of Proposal 35

4. Potential Social Impacts 37

- 4.1 Resident Population Impact 37
- 4.2 Implications for Regional Development 40
  - 4.2.1 Community Objectives 40
  - 4.2.2 Effect on Lihu'e Town 41

4.3 Impact on the Neighboring Communities........45
4.3.1 Description of Existing Neighborhoods .46
4.3.2 Project Impacts 48
4.4 Displacement..49
4.5 Impact on Public Services and Facilities 49
4.5.1 Police Protection.............................49
4.5.2 Fire Protection................................51
4.5.3 Recreation.......................................52
4.5.4 Health Care Facilities 54
4.5.5 Schools 56

5. Preliminary Community Issues 59

5.1 Background and Methodology........................59
5.1.1 Description of Issues Analysis 59
5.1.2 Description of the Interview Process 60
5.1.3 Profile of Those Interviewed 61
5.2 Summary of Interview Findings......................63
5.3 Feelings About the Existing Community.........64
5.3.1 Community Strengths and Positive Characteristics 64
5.3.2 Problems and Issues.......................65
5.3.3 Solutions and Expectations 67
5.4 Knowledge of and Use of the Project Site 68
5.5 Reactions to the Proposed Plan 68
5.5.1 Positive Aspects..............................68
5.5.2 Potential Problems and Issues 70
5.5.3 Project-Related Recommendations..71
5.6 Analysis..73

6. References 76

Appendix A: List of People Interviewed in This Study

Tables and Figures

1. Proposed Land Use Allocation 5
2. Kaua'i Resident Population by Planning Area, 1970 to 1990 11
3. Age and Ethnicity: 1990 13
4. Education and Labor Force: 1990 15
5. Households and Families: 1990 19
6. 1990 Housing Characteristics 22
7. Economic Data for Kaua'i County: 1988 to 1993. 24
8. M-K Population and Economic Projections for Kaua'i County: 1990, 2000 and 2010 30
9. Population and Economic Projections for Kaua'i County: 1990, 2000 and 2010 31
10. Lands Recommended for Urban Designation in the Five-Year Boundary Review 32
11. Estimated Resident Population: 1997 to 2017 38
12. Impact on Resident Population: 2000, 2010 and 2020 ..39
13. Hospital Utilization: 1992 55

1 Background and Introduction

1.1 Report Purpose and Preparation

Amfac/JMB Hawaii, Inc. proposes to develop lands in Lihu'e and Hanama'ulu on Kaua'i. A conceptual plan has been prepared for approximately 522 acres located just outside of Lihu'e town, and 30 acres situated near Hanama'ulu.

The land is currently designated for agricultural uses. Implementation of the project requires, in part, a State Land Use District Boundary amendment, a Kaua'i General Plan Amendment and a County change of zoning. An Environmental Impact Statement (EIS) is being prepared as part of the application process for these requests.

This report contains the social impact assessment (SIA) which was prepared in conjunction with the EIS. The SIA describes the existing social environment, evaluates a no-project scenario, identifies potential social impacts, and presents preliminary community issues. The SIA will be summarized in and appended to the EIS.

This report was prepared by Earthplan, whose offices are located at 81 South Hotel Street, Suite 211 in Honolulu. Berna Cabacungan, principal of Earthplan, was project manager, and primary researcher, interviewer, analyst, and writer.

Assistance was provided by two independent contractors. Traver Carroll analyzed census information, did research on relevant land use policies and other development projects, gathered information regarding public services and facilities and conducted interviews. Lani Nedbalek described the existing community and conducted interviews.

1.2 Report Organization

The remaining portion of Section 1 describes the proposed plan for this area.

Section 2 begins with a historical perspective and describes the existing community. Information includes population trends, demographic characteristics, labor force and education statistics, household and family characteristics, and housing information. This section also presents an economic profile, and information about County conditions after Hurricane Iniki.

Section 3 presents a future scenario of the area without the proposed project. The section includes information about public policies and other proposed projects which may be major forces for change independent of the proposed plan.

Potential social impacts are discussed in Section 4. Included in this discussion are population impacts, the effect on the character on the region, impacts on the surrounding neighborhoods, displacement, and impacts on public services and facilities.

In Section 5, preliminary issues about the project are presented. The issues analysis is based on community interviews conducted for this SIA.

1.3 Description of the Proposed Plan

The 552-acre project area is located on several parcels east, north and northeast of Lihu'e town and north of Hanama'ulu. The Molokoa, Ahukini Mauka, and Ahukini Makai segments are bounded by Hanama'ulu Stream on the north and west, county and state lands on the south and east, and a portion of the Molokoa Lihu'e Homes on the southwest. The Hanama'ulu segment lies to the north of Hanama'ulu Stream beyond the Hanama'ulu Town Tract. The following describes the four sub-areas:

- **Molokoa**

  This sub-area is the southernmost portion of the project area, and is located south of Ahukini Road immediately east of the existing Lihu'e town. The Molokoa sub-area encompasses approximately 156 acres and is envisioned as the main commercial center and civic facility center of the total project. Single family residential and multi-family uses are also planned for this area.

- **Ahukini Mauka**

  This 222-acre sub-area is located immediately north of the Molokoa sub-area and Lihu'e Town. The predominant use planned for this area is residential. This plan component is complemented by commercial and office uses and service industrial uses, as well as multi-family residential units and school and park uses.

- **Ahukini Makai**

  Located makai of the Kapule Highway and east of the Ahukini Mauka sub-area, this portion of the project area covers 144 acres. Its primary function in the overall plan is to provide areas for airport-related and other industrial uses.

- **Hanama'ulu**

  This sub-area is located at the intersection of Kapule and Kuhio Highways and encompasses 30 acres and is planned for residential uses.

The major components in the Lihu'e-Hanama'ulu Master Plan are as follows. *Table 1* shows how the plan breaks down by sub-area.

- **Residential component**

  Amfac/JMB proposes to develop between 1,400 and 1,800 residential units. Between 1,000 and 1,250 units are proposed as single family units; this accounts for 69 percent of the residential count. The remaining units are proposed for multi-family development.

  Most of the residential units are to be located in the Ahukini Mauka sub-area. No residential uses are planned for Ahukini Makai.

- **Village Mixed Use**

  Mixed use areas are proposed for approximately 70 acres. The Village Mixed Use areas are to contain commercial and retail establishments and offices. Most of this area, or 58 acres, would be located in the Molokoa sub-area. The Ahukini Mauka sub-area would contain twelve acres of Village Mixed Use.

- **Industrial**

  The industrial component would be located in the Ahukini Makai sub-area. This area would complement the adjacent airport and Nawiliwili Harbor, and provide manufacturing and warehouse spaces. Also proposed in the industrial area is a 35-acre County Debris Recycling Station and a four-acre

Fruit Disinfestation Center to be operated by the University of Hawai'i.

- **Public facilities**

The proposed plan includes several public facilities. In the Molokoa sub-area, 23 acres are planned for a variety of public and quasi-public facilities. A Veterans Center is already under construction, and other uses may include a YMCA - Teen Center, the Kaua'i Judiciary Complex, and a police station. Also, eight acres are proposed for a school site in Ahukini Mauka.

Approximately 48 acres of parks and open space will be available to the public, as well as a system of bike routes and pedestrian walkways.

Table 1: Proposed Land Use Allocation

Plan Component	Approximate Acreage by Sub-Areas				
	Molokoa	Ahukini -Mauka	Ahukini -Makai	Hanama 'ulu	Total
Residential	59	124		29	212
Village Mixed Use	58	12			70
Industrial and service		26	102		128
Public and quasi public, inc. school	23	8	39		70
Parks and open space [a]	10	38			48
Major road-ways					24
Total	156	222	144	30	552

a. Includes the landscaped gateway area.

2 Profile of the Existing Community

This section establishes the social context for the proposed Lihu'e-Hanama'ulu Master Plan. Section 2.1 gives a brief historical perspective. This is followed by a discussion on population trends in Section 2.2.

Demographic information is presented in Section 2.3, and education and labor force characteristics are contained in Section 2.4. In Section 2.5, household and family statistics are presented, followed by housing information in Section 2.6. Economic information is presented in Section 2.7.

Most of the statistical information is derived from the 1990 U.S. Census, which is the most comprehensive source available for this analysis. Hurricane Iniki, which occurred in 1992, has drastically altered Kaua'i's social and economic environment, and information regarding some of these changes are presented in Section 2.8.

2.1 Historic Perspective

Kaua'i, the oldest of the main populated islands in the Hawaiian archipelago, lies approximately 70 miles northwest of O'ahu. Diverse topographic features and climatic conditions lend distinction to inland landscapes, where rain waters from Mount Wai'ale'ale, the "wettest spot on earth," drain into the bogs and mire of the Alaka'i Swamp, and the eroded beachfront cliffs of Na Pali back the canyon walls of Waimea. Beaches, bays and inlets form coastal views surrounding the island's fringe.

Kaua'i's natural environment played a part in the island's early history, when channel winds and currents swamped the invading forces of King Kamehameha I. A second attempt to conquer the island also failed, and Kaua'i remained independent from the king's rule. After all the other islands had been subjugated, Kaua'i's king, Kaumuali'i, joined Kamehameha through negotiations, not warfare.

Presently five districts delineate Kaua'i: Kawaihau, Hanalei, Waimea, Koloa and Lihu'e. [1] The project area is located in the Lihu'e District, whose boundaries extend from the "Hoary Head" Range north to the Wailua River and include Hanama'ulu, where during the 1830s, Kaikioewa, the area's governor, erected a harbor opening windward. [2]

The name Lihu'e (*cold chill*) first appears in written records during the 1830s. It is believed to have been bestowed by Governor Kaikioewa, who constructed his residence and a church in the area, with the apparent intentions of creating a "place of considerable importance." Kaikioewa found the area's soils and rainfall suitable for growing cane, and before his death in 1839, a few acres of crop had been planted on selected tracts. [3]

In the decades that followed, much of Lihu'e's lands would be occupied by fields of sugarcane planted by The Lihue Plantation Company, Limited, an enterprise conceived when Henry A. Pierce, the son of a Boston merchant arrived at Nawiliwili Bay and visualized the area growing with cane. Efforts and alliances proved sufficient to form the needed partnerships to purchase land, build a mill, and hire a labor force of Hawaiians, who built their homes on the land surrounding the mill.

1. *Clark, 1990.*
2. *Joesting, 1987.*
3. *Joesting, ibid.*

In 1863, Paul Isenberg leased the ahupua'a of Hanama'ulu and, in 1870, purchased 17,000 acres at auction for Lihue Plantation. Wailua lands were leased in 1887, and in 1916, additional lands at Kealia and Kapa'a were purchased. Lihue Plantation then extended almost the entire length of the east coast of Kaua'i.

In 1870, George Wilcox had bought the nearby Grove Farm Plantation from Herman Widemann for $12,000. Four years later, sugarcane grew on 200 acres of land. In 1881, an additional 10,500 acres of land at Ha'iku increased the acreage tenfold and made the production of cane economically profitable. [4]

In the meantime, as on the other islands, immigrants were arriving. People of Chinese, Japanese, Puerto Rican, Korean, German, Portuguese, Filipino and other ancestry added to the growing community that included workers from the nearby Hanama'ulu and Grove Farm plantations. According to written reports, Lihue Plantation and these other two plantations formed one community.[5]

Sugar from Grove Farm and Lihue Plantation was originally shipped from Ahukini Landing at the edge of Hanama'ulu Bay. Later, in the early 1900s, Nawiliwili became the main port of exit. Lihu'e, as the closest population center, became the island's seat of government. [6]

Today the islandwide population numbers over 50,000. More than 5,000 persons reside in the town of Lihu'e, which now includes shopping areas, state and county offices, banks, a stadium, convention hall, library, and establishments associated with a

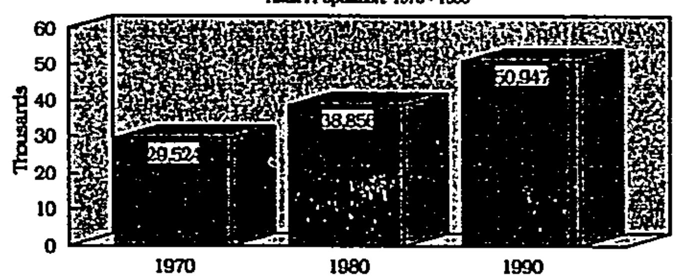
4. *Joesting, ibid.*
5. *Kaua'i Historical Society, 1991.*
6. *Donohugh, 1991.*

business and government hub. Another 5,000 people live in the neighboring Puhi and Hanama'ulu residential communities.

2.2 Population Trends

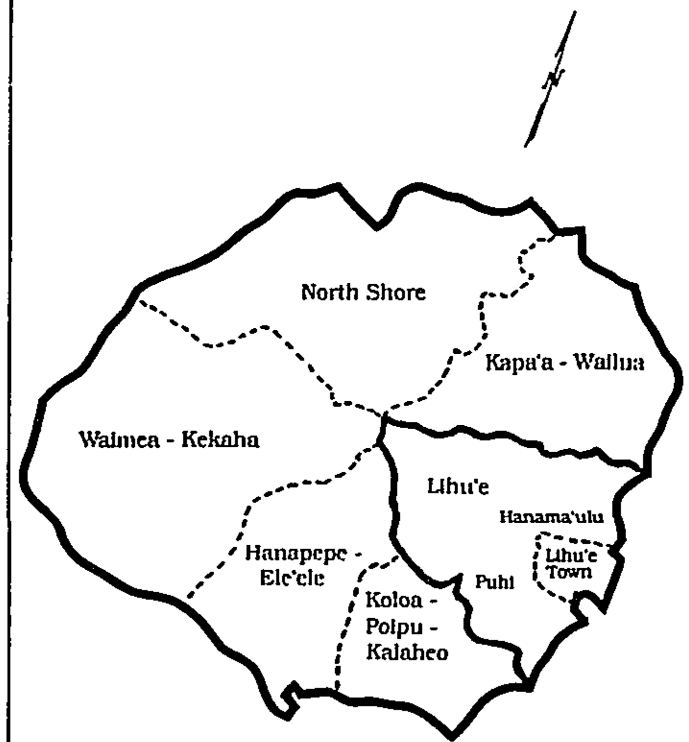
As *Figure A* indicates, Kaua'i's population has grown from 29,500 in 1970 to almost 51,000 in 1990.

Figure A
Kaua'i Population: 1970 - 1990



Over the 20-year period, Kaua'i's population grew by 73 percent. When one compares growth within these two decades, the rates and proportions are similar. Between 1970 and 1980, the island's population grew by 32 percent, for an average annual growth rate of 2.8 percent. In the 1980s, the overall change was 31 percent, with an average annual rate of 2.7 percent.

Figure B illustrates the planning areas delineated by Kaua'i County. In terms of population, the largest planning area is Kapa'a - Wailua, which housed a population of over 15,600 persons in 1990. As shown in *Table 2*, between 1980 and 1990, Kapa'a-Wailua experienced a 49 percent increase over the 1980 population, which represents an average annual growth rate of four percent in that decade.



FigureB
Kaua'i County Planning Areas
and SIA Study Area

The fastest growing area is also Kaua'i's smallest planning area in terms of resident population. The North Shore population grew by almost 74 percent between 1980 and 1990, at an average of 5.7 percent a year. The North Shore's 1990 population is estimated at 4,631 persons.

Table 2: Kaua'i Resident Population by Planning Area, 1970 to 1990

Planning Area	1970	1980	1990	Percent Change 1980-1990	Average Annual Growth Rate 1980-1990
Lihu'e [a]	6,786	8,590	10,663	24.13%	2.19%
Kapa'a-Wailua [b]	7,393	10,497	15,627	48.87%	4.06%
North Shore [c]	1,182	2,668	4,631	73.58%	5.67%
Waimea-Kekaha [d]	4,159	5,256	5,745	9.30%	0.89%
Hanapepe-Ele'ele [e]	6,883	7,996	9,381	17.76%	1.65%
Koloa - Poipu [f]	3,141	3,879	4,900	26.32%	2.36%
Total Kaua'i	29,524	38,856	50,947	31.12%	2.75%

a. Lihu'e comprised Census Tracts 404 and 405 in 1990.
b. Kapa'a -Wailua comprised Census Tracts 402.01, 402.02 and 403 in 1990.
c. The North Shore is coterminous with Census Tract 401.
d. Waimea-Kekaha is coterminous with Census Tract 409.
e. Hanapepe - Ele'ele includes Census Tracts 407 and 408.
f. Koloa - Poipu is coterminous with Census Tract 406.

Source: U.S. Bureau of the Census 1970 PHC (1) 88, 1972; 1980 PHC 80-2-13, 1983; and 1990 CPH-3-13, 1993.

The project area is located in the Lihu'e Planning Area, which is the second largest planning area in Kaua'i County. Lihu'e's population grew from 8,600 in 1980 to 10,700 persons in 1990. This

translates into a 27 percent increase from 1980 to 1990 and an average annual growth rate of 2.19 percent.

2.3 Demographic Characteristics

The Lihu'e Planning Area was selected as the Study Area for this SIA.[7] The Study Area was further delineated into two areas. Census Tract 405 boundaries are generally coterminous with Lihu'e Town. The communities of Hanama'ulu and Puhi are part of the larger Census Tract 404. *Figure B* shows the Study Area for this report.

As indicated in *Table 3*, approximately 20 percent of Kaua'i's population or 10,659 people lived in the Lihu'e Planning Area in 1990. There are roughly the same number of people living in Lihu'e Town as in the combined communities of Hanama'ulu and Puhi. In 1990, 5,275 people resided in Lihu'e town; in Hanama'ulu and Puhi, 5,384 persons.

Overall, Lihu'e Planning Area residents tended to be slightly older than the islandwide population. The Planning Area median age was 34.9 years, whereas the island median age was 33.9 years.

Within the district, the Lihu'e Town population tended to be older than that of Hanama'ulu and Puhi. Only 21 percent of the population was younger than 18 years old, compared to 28 percent islandwide, and 29 percent in Puhi and Hanama'ulu. Also, the median age in Lihu'e Town was 38.7 years, which is almost five years older than Kaua'i's and more than seven years older than the median age of 31.1 years in Puhi and Hanama'ulu.

7. *While the boundaries of Census Tracts 404 and 405 do not exactly coincide with the Lihu'e Planning Area, they collectively include the Planning Area's populated areas.*

Table 3: Age and Ethnicity: 1990

	Kaua'i	Total Lihu'e Planning Area	Lihu'e Town [a]	Hanama'ulu and Puhi [b]
Population	51,177[c]	10,659	5,275	5,384
Age				
Less than 5	7.8%	6.5%	5.2%	7.8%
5 to 17 years	19.8%	18.5%	15.6%	21.4%
18 to 44 years	41.3%	39.1%	39.5%	38.7%
45 to 64 years	18.0%	20.3%	20.5%	20.1%
65 years +	13.1%	15.6%	19.2%	12.0%
Median Age [d]	33.9 years	34.9 years	38.7 years	31.1 years
Ethnicity				
Caucasian	34.6%	23.3%	30.0%	16.8%
Chinese	1.6%	1.6%	2.1%	1.1%
Filipino	24.8%	36.1%	15.0%	56.7%
Hawaiian	15.1%	11.1%	11.5%	10.6%
Japanese	20.0%	25.1%	38.5%	12.0%
Korean	0.4%	0.3%	0.3%	0.2%
Other	3.4%	2.5%	2.6%	2.5%

a. Lihu'e Town is Census Tract 405.
b. Hanama'ulu and Puhi are in Census Tract 404.
c. The U.S. Census includes the population of Ni'ihau in the total for Kaua'i County
d. Planning Area aggregate was calculated as a weighted means of medians.

Source: U. S. Bureau of the Census 1991 and 1992

Compared to Kaua'i County, the Lihu'e Planning Area tended to have more people of Filipino and Japanese ancestry. Collectively, these two ethnic groups made up over 60 percent of the Planning Area population. Islandwide, Filipinos and Japanese accounted for 45 percent of the population.

There were ethnic distinctions within the Lihu'e Planning Area communities. In Lihu'e Town the largest ethnic group was Japanese, at 38.5 percent. This is high, compared to the islandwide proportion of 20 percent. Consequently, the Lihu'e Town proportions of Caucasians, Filipinos and Hawaiians were lower than those of Kaua'i County.

In Hanama'ulu and Puhi, there was a significantly high proportion of people of Filipino ancestry; they accounted for 56.7 percent of the total population. This is more than double the islandwide proportion of 24.8 percent. The proportions of Japanese and Caucasians were relatively low. Like Lihu'e Town, the percentage of persons of Hawaiian Ancestry in Hanama'ulu and Puhi (10.6 percent) was lower than that of Kaua'i.

2.4 Education and Labor Force

Islandwide, 27 percent did not complete high school, as shown in *Table 4*. In the Lihu'e Planning Area, this proportion was higher at 30 percent, and this is mostly due to the Hanama'ulu and Puhi communities, where 39 percent had less than a high school education. In Lihu'e Town, 22 percent did not complete high school.

The proportions of college graduates for the Lihu'e Planning Area and the island were almost equal at 16.4 percent and 16.3 percent, respectively. Within the Lihu'e Planning Area, Lihu'e Town residents tended to have more education than those in the surrounding communities. The proportion of college graduates for Lihu'e Town was a high 21 percent while the surrounding area's was eleven percent.

Table 4: Education and Labor Force: 1990

	Kaua'i	Total Lihu'e Planning Area	Lihu'e Town [a]	Hanama'ulu and Puhi [b]
Educational Attainment *(for people 25 years and older)*				
Less than high school	26.9%	30.1%	22.2%	39.3%
High school graduate	26.9%	26.4%	27.8%	24.9%
Some college	30.0%	27.1%	29.1%	24.8%
Four or more years of college	16.3%	16.4%	21.0%	11.0%
Labor Force *(for people 16 years and older)*				
In civilian labor force	68.3%	67.5%	65.9%	69.3%
In armed forces	0.7%	0.2%	0.2%	0.2%
Not in the labor force	31.1%	32.3%	33.9%	30.5%
Unemployed	3.6%	3.5%	2.8%	4.2%

Table 4: Education and Labor Force: 1990 *(Continued)*

	Kaua'i	Total Lihu'e Planning Area	Lihu'e Town [a]	Hanama'ulu and Puhi [b]
Occupation of the Civilian Labor Force				
Managerial and professional	22.3%	21.3%	29.0%	13.6%
Technical and sales	26.9%	27.3%	28.8%	25.8%
Service	21.3%	20.4%	14.7%	26.1%
Farming and fishing	6.2%	5.8%	3.8%	7.9%
Precision and craft	12.2%	12.3%	15.0%	9.5%
Operator and laborer	11.0%	12.8%	8.7%	17.0%
Mean travel time to work [c]	19 minutes	12.6 minutes	12.4 minutes	12.8 minutes

a. Lihu'e Town is Census Tract 405.
b. Hanama'ulu and Puhi are in Census Tract 404.
c. Planning Area aggregate was calculated as a weighted means of medians.
Source: U. S. Bureau of the Census 1991 and 1992

Labor force statistics from 1990 indicate that the Lihu'e Planning Area exhibited an unemployment rate similar to that of Kaua'i, at 3.5 percent and 3.6 percent, respectively. However, a comparison within the Planning Area indicated a higher unemployment rate for Hanama'ulu and Puhi of 4.2 percent and a lower one for Lihu'e Town at 2.8 percent.

The most recent unemployment rate for Kaua'i County is estimated at 12.4 percent in April 1994.[8]

When compared to islandwide statistics the Lihu'e Planning Area tended to mirror Kaua'i's occupational pattern with less than one percentage point difference in any of the categories.

There were big differences within the Planning Area, however. Residents in Lihu'e Town had proportionally more than twice the managerial jobs (29 percent) than those in the surrounding area (14 percent). They also held proportionally slightly over half the service jobs (15 percent versus 26 percent) of the surrounding area.

As may be expected, Lihu'e Planning Area residents tended to spend less time traveling to work than their islandwide peers. The mean travel time to work for the Lihu'e Planning Area was 12.6 minutes; for Kaua'i County, 19.0 minutes. For further comparison, Wailua and Kapa'a had mean travel times of 19.8 and 22.2 minutes, respectively, in 1990.

2.5 Household and Family Characteristics

Household sizes were small in Lihu'e Town, but significantly large in Hanama'ulu and Puhi. In 1990, Kaua'i's average household size was 3.1 persons. Lihu'e Town had an average of 2.6 persons per household, while Hanama'ulu and Puhi had large households with an average of 3.91 persons.

8. *Personal communication with Manual Fragante, Statistician in the Statistics Office of the Hawai'i Department of Labor, June 14, 1994.*

Family households are those in which members are related to each other. Overall, the Lihu'e Planning Area tended to be slightly less family-oriented than the islandwide community. As shown in *Table 5*, more than three-fourths of Kaua'i's households were family households. In the Lihu'e Planning Area, only 71 percent of total households were families.

Lihu'e Town tended to have a very low proportion of family households with 65 percent in this category. Puhi and Hanama'ulu had a significantly higher proportion of family households, with 81 percent.

When compared to the overall Kaua'i County, the Lihu'e Planning Area had a lower proportion of married couples with children under 18 years old. About 35 percent of the overall Lihu'e Planning Area families had young children, compared to the islandwide 41 percent.

Consistent with the high median age, Lihu'e Town had a low proportion of 33 percent of its families with young children. Puhi and Hanama'ulu had 38 percent in this category.

The Lihu'e Planning Area had relatively large families. Islandwide, the average family size was 4.14 persons. In the Lihu'e Planning Area, there were 4.40 persons per family. The largest families were found in Puhi and Hanama'ulu, with 4.75 persons per family.

Table 5: Households and Families: 1990

	Kaua'i	Total Lihu'e Planning Area	Lihu'e Town [a]	Hanama'ulu and Puhi [b]
Households	**16,326**	**3,375**	**1,983**	**1,392**
Percent of Family Households	75.8%	71.8%	65.1%	81.4%
Persons per Household	3.10 persons	3.16 persons	2.60 persons	3.91 persons
Family Households				
Married couples	81.9%	80.5%	82.3%	78.5%
with children under 18	41.2%	35.2%	32.5%	38.1%
Female householder	11.9%	12.0%	11.5%	12.7%
with children under 18	5.6%	4.4%	3.6%	5.2%
Persons per Family	4.14 persons	4.40 persons	4.09 persons	4.75 persons
Median Family Income	$41,099	$45,023	$48,472	$41,334
percent of families below poverty level	5.0%	4.6%	3.2%	6.0%
Residence in 1985				
Same house	57.2%	57.7%	54.7%	60.8%
Same island	21.9%	20.7%	18.1%	23.4%
Other island	6.0%	7.7%	8.1%	7.2%

Table 5: Households and Families: 1990 *(Continued)*

	Kaua'i	Total Lihu'e Planning Area	Lihu'e Town [a]	Hanama'ulu and Puhi [b]
Other state	11.9%	10.4%	16.3%	4.4%
Abroad	2.9%	3.5%	2.8%	4.3%

a. Lihu'e Town is Census Tract 405.
b. Hanama'ulu and Puhi are in Census Tract 404.
Source: U. S. Bureau of the Census 1991 and 1992

Families had relatively high incomes in the overall Lihu'e Planning Area. In 1990, the Kaua'i median family income was $41,099. The weighted median for the Lihu'e Planning Area was $45,023.

The median family income for Lihu'e Town and the surrounding communities differed significantly. In Lihu'e Town, the median family income was a high $48,472. The median for Puhi and Hanama'ulu was $41,334.

Puhi and Hanama'ulu also had a higher proportion of families below the poverty level. Six percent of the area's families were below the poverty level, as compared to five percent islandwide. Lihu'e Town had a very low three percent of families below the poverty level.

In terms of residential stability, the Lihu'e Planning District tended to reflect the stability of the islandwide community. For both, the proportion of families who lived in the same house for at least five years was about 57 percent. Puhi and Hanama'ulu tended to have slightly more residents in this category, at 61 percent.

Lihu'e Town tended to have proportionally more in-migrants. In 1990 eight percent had lived on another island five years prior, while another 16 percent lived in another state in 1985. The proportions for Kaua'i were six percent and twelve percent, respectively.

2.6 1990 Housing Unit Characteristics

In 1990, there were 3,526 housing units in the Lihu'e District. Lihu'e Town contained 2,141 units or 61 percent of the Lihu'e District count.

As indicated in *Table* 6, home ownership was prevalent in the Lihu'e Planning Area. Whereas 54 percent of Kaua'i's housing units were owner-occupied in 1990, 56 percent of Lihu'e Planning Area's housing units were owner-occupied.

Within the Planning Area, Puhi and Hanama'ulu had a higher rate of homeownership (66 percent) than Lihu'e Town (49 percent).

The Lihu'e Planning Area is considered a desirable place to live, as suggested by relatively low housing vacancy rates. At 5.6 percent, the 1990 housing vacancy rates in the Lihu'e Planning Area was lower than the islandwide 7.5 percent. The vacancy rate of 2.9 percent was very low for Puhi and Hanama'ulu, especially when compared to the islandwide and Lihu'e Town rate of seven percent.

Lihu'e Town also had a higher proportion of multi-family units. Thirty-seven percent of the town's housing units were multi-family units, compared to the islandwide proportion of 21 percent. The proportion of multi-family units in Puhi and Hanama'ulu was relatively low at 26 percent.

Table 6: 1990 Housing Characteristics

	Kaua'i	Total Lihu'e Planning Area	Lihu'e Town [a]	Hanama'ulu and Puhi [b]
Housing Units	**17,613**	**3,526**	**2,141**	**1,385**
Owner-occupied	54.4%	56.0%	49.3%	66.2%
Renter-occupied	38.1%	38.5%	43.4%	30.9%
Vacant	7.5%	5.6%	7.3%	2.9%
Units per Structure				
1 detached	79.1%	65.4%	59.6%	74.4%
1 attached	6.6%	8.9%	3.8%	16.8%
2 to 9	8.5%	12.9%	17.7%	5.5%
10 or more	3.7%	10.8%	17.4%	0.6%
Other	2.1%	1.9%	1.4%	2.7%
Median Value of Owner-Occupied Units	$171,500	$161,200	$176,300	$142,400
Median Rent of Renter-Occupied Units	$532	$595	$665	$508
Persons per room in occupied housing units				
1.00 to 1.50 persons per room	8.6%	8.0%	4.8%	12.9%
1.51 or more persons per room	7.4%	8.2%	3.4%	15.2%

a. Lihu'e Town is Census Tract 405.
b. Hanama'ulu and Puhi are in Census Tract 404.
Source: U. S. Bureau of the Census 1991 and 1992

If a unit contains one to 1.5 persons per room, it can be considered mildly crowded. With 1.51 or more persons per room, the unit is considered very crowded. On Kaua'i, 8.6 percent of the total housing units were considered mildly crowded in 1990, while another 7.4 percent were considered very crowded.

In general, the Lihue Planning Area's housing units had a lower rate of mildly crowded conditions (eight percent), and a higher rate of very crowded conditions (8.2 percent).

Crowding was most evident in Puhi and Hanama'ulu, where almost 13 percent of the units were mildly crowded. Another 15 percent were considered very crowded. This is consistent with the relatively large household sizes in these communities. Lihu'e Town had only a 4.8 percent proportion of units in the mildly crowded category and 3.4 percent in the very crowded category.

In 1990, the median value of owner occupied housing units in the Lihu'e Planning Area of $161,200 was lower than the islandwide median of $171,500. The median value in Lihue Town was slightly higher than that of the island at $176,300. The median value for Puhi and Hanama'ulu was $142,400 in 1990.

Rent was relatively high in the Lihu'e Planning Area. In 1990 the median monthly rent for Kaua'i was $532. The median for the Lihu'e Planning Area was $595. The median rent in Lihu'e Town ($665) was higher than that of Puhi and Hanama'ulu ($508).

2.7 Economic Profile

Selected economic data for Kaua'i from 1988 through 1993 is presented in *Table 7*. Most of the trends indicate steady growth until 1992, when Hurricane Iniki struck the island in September of that year.

Table 7: Economic Data for Kaua'i County: 1988 to 1993.

	Unit	Period	1988	1991	1993
Total Job Count	Number	Mo. Ave.	24,250	28,900	26,006
Unemployment Rate	Percent	Mo. Ave.	3.7	3.7	12.5
Gross Business Receipts	$Million	Year Total	777.1	984.8	682.2
State Tax Collections	$Thous	Year Total	55,252	67,116	50,452
Est. Westbound Visitors	Thous	Year Total	1,043.7	1,085.3	444.7
Est. Eastbound Visitors	Thous	Year Total	not available	182.3	127.1
Construction Put in Place	$Thous	Year Total	56,811	101,031	187,093
Sugar Production	Thous. Tons	Year Total	228	176	not available
Diversified Agriculture	$Thous	Year Total	13,034	13,598	not available

Source: First Hawaiian Bank, Research Department, "Economic Indicators," November/December 1993. The 1993 visitor count for Kaua'i was provided by Minh-Chau Trinh, Research Assistant, Research Department, at First Hawaiian Bank on June 13, 1994.

The most devastating economic impact has been to the island's tourist industry. The 1993 figures indicate a drop of more than two thirds in the number of visitors compared to the average of the totals between 1989 and 1991.

As of 1994, approximately half of the pre-Iniki room inventory of 8,000 units, including those in the Princeville and Hyatt Regency Kauai hotels, had resumed operation. Several other major hotels will not open until 1995, however, and some have not yet determined any opening date. Some of the delays have been due to insurance disputes.

Both the decrease in job count and the significant increase in unemployment are due to job losses in the tourist industry. For example, the Westin Kauai, tentatively scheduled to reopen in 1995, employed 1,200 workers and was the island's largest employer prior to Iniki, with about five percent of Kaua'i's work force.

Construction activity on Kaua'i was given a boost after the storm because of reconstruction efforts financed by both private insurance and Federal Emergency Management Agency (FEMA) funds. Construction put in place in 1993 was 85 percent greater than in the last year before Iniki.

Notwithstanding the increase in construction activity, the island's economy is recovering at a slower than hoped for pace. Compared to 1991, there has been a 31 percent decline in gross business receipts and a 25 percent decline in State tax revenues. If economic recovery, particularly in the tourist industry, does not occur in a timely fashion, then high unemployment will continue, which could lead to continued out-migration. The unemployment rate for Kaua'i is then expected to decline, because of both out-migration and reopening of some employment positions.

Current agricultural activity, once the mainstay of Kaua'i's economy, consists of declining sugar production and a gradually increasing diversified industry. The latter has experienced five percent growth in revenues over the last three years. The data does not indicate the extent of damage the industry sustained from the storm, but significant losses to most crops have been reported.

2.8 Effects of Hurricane Iniki

Hurricane Iniki passed over Hawai'i on September 11, 1992. Most of the significant damage occurred on Kaua'i, and as the information in Section 2.7 suggests, Kaua'i is still recovering from economic repercussions.

It is estimated that the damage done to Kaua'i by Hurricane Iniki is approximately four times the losses due to Hurricane Iwa ten years earlier. The total damage to public and private property was estimated at $1.6 billion, and is summarized as follows:

- **Commercial**

  It is estimated that damage to commercial facilities amounted to $668 million. Visitor accommodations sustained almost $312 million in damage, and it is estimated that visitor-related facilities, such as restaurants and attractions, suffered another $66 million in losses.

- **Residential**

  Approximately 77 percent of Kaua'i's 18,600 residential units suffered some damage. Over 7,000 units had minor damage, over 5,000 received major damage, and 1,420 units were totally destroyed. Anticipated insurance claims for residential losses totaled $674 million.

- **Public Utilities**

The electric and telephone companies had preliminary estimates of $139 million in damages.

- **Agriculture**

  The State Department of Agriculture estimates that damage to standing or harvested crops may have reached $75.5 million, and that facilities and agricultural infrastructure suffered about $2.5 million in damages.

- **Public Infrastructure**

  Government officials estimate that State and County facilities suffered damages of $122 million. Federal facilities incurred an estimated $3.6 million in losses.

Reconstruction continues to occur, albeit slowly. The Office of Emergency Permitting was established soon after the hurricane, and as of October 1993, about 3,900 permits were issued; this is only the halfway point for the estimated 7,900 permits which are estimated as needed.

While economic recovery continues, it is difficult to ascertain the extent of social recovery. The residential stability of the population is still in question. It is estimated by some that, immediately after the hurricane, about 15 percent of the households out-migrated. [9] This means that the local population may have decreased by between 7,000 and 8,000 persons. This is a guesstimate, however, and the extent of people returning to Kaua'i is unknown.

9. *Based on information provided by Dr. Leroy Laney, Senior Vice President and Chief Economist, Research Department, First Hawaiian Bank, June 14, 1994. This estimate was made during First Hawaiian Bank's annual Kaua'i economic survey in 1992. Sources included interviews with various people, including movers, as well as the number of electrical hookups. The survey estimated that Kaua'i lost approximately 15 percent of its households, and this estimate was extended to reflect a similar loss of population.*

At the same time, construction workers moved to Kaua'i. This temporary in-migration resulted in increased competition for much-needed housing and public assistance, as well as social problems, such as increased crime and conflicts between the workers and residents.

Further, social workers indicate that many are still recovering from the emotional and psychological stress of having to adjust to post-hurricane conditions. Many families have been doubling up while reconstruction occurred, and this sometimes results in domestic tension. Unemployment benefits have terminated for most, but jobs are still scarce.

3 Major Forces for Change

This section extends the baseline information established in Section 2 by exploring major influences which can direct the future of the Study Area.

Section 3.1 presents current population and economic projections for Kaua'i, based on State M-K projections. Section 3.2 presents information on the public policies which guide the development of Kaua'i County, with emphasis on the Lihu'e Planning Area. Section 3.3 identifies proposed projects which may alter the character or otherwise change the area in some way. Section 3.4 presents a possible future scenario of the area without the applicant's proposed actions.

3.1 County-wide Projections

The State Department of Business, Economic Development and Tourism prepares population and other projections for use by public agencies and the business communities. These projections are intended to assist in the planning of long term programs and policies that require many years of preparation. The projections are based on objective assumptions, and not necessarily on preferred levels of future economic activity or population. The projections are also intended to reflect the long-run average growth rates; they are not expected to match actual population and economic values in any given year. Currently, Series M-K projections are used.

The potential long-term economic effects of Hurricane Iniki are not reflected in the Series M-K projections, which were prepared in 1988. Hence, while these projections may be lower than what may actually occur, they nevertheless indicate a pattern of growth which is expected to occur.

It is generally expected that Kaua'i will experience a reduction in the pace of growth, compared to that experienced in the 1980s. Between 1980 and 1990, the County's population increased 31 percent. The State M-K projections anticipates that Kaua'i's population may reach 68,100 in 2010 and 84,600 in 2020. This translates into an increase of 26 percent between 1990 and 2000, and 24 percent between 2000 and 2010. *Table 8* contains these projections.

Table 8: M-K Population and Economic Projections for Kaua'i County: 1990, 2000 and 2010

	Projections (in thousands)			Percent Change		
	1990	2000	2010	1990 to 2000	2000 to 2010	1990 to 2010
County resident population	54.1	68.2	84.6	26.1%	24.1%	56.4%
De facto population [a]	70.1	94.0	120.3	34.1%	28.0%	71.6%
Civilian jobs	25.3	34.2	42.5	35.2%	24.3%	68.0%
Average visitor census	16.7	34.2	42.5	60.5%	37.7%	121.0%
Personal income *(in thousands of 1982 dollars)*	$11.6	$13.9	$15.1	19.8%	8.6%	30.2%

a. Includes visitors present in the County, but excludes residents temporarily absent.

Source: State Department of Business and Economic Development, 1988.

In terms of visitor industry growth, it is projected that Kaua'i will account for 13 percent of the statewide inventory of visitor units. Based on that assumption, Kaua'i's average visitor census was projected to reach 34,000 in 2000, which is a 60 percent increase over that projected for 1990.

3.2 Public Policies

3.2.1 State Land Use Boundary Review

In 1992, the Office of State Planning (OSP) conducted a statewide, comprehensive, policy-oriented examination of State land use district classifications. This Five-Year Boundary Review provides the state Land Use Commission the opportunity to review urbanization proposals from a long-range perspective, rather than only on a case-by-case basis.

As part of the Five-Year Boundary Review, OSP examined urban lands to determine whether there is sufficient urban-zoned land to accommodate population and economic growth. *Table 9* contains the population projections which were the bases of this analysis.

Table 9: Population and Economic Projections for Kaua'i County: 1990, 2000 and 2010

Planning Area	Projections [a]			Percent Change		
	1990	2000	2010	1990 to 2000	2000 to 2010	1990 to 2010
North Shore	5,787	6,936	8,158	19.9%	17.6%	41.0%
Kapa'a - Wailua	15,253	18,965	23,198	24.3%	22.3%	52.0%
Līhu'e	11,649	17,171	24,384	47.4%	42.0%	109.3%
Koloa - Poipu	13,690	16,049	19,300	17.2%	20.3%	41.0%
Waimea	7,720	8,719	9,559	12.9%	9.6%	23.8%
Total	54,099	67,840	84,599	25.4%	24.7%	56.4%

a. *The projections for 1990 are lower than that which actually occurred according the census information.*

Source: Office of the Governor, Office of State Planning, 1992.

The islandwide population projection basically mirrors the M-K population projections for Kaua'i. In terms of Planning Area allocations, the Līhu'e Planning Area is projected to experience steady growth through 2010, while increasing its share of islandwide population. In 1990, the Līhu'e Planning Area is projected to accommodate 21 percent of the islandwide population. This share is expected to increase to 25 percent in 2000 and 29 percent in 2010.

Based on these projections, on the supply of urbanized lands, and on the vacant developable lands, it was found that more land is needed in the Urban District to meet future requirements. An additional 1,100 acres are needed by 2000, and 3,800 acres are needed by 2010. *Table 10* lists the specific acreages recommended for inclusion in the Urban District.

Table 10: Lands Recommended for Urban Designation in the Five-Year Boundary Review

Area and Description	Recommended for Urban Designation
Hanama'ulu and Molokoa Encompasses the project area and includes a mix of uses, including residential, commercial and industrial uses, and public facilities	792 acres
Kauai Lagoons Resort Intended to conform the State land use classification to the existing use; 200 acres are already in golf course use; the remaining 48 acres are undeveloped	248 acres
Kukui'ula Phase 2 Intended to allow for development of second phase of A&B planned community; includes single- and multi-family housing, parks, commercial space, and so on.	800 acres

Source: Office of the Governor, Office of State Planning, 1992.

The project area is recommended for urbanization for several reasons. Its proximity to Lihu'e was considered crucial because the project can help fill future commercial and industrial needs. It was also found that, because Lihu'e is expected to continue to remain the economic hub of the County, most of the urban lands should be allocated to Lihu'e.

3.2.2 Kaua'i General Plan

Kaua'i County's planning framework includes a wide array of mechanisms ranging from long term policies and plans to day-to-day actions. Established in 1971, the Kaua'i General Plan is the County's controlling, long-range planning design. It functions as legislation which establishes the framework, parameters, constraints and guidelines for all other legal and administrative instruments related to land use and water resources.

A key element in the General Plan is growth management. Growth of the resident population is to be maintained in accordance with resource and infrastructure capabilities, as well as social values.

The General Plan was updated in 1982. The General Plan Update (GPU) found that the county had managed its growth well for the prior ten years, but infrastructure improvements were needed if these efforts were to be replicated in the future. The GPU therefore recommended a resource management system that would be the basis of determining capital improvement programs, infrastructure master plans and so on. Some areas to be incorporated in this management system include housing, agriculture, industry, energy, historic resources, and transportation.

Based on government and community input, the GPU recommended that Kaua'i work towards achieving a population of 49,000 in 1990, and an optimal annual growth rate of 2.25 percent. This entailed additional urban development of 1,100 acres and 3,750 new housing units.

The County Planning Department may initiate another GPU process by the end of this year.

3.2.3 Lihu'e Development Plan

The 1976 Lihu'e Development Plan was developed to enable the Lihu'e area to grow and change in accordance with expressed goals and objectives. It retained and expanded the goals of the original General Plan.

Lihu'e is the civic, commercial, financial and transportation center for the entire County. To deal with this function, the County provided detailed specifications for physical, social and economic measures. Goals and objectives were identified for the Civic Center, housing, the commercial, business and financial center, recreation, and other community elements. Also, several recommendations were made on how to achieve these goals and objectives.

In the land use recommendations, the Lihu'e Development Plan identified three project districts that were earmarked for development. Project District 1 is immediately west of Lihu'e Town and includes the westernmost portion of the Molokoa subarea of this project. Recommended for Project District 1 are 663 single and multiple family housing units, and a park and community center.

Project District 2 is the area from Kukui Grove to Puhi. This area was recommended for 1,048 residential units, and 252 acres for public facilities and commercial and industrial uses. District 3 on Kuhio Highway and adjacent to the westernmost portion of the

Ahukini Mauka. While not designated as a project district, Hanama'ulu was specifically identified in the Lihu'e Development Plan as an area in which new residential and commercial development should be directed.

3.3 Possible Changes Independent of Proposal

While most of recent construction activity in Kaua'i has been related to post-hurricane reconstruction, some development proposals have been re-initiated and are moving ahead.

In the Lihu'e Planning Area, much of the current development interest centers on lands owned by Grove Farm Properties. Grove Farm is proposing a three-phase expansion of the Kukui Grove Shopping Center. Expansion plans include the addition of 246,000 square feet of retail store space and 1,000 parking spaces. Kaua'i's first KMart is negotiating for space in this shopping center and is hoping to open its store this year. Also, the Puhi Business Center is the first project in the Puhi Industrial area, and is scheduled to offer over 15,000 square feet of office space this year.[10]

In terms of residential projects, Grove Farm has received approvals for its 519-acre Puakea project. The project area is situated between Nawiliwili Road and Hulumalu Road from Nawiliwili Harbor to Puhi. The project area was redesignated to Urban designation by the State Land Use Commission in June 1989, and subsequently was rezoned by Kaua'i County.

10. *Cameron, 1994*

Of the total 1,690 units, 910 will be multi-family units and the remaining 780 will be single-family. To date, approximately 400 residential units have been completed. Also included in this project is a ten-acre school site, five acres of park, and an 18-hole golf course. Further, contracts have been signed for 75 percent of the industrial property segment of the project.

Additionally, Grove Farm is in the first phase of the permitting process for 228 affordable rental units. The site has not been identified yet, and no timetable for this project is presently available. [11]

The Kaua'i County Housing Agency proposes to develop the Charles River Project Development in Hanama'ulu. The property is located across the highway from King Kaumuali'i Elementary School and Peter Rayno Sr. Park. Included in the plans are 150 to 180 affordable rental units, including on-site improvements. Construction of the first of four phases of the project is projected to begin early next year. [12]

The County project is also pursuing the Lihue Civic Center Complex Master Plan. Kaua'i County is proposing to consolidate county offices in one location at the Lihu'e Shopping Center. The first phase, which entailed improvements to an existing circular structure and renovation of a former retail store, was recently completed.[13]

11. *Based on testimony of Greg Kamm, Vice President of Grove Farm Properties, Inc. before the State Land Use Commission dated 23 November 1993; personal communication with Greg Kamm on June 9, 1994; and personal communication with Keith Nitta, Acting Deputy Planning Director, Kaua'i Planning Department, June 1, 1994.*
12. *Kaua'i County Housing Agency, "Request for Proposal on the Charles River Development."*
13. *Kaua'i County Department of Public Works, 1992, and Cameron, 1994.*

4 Potential Social Impacts

This section presents potential social impacts resulting from implementation of the proposed Lihu'e-Hanama'ulu Master Plan. Residential population impacts are presented in Section 4.1. In Section 4.2, the implications for the regional character are discussed. Section 4.3 explores potential impacts on the neighboring community. Displacement is discussed in Section 4.4, and potential impacts on public facilities and services are presented in Section 4.5.

4.1 Resident Population Impact

Implementation of the proposed plan will add new residential uses to the area, thereby increasing the resident population. As presented in *Table 11*, the maximum scenario for the proposed project could generate a population of approximately 4,400 persons.

The proposed 1,250 single family units will house an estimated population of approximately 3,300 persons, based on an average household size of 2.64 persons. The 550 multi-family units are estimated to house approximately 1,100 persons, based on an average household size of 2.00 persons. The average household sizes were provided by the project's market study produced by Arthur Andersen & Co.

Table 11: Estimated Project Resident Population: 1997 to 2017

Year	Units		Estimated Population [a]			Cumulative Population
	Single family	Multi family	Single family	Multi family	Subtotal	
1997 to 2001	418	134	1,103	268	1,371	1,371
2002 to 2006	310	256	792	512	1,304	2,675
2007 to 2011	470	160	1,241	320	1,561	4,236
2012 to 2016	52	0	137	0	137	4,373
Total	1,250	550	3,273	1,100	n/a	4,373

a. Population estimates were based on average household sizes of 2.64 persons for single family units, and 2.00 persons for multi-family units. These factors were provided by the market study produced by Arthur Anderson & Co.

In 2000, it is estimated that the project's resident population will account for two percent of the projected Kaua'i County population and nine percent of the Lihu'e Planning Area population. As *Table 12* indicates, the project population could account for five percent of the projected islandwide 2010 population, and 18 percent of the Lihu'e Planning Area 2010 projected population. At full build-out, the project resident population is estimated to account for 4.6 percent of the island's projected population, and 16 percent of Lihu'e Planning Area's population.

Table 12: Impact on Resident Population: 2000, 2010 and 2020

	Year		
	2000	2010	2020
Projected Kaua'i County Population [a]	62,177	77,945	92,575
Projected Lihu'e Planning Area population [b]	15,655	22,648	26,683
Estimated Project Population [c]	1,371	4,236	4,373
Percent of Projected County Population	2.2%	5.4%	4.7%
Percent of Projected Population for Lihu'e Planning Area	8.8%	18.7%	16.4%

a. *Island projection was adjusted from Series M-K to reflect population decrease after Hurricane Iniki. Source: Strategy Pacifica, 1994.*
b. *Island projection was adjusted from Series M-K to reflect population decrease after Hurricane Iniki. District proportions were derived from OSP Five Year Boundary Review. District estimates were revised to accommodate adjusted island projection. Source: Strategy Pacifica, 1994.*
c. *See Table 11.*

It is noted that this resident population impact is mostly due to a decrease in household size and a resettling of Kaua'i's population, and is not expected to cause significant in-migration to the island. As discussed in Section 3, public policy calls for further growth in the Lihu'e area and this project is intended to respond to the corresponding demand for housing units.

4.2 Implications for Regional Development

The Lihu'e-Hanama'ulu Master Plan will affect the regional character of the Lihu'e Planning Area, specifically Lihu'e Town. This section looks at potential effects relative to community objectives (Section 4.2.1) and Lihu'e Town (Section 4.2.2).

4.2.1 Community Objectives

The proposed plan is consistent with community desires for the future growth of the Lihu'e region. Expressed through public policies, community objectives call for further growth and, to a large extent, this growth is to occur in the project area.

As discussed in Section 3, the OSP Five-Year Boundary Review recommends the project area for redesignation to Urban. OSP specifically identifies a 792-acre site which includes the 552-acre project area. The project is seen as a potential source of market and affordable housing, and its location relative to Lihu'e Town is considered an asset to the town's economic function.

The 1982 Kaua'i General Plan Update designates a portion of the project area for Urban Mixed Use.

In the Lihu'e Development Plan, a portion of the project area is recommended for residential units, a park and a community center.

These policies and plans consistently call for development on a portion of, and in one case on the entire, project area. While the project area or the actions proposed in the Lihu'e-Hanama'ulu Master Plan are not identical to these plans, they do support the intent to expand Lihu'e town to include portions of the project area.

Also, those interviewed expected development to occur on the project site. Molokoa and Hanama'ulu residents in particular pointed out that portions of the project have been targeted for development in the past, and that public plans contain provisions for this development. Further, several components of the proposed Master Plan meet community needs as expressed through the interview process for this report.

4.2.2 Effect on Lihu'e Town

Centralism is where mass tends to center around a nucleus. This tendency toward a centralistic order is exhibited in the structure and organization of organic and inorganic matter.

In our human environment, people tend to be drawn to a "central place." Some single structures are considered central spaces, such as a city hall, a church, and a school. In some areas, employment centers, such as a mine or a factory, are central places.

In the larger context, settlement patterns exhibit centralism and towns are often, but not always, considered central places. A town's centrality is relative, however. It is central only as long as it is important to the surrounding area. Hence, a town's identity as a central place increases or decreases as its importance changes. [14]

Lihu'e Town has long been a central place, and its centrality can be viewed from several perspectives.

- **Administrative center**

  Lihu'e is the County seat, and contains the mayor's office, the main offices of county departments, the State offices, and Federal offices. People go to Lihu'e to obtain building

14. *Christaller, 1966.*

  permits, apply for marriage, birth and death certificates, and pay taxes.

- **Trading and transportation**

  Lihu'e Town has long since been the island's trading and transportation center. In its early days, it was the center for three surrounding plantations. It was near the once active Ahukini Landing and is still within minutes of Nawiliwili, the island's main harbor. The airport is just beyond the town's residences and schools. The main branch of the island's banks are located in Lihu'e, as are branch offices of statewide corporations.

  Lihu'e is also the professional center for the island. Offices of engineers, architects, attorneys, dentists, physicians, realtors, social workers, and other professionals are found in Lihu'e.

- **Social and cultural center**

  Lihu'e is the center of social activity for residents of the area. The high and intermediate school campus and the stadium are focal points for many activities, and the churches provide other gathering places. Because islandwide residents often come to Lihu'e for financial, medical or government services, they also have occasion to socialize within the town's environs.

Within the town there is physical centrality as well. The area including the Kaua'i County building, Civic Center Complex, the Kaua'i Museum, and the State Office Building appear to be at the heart of the town. The street pattern with Rice Street, Kuhio Highway and the circular Hardy Street strengthens this sense of the town's core.

Over the years, Lihu'e Town's centrality relative to the island has changed. The town is no longer the most populated area, nor is it the fastest growing community. In terms of economic importance, other communities, particularly which those containing visitor destinations and resort complexes, have increased their centrality for their surrounding regions. Also, areas such as Kapa'a and Wailua are transforming from primarily residential neighborhoods to full service and self contained communities.

The settlement pattern on the periphery of Lihu'e has a direct effect on Lihu'e town's centrality. South of the existing town, the Kukui Grove Shopping Center is a regional retail center which also serves as a gathering place for senior citizens, teenagers and families. Along with the adjacent professional and office complex, the services and facilities in this newer area are drawing people away from the existing town.

The Puakea project will further affect Lihu'e town's centrality. Between Lihu'e and Puhi, a new community will be added, as well as an industrial area, a golf course and a school. The 1,700 new units will increase the 1990 Lihu'e Town's housing supply by 80 percent.

This proposed project will add another dimension to Lihu'e Town's centrality, this time to the east and the north.

Puakea and this proposed project fall somewhere between a "satellite town" and a complete urban complex. Satellite towns have all of their essential facilities, but depend on a nearby urban center for almost all of its economic support. Complete urban complexes contain sources of employment in a wide range of commerce and industry; they have a full range of educational facilities and major health facilities. [15]

15. *Classifications based on Elsner, etal., 1993.*

Public policies already call for the development of these peripheral areas. Such development will influence how Lihu'e Town is perceived in the future, and subsequently the town's importance and centrality.

The new planned communities will bring much needed housing and economic development. They also will increase the critical mass needed to support existing retail operations, service establishments and professionals in Lihu'e Town. The increased population will also eventually lead to new public facilities, such as schools and parks, which will be used by residents of the existing town as well as the new communities.

Public policies which call for these new communities can also inadvertently contribute to an undesirable future for the existing Lihu'e town. From a business perspective, competition between the new shopping centers and existing commercial enterprises may make it difficult for the smaller independent businesses to survive. From a social perspective, Lihu'e Town could be perceived as "the old part of town," and people may prefer the newer schools, and may no longer frequent the small shops and restaurants which gives Lihu'e a feeling of being a small town. There may also be a tendency to look for social distinctions between residents of the newer communities and longtime residents of the town.

The changes in Lihu'e's identity and centrality are not due to a specific project or a particular public policy. These changes are typical of communities which are growing and expanding. They occur in urban as well as rural areas.

Lihu'e Town centrality is an important social resource, and public and private interests need to work together to ensure that Lihu'e retains its character and identity as these newer areas develop.

There are several ways to strengthen the identity, importance and thus centrality of Lihu'e Town. First, from a policy standpoint, public plans are needed to ensure that Lihu'e Town becomes the center of a larger region which includes the proposed project and Puakea. The newer communities should be supportive of the existing town, rather than competitive or duplicative. In the proposed project, the public and quasi-public facilities are intended to complement and expand upon what exists in Lihu'e Town today.

Second, public policy needs to examine the options for redevelopment of the existing town. The update of the Lihu'e Development Plan could explore urban design approaches and implementation strategies which promote economic development and work towards beautification. Economic strategies can include tax incentives and low-interest loans for small business.

A crucial element to maintaining the town's identity is already being undertaken. The enhancement of the Civic Center Complex and the surrounding area was the subject of a recent master plan and the 1976 Lihu'e Development Plan; initial work was recently completed.

4.3 Impact on the Neighboring Communities

The proposed project will bring change to the area, and this section examines potential effects on existing neighboring communities. Section 4.3.1 describes existing neighborhoods, and is followed by a discussion of project impacts in Section 4.3.2.

4.3.1. Description of Existing Neighborhoods

The project area is currently planted with sugar cane. To the south and southwest, the existing Molokoa Village Lihu'e Subdivisions 1 and 2 form a boundary of single-family homes that, together with the Lihu'e Town Tract, extends the established residential area to Kuhio Highway and Ahukini Road. The Lihue Industrial Park and the Vidinha Memorial Stadium abut the project area to the south.

The Lihue Airport occupies land to the east and southeast. Hanama'ulu Bay edges a portion of the proposed recycling station to the northeast, and proposed residential areas follow the upper contours of the Hanama'ulu Stream Gulch. The triangular shaped Hanama'ulu segment lies beyond the existing Hanama'ulu Town Tract to the north.

The following describes specific residential neighborhoods in the project area vicinity:

- **Molokoa Village Lihue Subdivisions 1 and 2/Lihu'e Town Tract**

  Molokoa Subdivisions 1 and 2 extend from Ahukini Road on the north, along Puaole to approximately Ho'olako Street. Little evidence of Hurricane Iniki can be seen in these subdivisions, where internal roadways lead to attractive homes setback on well-kept lawns. The approximately 300-unit subdivision was developed by The Lihue Plantation Company; the two-phase project was built in the mid to late 1960s.

  Those interviewed observed that the subdivision is occupied, in large part, by government workers, retired professionals and business people. Census statistics presented in Section 2 suggest that this profile is accurate.

In the older adjacent Lihu'e Town tract area, in the vicinity of Akahi and Elua Streets, residential dwellings are interspersed with several commercial establishments, including a motel-bakery-restaurant, a medical center and professional and service establishments. Despite the commercial presence, a sense of the rural remains.

The residential-commercial nature of this area creates a transition area between the residential subdivisions of Molokoa and the Lihu'e business center, where government buildings, retail shops, fast food establishments, banks and private businesses exist in proximity to each other. For many of those interviewed, this convenient access from home to shopping, merchandising, and other industries was ranked as the area's primary attraction.

- **Hanama'ulu**

Located north of Lihu'e Town, the Hanama'ulu subdivisions originated out of efforts by the unions and the plantation to offer homeownership opportunities to plantation employees. The subdivisions include Wiliko 1 and 2, Hanama'ulu Home Units, and Hanama'ulu Town Tract. The various homes were built in the 1950s and 1960s.

In contrast to the almost uniform landscaped lawns of Molokoa, the residential lots in Hanama'ulu tend to reflect a wide diversity of personal taste. The maintenance level varies from lot to lot, and front yard vegetables, papaya trees, and calamunguy grow among flowering plants. Those interviewed noted that a few older homes close to Kuhio Highway served as residences for the plantation managers and supervisors.

4.3.2 Project Impacts

Overall, at least a portion of the proposed project will be perceived as an extension of the Molokoa Subdivision 1 and 2. The easternmost portion of the project's Molokoa subarea is planned for single family residential development, and this will be consistent with existing uses. According to those interviewed, development of single family homes is expected here, so the project is consistent with these expectations.

The project will also increase the level of activity in this area and this will alter the character of the Molokoa Subdivision 1 and 2 to some extent. In particular, Ka'ana Street is being planned to be a collector street with a connection to Kapule Highway across from the existing post office. Also another project access will be via Malae Street.

These streets are currently deadend roadways, and residents along these streets currently enjoy privacy and a general quiet ambience. The project will alter this character and, even though there may be expectation for change in this area, the actual experience of the increased traffic and activity may be difficult for some residents.

The neighborhoods farther away are not expected to be affected by the project. The new shops, office buildings and other establishments will add to the convenience currently enjoyed by Lihu'e residents.

The Hanama'ulu portion of the project is consistent with the predominant residential character of the neighboring community.

4.4 Displacement

Most of the project area is either in agricultural production or is vacant. [16]

One non-agricultural use is currently conducted on-site. For the past five years, Jack Harter Helicopters, Inc. has maintained a month-to-month lease for office space on land along Ahukini Road in the Molokoa subarea of the project. The business involves two helicopters based at Lihu'e Airport. Seven people are employed to operate and maintain the helicopters.[17]

The project will displace this operation, but this is not a significant impact. The lessee has considered this a temporary location and has been working to relocate to the Lihu'e Airport.

4.5 Impact on Public Services and Facilities

4.5.1 Police Protection

Existing Conditions

The project site is in Sector 5 of the Lihu'e District of the Kaua'i Police Department. Sector 5 extends from the Wailua Correctional Center and the Wailua Golf Course on Kuhio Highway in the north to Rice Street in Lihu'e in the south; it includes Hanama'ulu.

The District's police protection services are provided by officers from the Lihu'e Police Station located on Umi Street in Lihu'e. One officer is on duty in Sector 5 during each shift; the response time is two to three minutes to locations near the project site.

16. *Project impacts on agricultural uses are being studied by another member of the project team.*
17. *Personal communication with Beverly Harter, co-owner of Jack Harter Helicopters, Inc., July 14, 1994.*

At present, there are approximately 400 residents per officer on Kaua'i. When the de facto population is considered, the ratio is approximately 550 persons per officer.

Project Impact

To maintain the present ratio, an additional ten to twelve officers will be needed in the Lihu'e District to service project population increase at full build-out. [18]

Mitigation

The proposed project may mitigate project impacts in three ways. First, the proposed plan includes a nine-acre parcel designated for a new police station. This newer, larger facility will replace the police station on Rice Street, and will help mitigate project-related impacts.

Second, the potential increase in the tax base due to related population increases will help pay for the costs in increasing service levels. The fiscal impact study of the EIS provides a cost-benefit analysis regarding public services.

Third, the project concentrates development in Lihu'e and allows for consolidation of efforts and efficient police operation.

Fourth, the project can be designed to help deter crime and traffic problems, thereby minimizing the need for police services. Design measures can include well-lit and highly-visible common areas and parks and an efficient circulation system.

18. *Personal communication with Police Chief Calvin Fujita, Kaua'i Police Department, June 14, 1994; and with Inspector Dennis Higashi, Kauai Police Department, May 5, 1994*

4.5.2 Fire Protection

Existing Conditions

Lihu'e Fire Station No. 3, located on Rice Street, has primary responsibility for fire protection in the area of the project site. The station houses a pumper fire truck and a HAZ-MAT (hazardous materials) heavy rescue truck. Each vehicle is staffed by four firefighters in 24-hour shifts. When not in use at its primary function, the HAZ-MAT truck also answers fire alarms with the pumper. The project site can be accessed in less than six minutes from Station No. 3.

Two fire trucks are required to respond to any structure fire. The backup station for the area is Kapa'a Fire Station No. 2, which is located eight miles away. Its response time to the project site is approximately ten minutes.

There are no plans for facility expansion in the next ten years. [19]

Project Impacts

The Fire Department's current facilities have sufficient capacity to serve the proposed community. The only constraint would be insufficient water supply and delivery.

Mitigation

Project impacts can be mitigated by including a water transmission and distribution system which meets fireflow requirements.

19. *Personal communication with Fire Chief Alejandro Lomosad, Kaua'i Fire Department, June 14, 1994; and with Captain Mike Kano, Kaua'i Fire Department, May 9, 1994*

4.5.3 Recreation

Existing Conditions

Three county land-based parks in the Lihu'e/Hanama'ulu area are as follows:

- *Peter Rayno County Park*, next to King Kaumuali'i School is an all-purpose park. It provides a baseball field with backstop and bleachers, playground equipment, and can be used for soccer and other activities. The park covers approximately 3.5 acres.
- *Laukona Park*, a neighborhood park, is located mauka of Kuhio Highway in Hanama'ulu near the Kaua'i Memorial Gardens Cemetery.
- Another neighborhood park is *Wiliko Park* is located in Hanama'ulu makai of Kuhio Highway.

Near the project site is the A. Vidinha Memorial Stadium which is operated by the County. The facility is open 8.5 hours daily and is used for personal training. The facility is also used for scheduled public events, such as track meets, baseball, softball, football and soccer games. [20]

Also available in the area are two ocean-based parks on Hanama'ulu Bay, which is wide and well protected from the open ocean.

The Ahukini State Recreation Pier Park is a one-acre park on the southern point of Hanama'ulu Bay near the Ahukini-Makai subarea of the project area. The pier was the island's first where interisland and overseas vessels could tie up for loading and

20. *Personal communication with Mel Nishihara, Director of Parks, County of Kaua'i, May 9, 1994.*

unloading. After World War II, all shipping operations at Ahukini were relocated to Nawiliwili Harbor, and the pier was eventually vacated. In 1978, the landing was converted into a park. It is frequented by pole fishers; certain spearing and netting activities are prohibited from the pier and the surrounding waters of Hanama'ulu Bay.

Hanama'ulu Beach Park is located at the mouth of the bay. Operated by the County, this beach park offers pavilions, uncovered picnic tables, rest rooms, and a parking lot. The park covers more than four acres. It is a popular picnicking and camping site for families. Fronting the park is a narrow sand beach. Because the Hanama'ulu Stream crosses the southern end of the beach, the bay waters are usually murky and not conducive for in-water activities. The cleaner waters in the outer reaches attract scuba divers and other fishers. Akule and other migratory seasonal fish are caught here. Mullet and sharks are also found in the bay. [21]

Project Impacts

The project will increase the resident population in the area, thereby increasing the need for community and neighborhood parks. Space for both active and passive recreational activities will be needed to accommodate the additional demand.

The project is not expected to have direct impacts on the nearby ocean-related parks. The Ahukini Makai subarea is the nearest to these parks, but is not contiguous to either site. The proposed uses nearest these ocean recreation areas are industrial, with the closest being the proposed County recycling station. The project will not impede access to the parks.

21. *Clark, 1990.*

The project will add to the increased competition for beach parks in the area. This effect is not unique to the proposed project, however. Beach parks are regional and islandwide resources and will continue to be needed due to the expected increase in population. Hence, though the project will add population to the area, it will not cause an increase beyond that which is expected for the region or the island.

Mitigation

The County will need to acquire land and develop additional park space in this area. The project will be able to meet this need through the dedication of 18 acres of park space presently proposed in the Lihu'e-Hanama'ulu Master Plan. [22] Also, complementing the large parks will be tot lots and playgrounds interspersed throughout the project area.

Because no significant impact on beach parks is anticipated, no mitigation is recommended.

4.5.4 Health Care Facilities

Existing Conditions

Kaua'i's three hospitals include G.N. Wilcox Memorial, Kaua'i Veterans Memorial, and Samuel Mahelona Hospital. Together, they provide 113 acute care beds. There are also 271 long term care beds and four advanced life support ambulances. *Table 13* contains utilization information of the acute care portion of these facilities.

22. *Personal communication with Mel Nishihara, Director of Parks, June 14, 1994. Note that, at the time of this communication, 16 acres was planned for park uses. Presumably, the addition of over two acres for parks is considered a positive impact and no follow-up communication was made.*

Table 13: Hospital Utilization: 1992[a]

	Number of Acute Care Beds	Average Length of Stay	Percent Occupancy	Average Daily Census
G.N. Wilcox Memorial	81	5.0 days	63.95%	52
Kaua'i Veterans Memorial Hospital	24	4.5 days	37.29%	9
Samuel Mahelona Hospital	9	10.5 days	26.91%	2
Total Kaua'i	114	5.0 days	55.41%	63
Total State	2,583	6.6 days	69.87%	1,805

a. *Source: State Health Planning and Development Agency, 1993*

The 185- bed Wilcox Memorial Hospital grounds are adjacent to the Ahukini-Mauka subarea of the project area. Of the total bed count, 81 are acute care beds, and 110 beds are used for long term care. Ambulance service to the hospital from the site is estimated five to eight minutes. [23]

Project Impact

The project will impact medical facilities because of the increase of population. This impact is not considered significant for two reasons. First, nationwide, inpatient care is decreasing while outpatient care is increasing. The need for inpatient beds is therefore declining. Second, utilization of Kaua'i's hospital is

23. *Personal communication with Lynn Joseph, Director of Planning, Wilcox Memorial Hospital; Annual Report Statistical Supplement 1990, Hawaii Department of Health; and The State of Hawaii Data Book 1992.*

relatively low when compared to statewide statistics. The occupancy rate at G.N. Wilcox, which is the closest to the project area, is 64 percent, which is lower than the statewide occupancy rate of 70 percent. The existing hospitals still have the capacity to accommodate additional capacity.

In terms of long term care, the need for beds and other facilities is increasing because of increased longevity. The project may impact long term care facilities in the long term time frame, but this impact is not considered significant.

Mitigation

The hospital is currently working with Amfac/JMB Hawaii, Inc. on the hospital's acquisition of approximately 25 acres behind the hospital. This will provide adequate space for expansion of the acute care and outpatient care facilities. [24]

4.5.5 Schools

Existing Conditions

The project area is currently served by three schools, as follows:

- The Wilcox Elementary School is located on Umi Street in Lihu'e Town. The school has a current enrollment of 1,004 students. Its 1993 capacity was estimated at 1,066 students.
- King Kaumuali'i Elementary is in Hanama'ulu, just north of Hanama'ulu Road. The school accommodates an enrollment of 835 students. Its 1993 estimated capacity was 713.
- Kaua'i Intermediate and High Schools is located on Lala Road, near Nawiliwili Road. Its current enrollment is 1,775;

24. *Information on project impacts and mitigation was provided by Lynn Joseph, Director of Planning, Wilcox Memorial Hospital on June 20, 1994.*

It had an estimated capacity of 1,718 in 1993.[25]

There are plans for three new schools to alleviate the current capacity problems. First, a new elementary school is being planned for the Kapa'a area, near the Coco Palms Hotel. This will help alleviate the capacity problems at King Kaumuali'i Elementary School. Second, a new intermediate school is planned for the upper areas of Kapa'a. Capacities at the existing intermediate schools will then be increased as students transfer to the new school. Third, the Puakea project proposed by Grove Farm Properties includes a ten-acre site for a school. Currently, this site is being considered for an intermediate school.

Project Impacts

The project will increase the residential population in the area, thereby adding to the student population. It is estimated that the project will generate 353 students in the elementary levels of kindergarten through grade five. Approximately 107 students are estimated for the intermediate level grades of six through eight, and 136 are estimated for the high school grades of nine through twelve. In all, the project is estimated to generate a student population of 596. [26] These increases will impact existing schools, which are operating close to or at capacity.

Mitigation

The three new schools planned for the area will help alleviate capacity problems which already exist.

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25. *Personal communication with Tom Saka, Information Specialist, Statistical Research and Analysis Section, Office of Information and Telecommunication Services, State Department of Education.*
26. *Ibid.*

The project will help mitigate related impacts by including a school site of approximately twelve acres. This site can accommodate an elementary school. At the time of this writing, the State Department of Education (DOE) is also considering an off-site alternative for a new elementary school. Further, DOE may request fees based on the number units, less the number of dedicated acreage. The developer and the State will discuss the extent of such fees, if any.

5 Preliminary Community Issues

Whereas potential social impacts are changes which are likely to occur due to the proposed project, community issues are people's reactions to the proposed actions. Issues are opinions, and they change over time, as people's priorities and values change.

This section presents preliminary issues related to the Lihu'e - Hanama'ulu Master Plan. These issues were identified in July 1994, and were based on the master plan current at that time. As the plan evolves through the various land use processes, some issues may no longer be considered important, while others may arise.

Section 5.1 provides the background and methodology for the issues analysis. Section 5.2 presents a summary of interview findings, and Sections 5.3 through 5.6 contain detailed information about each interview topic. An analysis of the issues is presented in Section 5.7.

5.1 Background and Methodology

5.1.1 Description of Issues Analysis

Issues analysis is designed to identify and analyze community concerns about a proposed action. To ensure that the project is reviewed in an overall social context in which the project is proposed, feelings and concerns about the existing community need to be considered as well. Also, trends are part of the overall social context. For example, it is helpful to understand if a project is unique in terms of its issues, or if reactions are consistent with other development projects.

Issues analysis differs from statistical surveys, the latter of which are designed to focus on frequency of reactions. Polls are valuable because they tell us about the opinions of the majority or the minority. The survey instrument is typically not conducive to dialogue, however, and the personalized reasons for these opinions are often not evident in the responses. In contrast, the only time we make reference to the quantity of opinion in issues analysis is where there is significant difference of number, such as "almost all respondents" or "only two respondents."

5.1.2 Description of the Interview Process

Three interviewers conducted interviews over a five-day period. Interviews were informal and held in person; four chose to be interviewed over the phone. The interviews were based on a common set of question prepared by Earthplan.

Interviewers provided project information contained in the environmental assessment prepared for this project, and updated by project planners. This initial information is generally consistent with current project plans, except for the number of housing units. The earlier information was based on a housing unit count of 1,300 to 1,500 units. The implications of this revision are discussed as appropriate in subsequent sections.

Interviewees were informed that their individual conversations are confidential, and that their comments would be collectively analyzed. Those interviewed were asked to share information and opinions as individuals; they were not asked to represent or take positions for their organizations.

Interviewees were asked to respond to questions related to three different topics, as follows:

- *Feelings about their existing community* -- The interviews began with questions related to how interviewees felt about their community. We asked them to discuss the community's most important strengths, as well as the most important issues or problems. Other questions pertained to ideas to solve problems, and expectations for the future of the community.

- *Knowledge and use of the project site and its environs* -- Interviewees were asked if they were familiar with the project site and to identify uses on or near the site.
- *Feelings about the proposed Lihu'e-Hanama'ulu Plan* -- Those interviewed were then presented with project information, after which they were asked to identify positive characteristics, if any. They were also asked to share their ideas about potential problems and recommendations, if any.

5.1.3 Profile of Those Interviewed

The source of information in this issues analysis was the community. To identify as many issues as possible, we sought to achieve a cross-section of interests which may be relevant to this project. The initial list of individuals was provided by staff of Amfac/JMB Hawaii, Inc., Kaua'i-based project team members, a County Planning Department planner and individuals in the community with whom Earthplan had made previous contact. This initial list was apparently adequate; when interviewees were asked to provide more names, several were duplicates of our original list.

In all, 62 persons were interviewed, and the list of names is provided in Appendix A. The following highlights characteristics of interviewees:

- In terms of length of residence, the majority were longtime residents of Kaua'i, as follows:

  - Fifty-six percent were born and raised in Kaua'i. A few had previously left the island for school or short term employment.
  - Another 21 percent lived on the island for more than 20 years.
  - Ten percent lived in Kaua'i for ten to 19 years.
  - Thirteen percent lived on the island for less than ten years.
- In terms of interests, those interviewed represented a wide spectrum of interests, and the following summarizes the cross section of interests: [27]
  - *Community, cultural or environmental organizations* -- The interviewees are very active in community affairs, and 46 percent (28 people) belong to organizations such as the Aloha United Way, Jaycees, the Rotary, the Royal Order of Kamehameha, the Kaua'i Veterans Council and the Kaua'i Filipino Community Council.
  - *Business organizations* -- Thirty-nine percent of those interviewed (24 people) were members of business-oriented organizations, such as the Chamber of Commerce and the Kaua'i Economic Development Board.
  - *Current or former public employees and/or officials* -- Thirty-eight percent (23 people) either work in a public facility, such as schools and the police department, or have formerly served in a government capacity.
  - *Religious and health organizations* -- Twenty-six percent are active in or work in a religious establishment (eight

27. *The total does not add up to 61 because many interviewees belong to more than one category.*

persons) or in health-related organizations (seven persons).

- *Project site neighbors* -- Thirteen people live near the project site, in the communities of Hanama'ulu and Molokoa.

5.2 Summary of Interview Findings

Community strengths cited by those interviewed included Lihu'e's centrality, its convenient location, the community's social characteristics, and the still-present rural qualities.

Problems and issues in the community were related to growth and planning matters, housing supply and costs, youth facilities and supervision, and the need for economic recovery. Those interviewed were generally optimistic that these problems could be solved, however. Potential solutions ranged from facilities such as a youth center to political leadership.

While the project site itself is rarely frequented by the general public, its perimeter and environs are used daily by joggers, bikers, beach users and ocean food gatherers.

When asked about positive characteristics about the proposed plan, those interviewed felt that the project area is a logical place for growth and that the plan was conducive to enhancing Lihu'e's role as the island's hub. Positive comments were made about several individual components of the proposed plan and the residential component was especially noted as a positive aspect. Another positive point was that the project was expected to contribute to the area's and island's economic development.

Interviewees wanted to make sure that the proposed housing was intended for Kaua'i residents, and this point was frequently raised

when asked about potential project problems or issues. Another area of concern centered around compatibility between the proposed plan and nearby airport activities and functions. There were issues raised about environmental impacts, particularly those on the nearby Hanama'ulu Bay and the ocean. Infrastructure concerns were also raised, with traffic congestion, roadway circulation requirements, and the adequacy of the sewerage system being frequent items.

Three types of project recommendations were made. First, informants recommended planning and design measures, such as widening of major roadways, the relocation of the proposed new school, and ample landscaping. The second area of recommendations had to do with suggested facilities and parks. Third, there were process-related recommendations; these included the early establishment of public facilities and implementation of a landscaping plan as soon as possible.

5.3 Feelings About the Existing Community

5.3.1 Community Strengths and Positive Characteristics

Social Characteristics -- Regardless of the location of one's residence, those interviewed appreciated the social climate in Kaua'i. It was noted that the community is still small enough to minimize "urban anonymity;" people have longtime social ties and know each other by name. Kaua'i residents were described as being very friendly, and short-term residents (less than ten years) felt accepted. A very important characteristic was the community's cohesiveness and willingness to work together; this attribute has helped many recover from Hurricane Iniki. Kaua'i was also described as being cosmopolitan. Although its residents have varied ethnicities and backgrounds, people are able to share their cultures and live in harmony.

Rural Qualities -- This is considered one of the island's greatest strengths. Those interviewed appreciated the predominance and beauty of open, undeveloped open areas. They liked the accessibility to both the mountains and the ocean, and equated these qualities with "the simple life."

Lihu'e's Centrality -- For those interviewed, Lihu'e was the "hub" and island's center, and this was considered a major positive characteristic. Interviewers appreciated the historic background of Lihu'e and felt that the evolution of the plantation town into the County seat was a natural transformation. It was also pointed out that Lihu'e is the financial and transportation center for the island, and that retail establishments serving local residents are located in and around Lihu'e.

Convenience -- Those who lived in and around Lihu'e liked the convenience of residing near the island's services and major establishments. This convenience was enhanced if one also worked in Lihu'e town.

5.3.2 Problems and Issues

Youth-Related -- Those who were active in community and cultural organizations felt that an emerging community problem is related to the island's young people. Interviewees said that parental supervision has decreased because both parents often need to work to make ends meet. Because of a lack of youth-oriented facilities and activities, young people fill their free time with unproductive activity, such as hanging out at shopping centers.

Affordable Housing -- Interviewees were concerned about the supply of affordable housing for sale. While it was felt that there was a large supply of rentals, it was felt that families who want to purchase homes have few alternatives. Many either use up their funds to pay rent, or double up with relatives until they can save

money for the downpayment on a home.

Growth and Planning -- Those interviewed were concerned that there has been a lag in infrastructure development. Of note was the roadway and circulation system; it was felt that government has not kept up with the pace of growth called for in public plans. Interviewees also cited a conflict between the desire to maintain the rural qualities and economic development. This has been a long-standing community conflict, and, changes in political leadership reflect the changes in social priorities and values.

Economic Problems -- Interviewees were worried that economic recovery from Hurricane Iniki has been slow in Kaua'i. It was pointed out that, in addition to high unemployment, there is also high underemployment; many people reportedly are overqualified for their present employment, but have taken the job because of financial necessity. Another type of problem cited was the dependence on the visitor industry; interviewees felt that economic base needed to be broadened for a healthier economy.

Social Conflicts -- Interviewees who were born and raised in Kaua'i or had lived on the island for more than 20 years tended to feel that one of the community's problems stemmed from value differences between newcomers and longtime residents. They felt that newcomers did not adapt easily to local ways and customs, and often tried to impose their values on longtime residents. Another type of social problem was ethnic distinctions. Interviewees were concerned that the emphasis on ethnic differences sometimes led to social stratification and divisions.

Lack of Lihu'e Community Identity -- Lihu'e residents noted that, even though many people live in town, there is no identifiable community organization; attempts to form neighborhood organizations often fail. Although there are strong personal ties, people reportedly rarely get together by neighborhoods or community.

5.3.3 Solutions and Expectations

Interviewees were asked about possible solutions to the earlier-mentioned problems. Government was a frequent part of the solution. People interviewed wanted to see an open government, and leaders with a progressive vision. Interviewees also felt that the County needed to implement plans which have already been approved or develop a long-range plan that works. Desired ingredients to this plan included economic incentives and diversity and growth management measures.

One part of growth management was infrastructure, and interviewees felt that the State and County governments need to better coordinate the expansion and improvement of infrastructure systems with the approved levels of development. Those interviewed wanted to see the new bus system expanded, more bike lanes, widened streets, more contraflow lanes, and an expanded sewerage system.

Interviewees felt that economic solutions were crucial to Kaua'i's future. They wanted to see tourism revived at least to previous levels, and felt that the economic base needed to diversify. It was hoped that more high technology industries would be established in Kaua'i. Those interviewed also felt that Kaua'i needs to aggressively encourage the growth and development of business.

In term of expectations for the future, those interviewed felt that they were already in a path of some kind, and there were no major changes anticipated. Interviewees expected more growth and development. This was good for those who wanted a strong economic future, and worrisome for those who wanted to keep the status quo and who did not want major population increases.

Those interviewed were hopeful about the economic future of the island, and it was frequently pointed out that Kaua'i is in the recovery mode. Full recovery was predicted for a range of two to five years. People expected an increase in industrialization, an increase in high technology, and increased activity in the filming industry.

5.4 Knowledge of and Use of the Project Site

The project site is not used by those interviewed because of the predominant agricultural activities. Longtime residents are acquainted with the Ahukini Makai sub-area, however. They or their relatives lived on plantation property several years ago. Also, at one time, ocean users were able to access the shoreline via on-site cane haul roads.

The periphery of the project site was familiar to all because of its proximity to the airport and major roadways. Those interviewed jog or bicycle along the fringes of the project site. Also shoreline users travel along the makai edges of the project site to the Ahukini State Park. With the older longtime residents, frequency of use has reportedly decreased greatly; their children have grown so the family activities have taken different forms.

5.5 Reactions to the Proposed Plan

5.5.1 Positive Aspects

Logical Plan -- Those who approved of the proposed plan felt that the project area and plan components are rational from a planning perspective. Longtime residents, in particular, said that Lihu'e will inevitably grow, and remembered that this area has been eyed for development in previous years. It was felt that the proposed plan builds upon and complement what already exists in Lihu'e.

Those interviewed were also optimistic that implementation of this plan will help strengthen Lihu'e as the hub of the island. Lihu'e is currently second in population to the Kapa'a - Wailua area, and interviewees felt that adding more people to Lihu'e will be a plus for the district.

Concentration of Infrastructure Requirements -- Another related view was that the plan will concentrate infrastructure requirements in an already urbanized area. While no one wanted to see more traffic, it was felt that the project would at least concentrate such traffic in one area, rather than spread it out among the less developed areas. It was also hoped that the project will encourage government officials to upgrade public services and facilities, including police facilities and staffing, educational facilities, and the sewerage system.

Economic Development -- The plan was seen as promoting economic development in several ways. First, project-related construction activity will occur over two decades. With that activity will come jobs and a long-term demand for supplies and services. A second economic advantage cited by those interviewed is the long-term employment related to the new commercial, retail and industrial establishments. Third, those interviewed felt that the new businesses would give local entrepreneurs opportunities to expand or establish their companies, as well as attract off-island businesses to invest in Kaua'i.

Individual Components -- Those interviewed liked the housing component of the proposed plan, providing that the targeted market is Kaua'i people. They also liked the mix of units, because while the single family units were preferred on Kaua'i, the multi-family units gave young people an opportunity to enter the housing market.

Interviewees also liked that the project is meeting many of its needs

by providing on-site facilities. They liked the school and parks because they expected that project impacts to off-site facilities will be minimized. It was also pointed out facilities such as the police station and civic center will benefit the rest of the community as well.

The industrial component was felt to be appropriate in the planned location, and those interviewed believed that the recycling center was needed on Kaua'i.

5.5.2 Potential Problems and Issues

Feasibility of Housing Component -- Regardless of whether one liked the residential component of the project, interviewees were concerned about the feasibility of building the proposed quantity of housing units. They pointed out that other landowners are proposing large quantities of housing, and one has already received necessary approvals for a large residential community in nearby Puhi. They did not believe that there was sufficient local market for the proposed residential component.

As discussed earlier, the project unit count provided during the interviews was lower than that currently proposed. It is assumed that concerns about the feasibility of the residential component apply and may even increase with the subsequent increase in units.

Compatibility with Airport Uses and Functions -- This concern has two facets. First, those interviewed were concerned that the project school and homes would be subject to aircraft noise, and that this would affect the public health and housing marketability. Second, interviewees pointed out that, currently, the first impression for visitors who arrive at the airport are the existing cane fields. This is a unique experience among the major Hawaii airports, and this promotes the rural qualities of Kaua'i. Those interviewed were worried that the project will change this experience.

Density-Related Issues -- Those interviewed were concerned that the population increase in the area resulting from the project will stress roadways and public facilities. Interviewees felt that there would be impact regardless of project-related improvements and on-site community facilities. It was also noted by those interviewed that the problems with infrastructure cannot be attributed only to the private developer; they felt that government needs to be more efficient in responding to growth.

Further, interviewees felt that, given the magnitude of proposed residential units, one large park is not sufficient to meet the needs of the project population. Because of the current big demand for parks, it was feared that the new on-site park could quickly become a regional park.

Environmental Impacts -- There was concern that drainage from the project area, particularly from the industrial facilities, may enter the ocean and Hanama'ulu Bay. Interviewees were concerned that this would negatively impact water quality and ocean habitats. Those interviewed also raised questions about the types of industrial activities which would occur on-site. They wanted to make sure that there would be no toxic materials or potentially hazardous activities near the airport and the new community.

5.5.3 Project-Related Recommendations

Three types of recommendations were made, with the most frequent being related to planning and design, as follows:

- Planning and design suggestions included:
  - Landscaping should be a top priority to maintain an attractive gateway to those arriving at the airport.
  - Buffer houses from the major roadways and the airport.

  - Buffer the industrial complexes from the major roadways.
  - Move the school farther from the airport.
  - Widen Ahukini Road and Kapule Highway.
  - Direct traffic away from Lihu'e town.
  - Make sure there is land for churches.
  - Design adequate parking spaces for the commercial establishments.
  - Leave the Judiciary Department in its present location.
- Proposed new facilities included:
  - A new sports complex within the project area.
  - Smaller community parks throughout the community; these parks could be used for passive activity and contain playgrounds and comfort stations.
  - A youth center.
  - A center for the elderly.
- Process-related recommendations are as follows:
  - Do a landscaping plan early, and begin planting in the initial phase.
  - Build public facilities in the first phase.
  - Check on possible kuleana lands within the project area.
  - Take the plan out to the community; ask for input.
  - Offer local people first choice in acquiring industrial and commercial lands.
  - Make sure housing is priced for local pocketbooks.
  - Be creative in building affordable housing; try self-help housing programs; arrange low-interest loans.
  - Work with the State Department of Transportation to relocate the airport's heliport to a less urban area.

5.6 Analysis

1. **Development in the project area is generally acceptable and consistent with community expectations.**

   A common reaction among those interviewed was that they expected the project area to eventually be developed. People know that sugar activities are to cease in the future and anticipated that these lands would be used for urban development of some kind. This was a trend for all except two people, who preferred that development occur on the company's mauka lands.

2. **The community does not expect the project to lessen or detract from what is considered existing community strengths.**

   As discussed in Section 5.3.1, those interviewed felt that the community's strengths included the community's social characteristics, rural qualities, the town's function as the island's hub, and the convenient location.

   In terms of the positive characteristics cited about the plan, the proposed actions are expected to support Lihu'e's central qualities, and build upon what is already existing.

   Further, the potential project problems identified by interviewees will not affect existing community strengths. The island's rural qualities were not expected to be affected because the development would occur in an already urbanized area. It was not anticipated that social characteristics would be altered by the project, because those interviewed expected that local people would be living in the new houses.

3. **Most of the project issues are typical of development concerns, and stem from problems which are already occurring.**

   For the most part, the project-related problems were typical development-related issues, and were not unique to the project. Traffic, sewerage system inadequacy, and crowded schools -- these are problems in the existing community, as identified by those interviewed. They were concerned that the project would further exacerbate these conditions.

   Issues which were specific to the project were related to the airport functions and uses, and the environmental impact on water quality. It was felt that both types of potential impacts could be mitigated.

4. **The project is expected to solve some of the existing community problems.**

   Section 5.3.2 contains information about existing community problems, and these were related to growth and planning matters, housing supply and costs, youth facilities and supervision and the need for economic recovery. Interviewees identified various solutions which are presented in Section 5.3.3.

   The project is seen as a partial solution to some of these problems. It is expected to bring economic development, and is hoped to substantially increase the supply of affordable housing. Further, the public facility component is seen as a major benefit for the general community.

5. **Process is as important as the project.**

   As of this writing, there is no outright opposition to the project. Even though there are community concerns about the project, it nevertheless appears to be generally acceptable to those interviewed.

   More specific concerns may be identified as people learn more about the project, and those interviewed expressed a desire for additional information. They wanted to know more about the project components, the market feasibility of the residential, commercial and industrial project components, financing, and the company's long range intentions regarding Kaua'i and this project.

   Further community dialogue is needed to ensure that project meets community objectives. The interviews were held at a very early stage in the project, and this study should be considered just the first step in maintaining a working relationship with the project.

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Appendix A

List of People Interviewed in This Study

Those interviewed were asked to provide input as individuals; they were not asked to represent their organization. Their affiliations are provided to indicate the various perspectives and interests.

Name	Affiliation
Gary Baldwin	Executive Director of Kaua'i Business Council Board member of Kauai Economic Development Board
Hartwell Blake	Member of the Royal Order of Kamehameha Member of Kanikaphuolotau (hula halau) Member of Kaua'i Advisory Committee for Na Ala Hele Board member of Hale Opio Kaua'i, Inc. Member of Kaiola Canoe Club Member of State and Kaua'i Bar Association
Maggie Cox	Principal of King Kaumualii Elementary School
Clayton Dela Cruz	Division Director of ILWU Local 142 Board member of Aloha United Way Former Police Commissioner
Ernest Dela Cruz	Principal of Wilcox Elementary School
Jean Dobashi	Teacher at Kaua'i High School Chair of March of Dimes Islandwide Walk Boys Scout Merit Badge Counselor Molokoa resident
Myron Dobashi	Deputy Commander of 201st Combat Communications Group Molokoa resident
Evelyn Estrada	Community Service Employment Program Worker
Calvin Fujita	Kaua'i County Chief of Police

Name	Affiliation
Grace Galiza	Co-Pastor of Aloha Church - Assembly of God
Vii Galiza	Co-Pastor of Aloha Church - Assembly of God Board member of School Based Health, Kaua'i Board member of Habitat for Humanity
Robert G. Girald	Vice President of ILWU Local 142 Member of the Water Resource Management Commission Former Police Commissioner
Holbrook "Hobey" Goodale	Life member of Board of United Way Past President of Rotary Chair of the Board of Garden Island Motors
Clyde Guerreiro	Pastor of Immaculate Conception Church President of Kauai Interfaith Council Roman Catholic Vicar of Hawai'i Hanama'ulu resident; lives near project site
Bev Harter	Co-Owner of Jack Harter Helicopters, Inc. (on-site business)
Dennis Higashi	Police Inspector Molokoa resident; lives near project site
David Iha	Provost of Kaua'i Community College Ex officio member of Kaua'i Economic Development Board Board member of Kaua'i Museum
Ron Iida	State Chapter Vice President of the Royal Order of Kamehameha (in charge of Kaua'i) Member of Kauai Life Underwriters Association Molokoa resident; lives near project site
Clifford Ikeda	Civil Defense Plans and Operations Officer for Kaua'i County Member of Kiwanis Member of Jaycees International
Ted Inouye	Chair of East Kauai Soil and Water Conservation District Director of Lihue Hongwanji

Name	Affiliation
John Iwamoto	Member of the Governor's Board Office of Veterans Services Kaua'i representative for Disabled Veterans Hawaii Boy Scout Troop Master Retired Chief Electrical Inspector of Kaua'i County Hanama'ulu resident
Lynn Joseph	Director of Planning for the Wilcox Memorial Health System
Sue Kanoho	Executive Director of Kaua'i Economic Development Board Ex officio member of Chamber of Commerce Member of the Mayor's Visitor Promotion Committee
LaFrance Kapaka-Arboleda	Executive Director for Habitat for Humanity President of Ho'ola Lahui Hawai'i Member of Hawaiian Sovereignty Election Council
Ed Kawamura	President of M. Kawamura Farm Enterprises, Inc. Past President of the Kauai Veterans Council
Melvyn Y. Kihara	President of Kaua'i Chamber of Commerce Board member of Hawaii Visitors Bureau Member of Small Business Development Center Kauai Vice President and Regional Manager of Bank of Hawaii Ex Officio member of Kauai Products Council
Maurice Lardizabal	Program Coordinator for Hanama'ulu Community Association Member of Kaua'i Visayan Club Member of Kaua'i Filipino Community Council Member of Filipino Catholic Club Hanama'ulu resident; lives near the project site
Don Lindsey	Member of Kauai Economic Development Board Member of the Rotary

Name	Affiliation
Alejandro Lomosad	Kaua'i County Fire Chief
Cheryl Lovell-Obatake	Member of Kaua'i Burial Council Member of Advisory Council for Nawiliwili Park
Jack Lundgren	Board member of Kauai's Thousand Friends Dentist
Richard Maeda	Chief Executive Officer of Kauai Builders Ltd. Member of the Lions Club
Nora Masuda	Secretary of Kaua'i County Civil Defense Agency
Jim Mayfield	President-elect of the United Way Member of the Wilcox Hospital Budget and Allocation Committee Branch manager of the Lihu'e and Kukui Grove Bank of Hawaii
Tad Miura, Jr.	Board member of the Salvation Army Board member of the Chamber of Commerce Board member of the Kapaa Business Association President of M. Miura Store in Kapa'a
Hisao Mizumura	Retired County Surveyor Hanama'ulu resident
Haruo "Dyna" Nakamoto	Farmer Past ILWU Division Director
Brian Nishimoto	Member of Kaua'i Society of Professional Engineers, Architects and Surveyors Former Kaua'i County Planning Director
Ken Ono	President of Wilcox Memorial Health System Board member of Chamber of Commerce
Jonathan Ota	President and General Manager of Tip Top Motel Cafe and Bakery Molokoa resident

Name	Affiliation
Warren Perry	President of Kaua'i Bar Association State Board Chair and Kaua'i Chair of Alu Like State Legal Counsel for Royal Order of Kamehameha Panel Member of Hawaiian Home Lands Trust Claims
Edwin Q. P. Pettys	District Manager of Division of Forestry and Wildlife, State Department of Land and Natural Resources Board member of the East Kauai Soil and Water Conservation District
Ed Pickop	PTA President of King Kaumualii Elementary School Plant Quarantine Inspector for the State Department of Agriculture
Oscar Portugal	Member of Kaua'i Advisory Committee for the Hawai'i Community Foundation Advisor of the Kaua'i Filipino Community Council Past President of the Kaua'i Filipino American Jaycees Member of Lihu'e Parish Council of the Roman Catholic Church
William "Neil" Rapozo	Owner and operator of Lihue Chevron
Peter Rayno	Member of the Hanama'ulu Community Association Senior Rod and Chain Man for Lihu'e Plantation
Wayne Richardson	Member of Executive Committee of the Wilcox Health System Member of the State Regulated Industry Board President of RHK Enterprises
Lana Rosa	Program Director of the Kaua'i Senior Centers

Name	Affiliation
Jan C. Rudinoff	St. Michael's Church and All Angel's Episcopal Church Member of Ethics Commission Police Chaplain Molokoa resident
Tom Shigemoto	League Coordinator of the Lihu'e Boys Baseball Organization President of Kaua'i High School Football Booster Club 1st Vice President of the Kaua'i AJA Baseball Association Board member of Wilcox Hospital Foundation Properties Board member of the Kaua'i Economic Development Board Trustee of Lihu'e Christian Church
Morris Shinsato	Retired County Attorney Molokoa resident
Kimiko Sugibayashi	Community Service Employment Program Worker Hanama'ulu resident
Turk Takita	Vice President of 442nd Veterans Club, Kaua'i Chapter Member of Kaua'i Veterans Council Retired Administrator of Kaua'i County Council
Linda Tanouye	Principal of Kaua'i High and Intermediate School
Ken Teshima	Chief Engineer for the Wilcox Memorial Health System
Paul Townsley	President of Rotary Kauai
George Toyofuku	Former State Senator Board member and past president of Lions Board member and past president of Lihue Hongwanji
Matsuko Uyeda	Lihue Senior Citizens Center Activities Manager

Name	Affiliation
David Wada	President of Fish Express Ltd.
Rick Watkins	Pastor of Lihue Baptist Church Member of Kaua'i Interfaith Recovery Effort
Barry Yap	Director of Marketing of Hawaii Visitors Bureau
Robert Yotsuda	President of Hale Opio Board member of Kaua'i 200 Vice President of Kapaa Hongwanji Former County Council member

Q

Economic & Fiscal Analysis of the Lihue-Hanamaulu Master Plan

ECONOMIC AND FISCAL ANALYSIS OF THE LIHUE-HANAMAULU MASTER PLAN AT MOLOKOA, AHUKINI AND HANAMAULU, KAUAI

FOR

LIHUE PLANTATION CO., LTD. AND
AMFAC/JMB HAWAII, INC.

OCTOBER 1994

Prepared by:

ARTHUR ANDERSEN & CO.

INTRODUCTION

This report summarizes the economic and fiscal impacts which are likely to result from the implementation of the development plan for the Lihue Plantation Company Limited properties at Molokoa, Ahukini and Hanamaulu.

The analysis is presented in two sections. The first section reviews the development program with respect to its probable economic impacts which are defined here as effects on the private sector economy. The second section deals with the program's probable fiscal impacts, defined for purposes of this analysis as the effects on the public sector economy as embodied in the governments of the County of Kauai and the State of Hawaii.

Project Description

The Lihue-Hanamaulu Master Plan provides for a range of residential and village mixed uses on 555 acres of land located at Lihue and Hanamaulu on the Island of Kauai (the "Project Area"). The four geographic sub-areas within the Project Area are Molokoa, Ahukini Mauka, Ahukini Makai and Hanamaulu. A substantial portion of the Project Area is projected to be developed over a 15 to 20 year period and is planned to be flexible in responding to community needs. The Master Plan for the Project Area includes several different components including, single and multi-family residential areas, public and quasi-public facility sites, village mixed-use areas, service/light industrial areas, a school site, parks and open space.

The village mixed-use areas within Molokoa and Ahukini Mauka envision a variety of retail and office uses that would form the village core of the community.

The general allocation of land uses is as follows:

Type of Use	Acres
Residential	
Single Family	180
Multi-Family	35
Retail/Office	70
Service/Light Industrial	26
Industrial	102

Main Roads	24
Parks, Open Space	48
Public/Quasi-Public	70
Total:	555

Residential development will provide approximately 1,400 to 1,800 dwelling units in a mix of product types, densities and prices that will include affordable, gap and market priced homes. Single-family homes will number from 1,000 to 1,400 units, and multi-family homes will number 350 to 400 units.

Plans for public and quasi-public facilities include sites for a veterans center, a judiciary complex, a new police station, a YMCA/teen center-type facility, an elementary school, a debris recycling center and a fruit disinfestation facility.

The economic and fiscal impacts analysis is based on the development of 1,800 dwelling units in the residential areas, and an average ratio of 10,000 square feet of leasable building space per acre of commercial and industrial area. The absorption projections for different residential, commercial and industrial categories are based on the higher market capture assumptions used in the market analysis of the Project Area. The analysis of the higher density, higher absorption assumptions provide an opportunity to analyze the impacts of the scenario with the greatest level of development in the shortest period of time.

REVIEW OF ECONOMIC IMPACTS

Direct economic impacts during a 20 year period are measured below in terms of projected total population, total employment, total development value and other economic indicators.

Land Use and Projected Resultant Development Value

Table 1 presents the projected market capture of residential units and commercial/industrial space over a twenty year period from 1997 to 2016. The market capture projections are based projections developed in the market analysis of the Project Area. The total number of residential units is rounded

out to 1,800 units to allow for the analysis of the maximum impact of the master plan.

Table 2 divides the residential unit projections from Table 1 into three categories of housing types for single family residential units and one category for multi-family residential units, and assigns a unit value to each type of housing. The number of units are then multiplied by the unit value to generate a development value by period for each housing type. The commercial and industrial market capture projections from Table 1 are multiplied by a dollar factor for each square foot of leasable building space and a dollar per acre figure for land area (based on one acre for every 10,000 square feet of commercial or industrial building area) to generate a development value by period for each land use type.

Development value over the initial 20 year period as measured in 1994 constant dollars is projected to approach $515.7 million. Of that total $310.0 million would reflect the anticipated residential unit valuation, and the balance of $205.6 million would reflect the anticipated commercial and industrial development valuation.

Residential Development

Table 1 also includes the adjusted projections of housing unit market capture for the 20 year period from 1997 to 2016. A total of 1,800 dwelling units are assumed to be absorbed during the 20 year period and distributed by housing type as follows: 1,391 single-family units and 409 multiple-family units.

Period	Single Family	Multiple Family	Total
Years 1 to 5	274	77	351
Years 6 to 10	434	122	556
Years 11 to 15	421	118	539
Years 16 to 20	262	92	354
Total:	1,391	409	1,800

Anticipated price ranges for the units expressed in 1994 constant dollars are summarized below.

Unit Type	Price Range
Affordable SF	$145,000 to $155,000
Gap SF	$175,000 to $190,000
Market SF	$200,000 to $225,000
Multi-Family	$110,000 to $120,000

It is anticipated that all of the residential units in the Project Area will be used by Kauai residents. The location of the Project Area's residential areas are conveniently located near, or have convenient access to, Kauai's major employment centers, and are close to schools, shopping areas and professional services.

Table 1.

Projected Development By Land Use Type
Project Area

Calendar Years	1997 to 1999	2000 to 2004	2005 to 2009	2010 to 2014	2015 to 2018
Residential Units					
Single Family (by period)	116	394	493	312	75
Single Family (cumulative)	116	511	1,003	1,316	1,391
Multi-Family (by period)	33	111	130	88	39
Multi-Family (cumulative)	33	144	282	370	409
Total Units (by period)	149	505	631	400	114
Total Units (cumulative)	149	654	1,286	1,686	1,800
Commercial/Industrial Leasable Area					
Retail GLA (by period)	43,724	69,092	94,996	85,704	35,058
Retail GLA Cumulative	43,724	112,816	207,812	293,516	328,574
Office GLA (by period)	21,384	43,362	54,054	50,490	20,196
Office GLA Cumulative	21,384	64,746	118,800	169,290	189,486
Industrial GLA (by period)	198,653	205,856	227,088	227,088	90,835
Industrial GLA Cumulative	198,653	404,509	631,597	858,685	949,520

Project Years	Years 1 to 5	Years 6 to 10	Years 11 to 15	Years 16 to 20
Residential Units				
Single Family (by period)	274	434	421	262
Single Family (cumulative)	274	708	1,128	1,391
Multi-Family (by period)	77	122	118	92
Multi-Family (cumulative)	77	199	317	409
Total Units (by period)	351	556	539	354
Total Units (cumulative)	351	907	1,446	1,800
Commercial/Industrial Leasable Area				
Retail GLA (by period)	71,361	79,454	91,279	86,480
Retail GLA Cumulative	71,361	150,815	242,094	328,574
Office GLA (by period)	38,729	47,639	52,828	50,490
Office GLA Cumulative	38,729	86,368	138,996	189,486
Industrial GLA (by period)	280,995	214,349	227,088	227,088
Industrial GLA Cumulative	280,995	495,344	722,432	949,520

Source: Arthur Andersen & Co.

Table 2.

Development Value
Project Area
($000s Constant 1994 Dollars)

Project Years:			1 to 5	6 to 10	11 to 15	16 to 20
Residential						
Total Units			351	558	539	354
	Portion	Unit Value				
Affordable SF (by period	25%	$150,000	$13,183	$20,841	$20,210	$13,277
Affordable SF (cumulative)			$13,183	$34,004	$54,214	$67,491
Gap SF (by period)	30%	$185,000	$19,482	$30,845	$29,910	$19,650
Gap SF (cumulative)			$19,482	$50,327	$80,237	$99,887
Market SF (by period)	25%	$225,000	$19,745	$31,262	$30,315	$19,916
Market SF (cumulative)			$19,745	$51,007	$81,321	$101,237
MF (by period)	20%	$115,000	$8,074	$12,783	$12,395	$8,143
MF (cumulative)			$8,074	$20,858	$33,251	$41,395
Subtotal (by period):			$60,464	$95,730	$92,830	$60,986
Subtotal (cumulative):			$60,464	$156,194	$249,024	$310,009
Commercial/Industrial						
	SF Value	Acre Value				
Retail Buildings	$90		$3,935	$6,218	$8,550	$7,713
Retail Land		$522,720	$3,730	$4,153	$4,771	$4,521
Subtotal (by period):			$7,665	$10,371	$13,321	$12,234
Subtotal (cumulative):			$7,665	$18,037	$31,358	$43,592
Office Buildings	$90		$3,486	$4,287	$4,737	$4,544
Office Land		$522,720	$2,024	$2,490	$2,751	$2,639
Subtotal (by period):			$5,510	$6,778	$7,488	$7,183
Subtotal (cumulative):			$5,510	$12,288	$19,775	$26,959
Industrial Buildings	$90		$25,290	$19,291	$20,438	$20,438
Industrial Land		$522,720	$14,688	$11,204	$11,870	$11,870
Subtotal (by period):			$39,978	$30,496	$32,308	$32,308
Subtotal (cumulative):			$39,978	$70,474	$102,782	$135,090
Subtotal (by period):			$53,153	$47,645	$53,117	$51,725
Subtotal (cumulative):			$53,153	$100,798	$153,915	$205,640
Total (by period):			$113,617	$143,375	$145,947	$112,711
Total (cumulative):			$113,617	$256,992	$402,938	$515,650

Source: Amfac/JMB Hawaii; Arthur Andersen & Co.

Projected Population and Socioeconomic Characteristics

Total population for the development has been projected utilizing a factor of 2.49 persons per unit, which is based on an average of 2.78 persons per unit derived from a 20-year (1970 to 1990) Kauai average of 378 new occupied dwelling units per 1,000 increase in population, plus an allowance for a 5.0 percent vacancy rate, and a small allowance for the replacement of demolished buildings.

It is projected that all of the residential units will be occupied by Kauai residents. Single family units are projected to have an average of 2.64 persons per unit, and multi-family units are projected to have an average of 2.00 persons per unit. As noted in Table 3 during the 20 year period a total of 4,475 residents are projected to reside in the Project area's residential areas. This total of 4,475 residents represents roughly 17.8 percent of the projected population of 25,098 in 2015 for the Lihue district as a whole.

The total addition to the labor force represented by this anticipated population is 2,284 workforce participants during the 20 year period, assuming a participation percentage of 52.5 percent of the total population. The 52.5 percent factor represents an assumption about the portion of the projected job counts on Kauai relative to the projected population of Kauai during the 1995 to 2015 period. The job count includes all types of jobs including self-employed workers.

Employment

Permanent operations in the commercial and industrial area are projected by the end of the 20 year period to accommodate the equivalent of 3,410 permanent, full-time jobs as shown in Table 3. These figures are based on the projected absorption of retail, office and industrial space in the Project Area (exclusive of government facilities), and an allocation of leasable area per employee.

With both a commercial center and an industrial area the Project Area program will accommodate substantial number of employment opportunities including warehouse, transportation, retail and office work.

Construction work during the 20 year period is projected to generate on a direct, indirect and induced basis the equivalent of an annual average 195 to 264 man-years of labor on an annual average basis as shown in Table 4. The direct jobs generated are directly involved in the construction activities at the Project Area, while indirect and induced jobs are based on activities which support the construction activities, or are removed from the construction, but which are supported by the income generated by the construction activity.

Wages

As presented in Table 5, average annual wages during the 20 year development period are projected to increase from $27.7 million during the initial five year period to $87.9 million by the fourth five year period, in constant 1994 dollars. The projections are based on the projections of average annual full time equivalent jobs generated by construction activity and full time equivalent jobs provided in the commercial and industrial areas multiplied by the 1991 average annual wage for the State of Hawaii, adjusted for inflation to 1993 levels.

Table 3.

Population and Employment Generation
Subject Area

		1 to 5	6 to 10	11 to 15	16 to 20
Project Years:		1 to 5	6 to 10	11 to 15	16 to 20
Average Resident/Household (1)		2.48	2.49	2.49	2.48
Number of SF Units (by period)		274	434	421	262
Number of SF Units (cumulative)		274	708	1,128	1,391
Number of MF Units (by period)		77	122	118	92
Number of MF Units (cumulative)		77	199	317	409
SF Persons/Unit (by period)	2.78	717	1,138	1,107	694
SF Persons/Unit (cumulative)		717	1,855	2,962	3,657
MF Persons/Unit (by period)	2.00	154	244	237	183
MF Persons/Unit (cumulative)		154	398	635	818
Total (by period):		871	1,382	1,344	878
Total (cumulative):		871	2,253	3,597	4,475
Total Labor Force Generated					
Total Project Area Residents % @	52.50%				
(by period)		457	726	706	481
(cumulative)		457	1,183	1,868	2,349
Total Employment Accommodated					
	Avg. SF GLA/ Employee				
Retail GLA		71,361	79,454	91,279	86,480
Retail (by period)	500	143	159	183	173
Retail (cumulative)		143	302	484	657
Office GLA		38,729	47,639	52,628	50,490
Office (by period)	500	77	95	105	101
Office (cumulative)		77	173	278	379
Industrial GLA		280,995	214,349	227,088	227,088
Industrial (by period)	400	702	536	568	568
Industrial (cumulative)		702	1,238	1,806	2,374
Total (by period):		923	790	856	842
Total (cumulative):		923	1,713	2,568	3,410

Note: (1) Persons to housing unit ration includes 5% housing unit vacancy factor, dwelling unit demolition, and 378 new units per 1,000 increase in population averaging 2.65 persons/new household

Table 4.

Development Period Labor Impacts
Project Area
(In constant 1994 $000s)

Project Years:		1 to 5	6 to 10	11 to 15	16 to 20
Residential					
Development Value		$60,464	$95,730	$92,830	$60,986
Construction Value @		70%	70%	70%	70%
Construction Value		$42,324	$67,011	$64,981	$42,690
Labor Hours/$1000					
Construction Value					
On-site Construction		9.20	9.20	9.20	9.20
Off-site Construction		1.50	1.50	1.50	1.50
Total Construction		10.70	10.70	10.70	10.70
Add'l Indirect, Induced Multiplier		179%	179%	179%	179%
Indirect, Induced		19.15	19.15	19.15	19.15
Total Labor Hours		1,263,513	2,000,482	1,939,874	1,274,428
FTE Jobs @ Hours	2,000	632	1,000	970	637
Annual Average		126	200	194	127
Commercial/Industrial					
Development Value		$39,978	$30,496	$32,308	$32,308
Construction Value @		70%	70%	70%	70%
Construction Value		$27,984	$21,347	$22,616	$22,616
Labor Hours/$1000					
Construction Value					
On-site Construction		9.20	9.20	9.20	9.20
Off-site Construction		1.50	1.50	1.50	1.50
Total Construction		10.70	10.70	10.70	10.70
Addl Indirect, Induced		179%	179%	179%	179%
Indirect, Induced		19.15	19.15	19.15	19.15
Total Labor Hours		835,419	637,274	675,149	675,149
FTE Jobs @ Hours	2,000	418	319	338	338
Annual Average		84	64	68	68
Total Labor Hours		2,098,932	2,637,757	2,615,023	1,949,577
FTE Jobs @ Hours	2,000	1,049	1,319	1,308	975
Annual Average		210	264	262	195

Source: Labor Hours Per $1000 Construction from Burchell, Robert E. et al, "Development Impact Assessment Handbook," 1994, Urban Land Institute and are based on national averages; DBEDT for indirect and induced employment generation; Arthur Andersen & Co.

Table 5.

Projected Average Annual Employment and Income
Project Area
(In constant 1994 $000s)

Project Years:	1 to 5	6 to 10	11 to 15	16 to 20
Development Employment				
Residential	126	200	194	127
Commercial/Industrial	84	64	68	68
Total:	210	264	262	195
Project Area Operations				
Retail (cumulative)	143	302	484	657
Office (cumulative)	77	173	278	379
Industrial (cumulative)	702	1,238	1,806	2,374
Total (cumulative):	923	1,713	2,568	3,410
Total Development and Operations				
Development	210	264	262	195
Operations	923	1,713	2,568	3,410
Total Annual Average Employees	1,133	1,977	2,830	3,605
Average Annual Employment Income (1)	$23,176	$23,176	$23,176	$23,176
Inflation Adjustment 1991 to 1993 (2)	1.06	1.06	1.06	1.06
Adjusted Average Annual Employment Income	$24,516	$24,516	$24,516	$24,516
Total Annual Average Employment Income	$27,766	$48,455	$69,374	$88,378

Note: (1) from DBED Data Book, 1992, Table 366 1991 annual average wage
(2) from Bank of Hawaii, Business Trends, November/December 1993, Honolulu CPI-U

Source: DBED, Bank of Hawaii; Arthur Andersen & Co.

REVIEW OF FISCAL IMPACTS

This section examines the fiscal impacts of the proposed Project Area development program upon the public sector. The projected public costs and revenues engendered by the plan are examined for both the County of Kauai and the State of Hawaii, the two entities which provide local municipal governmental activities to the Lihue and Hanamaulu communities. The basic methodology is that of an analysis of average per capita expenditures and revenues, with a project-specific analysis of potential real property taxes during the 20 year period.

Fiscal Impact on the County of Kauai

This section examines the projected fiscal impacts of the proposed Project Area development program on the County of Kauai. Projected general fund and highway special fund expenditures are projected and compared with projected revenues to the County of Kauai.

General Fund and Highway Fund Expenditures

The County of Kauai would provide the following major municipal services to Project Area residents and businesses: general government; public protection; road maintenance and repair; sanitation and waste removal; health and welfare; and culture and recreation. The total general fund budget for fiscal year 1992-1993 shows that the County spent $38.5 million, or $1,962 per capita[1] on various governmental services supported by the general Fund. The moneys are distributed by major category as follows:

[1]Based on an estimated January 1992 population of 55,300 residents for the County.

Budget Category	FY 1992-1993 Expenditures ($ millions)
General Government	$18.6
Public Safety	$11.8
Public Works	$3.2
Sanitation/Waste Removal	$1.4
Public Welfare	$0.9
Culture/Recreation	$2.6
Subtotal (General Fund):	$38.5
Highway Fund (Special Fund)	$4.9
Total:	$43.4

Each of these major expenditure areas is examined below.

General Government

General Government consists of salaries and overhead expenditures for the Mayor's Office, the County Council, and the County Clerk as well as major departments such as Finance, Planning, County Attorney, Prosecuting Attorney, and payments for insurance, pensions and employee benefits for all departments. During the pre-development and development phases the proposed project will undergo zoning and building review procedures, thus incur costs in this governmental sector. These costs will be of a transitory nature, and will be largely offset by governmental charges for current services in the form of application and permit fees and other processing charges. Zoning and building review costs are not considered to be long term recurring costs to County Government.

Per capita costs for General Government in fiscal year 1992-1993, based upon an estimate of 55,300 residents in 1992, were approximately $336. Assuming that this figure accurately portrays costs for this service to residents in the Project Area, at the end of the 20 year period the new residents would require annual expenditures approaching $1,505,145 as measured in 1994 constant dollars.

Public Safety

The three major cost areas within this service category are police protection; fire protection; and other protection, which includes civil defense and contributions to the humane society.

Per capita costs for Public Safety in fiscal year 1992-1993, based upon an estimate of 55,300 residents in 1992, were approximately $213. Assuming that this figure accurately portrays costs for this service to residents in the Project Area, at the end of the 20 year period the new residents would require annual expenditures approaching $954,725 as measured in 1994 constant dollars.

Public Works, Sanitation and Waste Removal

Most residences in Lihue, Hanamaulu and Puhi are served by a sanitary sewer system; the remainder are served individually by cesspool systems. The Master Plan for the Project Area anticipates that the residential, commercial and industrial areas would be served by sanitary sewer systems, and that sufficient facilities would be provided or would be caused to be provided to accommodate the planned uses. It is assumed that the Department of Public Works would operate the facilities, and collect taxes or service fees sufficient to offset the operations of the facilities.

Historically, solid waste disposal facilities have been supported from general and special fund revenues. Annual general fund costs for this service at present average approximately $25 per resident. At the end of the 20 year period, future solid waste disposal costs from the Project Area could reach $112,810 as measured in 1994 constant dollars.

Other public works activities have an annual general fund cost of approximately $57 per resident. At the end of the 20 year period the new residents would require annual expenditures approaching $257,161 as measured in 1994 constant dollars.

Public Welfare

The primary expenditures associated with this function are for the Office of Elderly Affairs and school bus programs. Fiscal year 1992-1993 expenditures for these functions were $926,623.

Per capita costs for Public Protection in fiscal year 1992-1993, based upon an estimate of 55,300 residents in 1992, were approximately $17. Assuming that this figure accurately portrays costs for this service to residents in the Project Area, at the end of the 20 year period the new residents would require annual expenditures approaching $74,981 as measured in 1994 constant dollars.

Culture and Recreation

The primary expenditures associated with this function are for park and beach personnel, park maintenance, recreation services and administration, constituting $2,552,990. This represents an expenditure level of approximately $46 per capita on a County-wide basis. Assuming that this per capita figure accurately portrays costs for this service to residents in the Project Area, at the end of the 20 year period the new residents would require annual expenditures approaching $206,585 as measured in 1994 constant dollars.

Road Maintenance and Repair

Road maintenance and repair of County roadways, together with street lighting and traffic signalization is financed from a separate Highway Fund. Fiscal year 1992-1993 expenditures for this function were $4,931,884 or approximately $89 per capita.

The Master Plan for the Project Area calls for the construction of all major and minor streets within the development and the dedication of these to the County for future operations and maintenance. These new streets will require minimal maintenance in the initial years of development, and Project Area residents, to the extent they reside near their places of employment may utilize the existing road network at levels comparable to or less on average than the existing island-wide population.

Per capita costs for road maintenance and repair in fiscal year 1992-1993, based upon an estimate of 55,300 residents in 1992, were approximately $89. Assuming that this figure accurately portrays costs for this service to residents in the Project Area, at the end of the 20 year period the new residents would require annual expenditures approaching $399,488 as measured in 1994 constant dollars.

Cost Summary

Total general fund and highway special fund costs associated with Project Area plan at the end of the first 20 years of development of the 1,800 residential units and associated commercial uses for the first 20 years of the project are summarized in Table 6. Projected in 1994 constant dollars these increased expenditures are projected to reach $3,510,488.

General Fund and Highway Fund Revenues

Public revenues generated by the proposed Project Area which will accrue to the County General Fund include property taxes and licenses and permits. Public revenues accruing to the Highway Fund which offset roadway maintenance expenditures are public utility franchise taxes, fuel taxes, and licenses for street use. These revenue sources are reviewed and projected for the Project Area program below.

It should be noted that the County of Kauai receives a substantial portion of its operating funds through intergovernmental transfers, which allow the County government to expend more funds than it takes in directly. In fiscal year 1992-1993 intergovernmental transfers totaled nearly $11.2 million out of a total general fund revenue budget of $48.2 million, representing over 23% of the total revenues of the County government's general fund. While the County of Kauai's general fund revenues in fiscal year 1992-1993 were substantially greater than its general fund expenditures there was a $6.7 million financing transfer out of general fund revenues to other operations. The remaining balance of general fund revenues above general fund expenditures was held in an adjusted balance for the next fiscal year.

Property Taxes

As shown in Table 6 property tax generation by the proposed Project Area program is projected to reach $2,936,190 at the end of the 20 year period, derived from application of current County tax rates to anticipated total development valuation of $515.7 million in constant 1994 dollars. These moneys would be available to the general fund for use as an offset to necessary public expenditures made on behalf of Project Area residents and businesses.

Business Licenses/Non-business Licenses and Permits

Revenues from licenses and permits totaled $548,781 for the County in fiscal year 1992-1993, representing a per capita figure of approximately $10. With its commercial center and industrial area, the Project Area program should generate permit and license revenues comparable to the County average; correspondingly, at the end of the 20 year period annual revenues from this source are projected to reach $44,407 as measured in 1994 constant dollars.

Rents and Concessions

Revenues from rents and concessions totaled $961,670 for the County in fiscal year 1992-1993, representing a per capita figure of approximately $17. With its commercial center and industrial area, the Project Area program should generate permit and license revenues comparable to the County average; correspondingly, at the end of the 20 year period annual revenues from this source are projected to reach $78,817 as measured in 1994 constant dollars.

Charges for Current Services

Charges for current services include miscellaneous user charges for general government activities and public safety. Revenues from charges for current services totaled $961,670 for the County in fiscal year 1992-1993, representing a per capita figure of approximately $8. At the end of the 20 year period annual revenues from this source are projected to reach $37,445 as measured in 1994 constant dollars.

Highway Fund Revenues

Moneys channeled to the Highway Fund are provided by three major sources: the public utility franchise tax; the fuel tax; and licenses and permits related to street use. These three sources in combination generated $5,220,025 to the Highway Fund in fiscal year 1992-1993, the equivalent of approximately $94 per capita. Project Area activities are projected to generate funds to this source at the current per capita level of $94 per capita. At the end of the 20 year period annual revenues from this source are projected to reach $422,397 as measured in 1994 constant dollars.

Table 6.

Government Expenditures and Revenues
FY 1992-1993 Per Capita and Amfac Property Projected Buildout
County of Kauai

EXPENDITURES					
Category	FY 1992-1993 Expenditures	1992 Population	FY 1992-1993 Per Capita Expenditures	Projected Amfac Prop Population	Projected Buildout Expenditures
General Fund (GF)					
General Government	$18,600,711	55,300	$336	4,475	$1,505,145
Public Safety	$11,798,572	55,300	$213	4,475	$954,725
Public Works	$3,178,015	55,300	$57	4,475	$257,161
Sanitation	$1,394,121	55,300	$25	4,475	$112,810
Culture & Recreation	$2,552,990	55,300	$46	4,475	$206,585
Public Welfare	$926,623	55,300	$17	4,475	$74,981
Subtotal (GF):	$38,451,032	55,300	$695	4,475	$3,111,406
Special Fund					
Highway	$4,931,884	55,300	$89	4,475	$399,082
Total:	$43,382,916	55,300	$785	4,475	$3,510,488
REVENUES					
General Fund (GF)	FY 1992-1993 Revenues	1992 Population	FY 1992-1993 Per Capita Revenues	Projected Amfac Prop Population	Projected Buildout Revenues
Property Taxes	$33,182,996	55,300	$600	4,475	$2,936,190
Licenses & Permits	$548,781	55,300	$10	4,475	$44,407
Rents and Concessions	$961,670	55,300	$17	4,475	$77,817
Charges for Current Services	$462,743	55,300	$8	4,475	$37,445
Subtotal (GF):	$35,156,190	55,300	$636	4,475	$3,095,858
Special Fund					
Highway Fund	$5,220,025	55,300	$94	4,475	$422,397
	$40,376,215	55,300	$730	4,475	$3,518,255
Revenues Over Expenditures Excess/(Deficit)					$7,767

Note: Table does not include intergovernmental transfers or other financing sources
Source: County of Kauai FY 1992-1993 general fund financial report; Arthur Andersen & Co.

Revenue Summary

Public revenues generated for the County of Kauai general fund and highway fund in the Project Area are projected to reach $3,518,255 at the end of the 20 year period. These revenues are summarized in Table 6. The revenue sources listed in Table 6 reflect the primary areas in which residents and businesses operating in the project area are likely to generate revenues. Other sources would be through the payment of state and federal taxes which return to the County of Kauai in the form of intergovernmental transfers. Also, commercial users of solid waste disposal facilities would also pay the associated service fees.

These projected general fund and highway fund revenues should almost completely offset the projected increase in County general fund and highway fund expenditures. Annual revenues are projected to exceed annual expenses by $7,767 in 1994 constant dollars.

As a non-monetary contribution to the County of Kauai the Master Plan for the Project Area includes the dedication of 18.0 acres of park area to the County of Kauai. The Master Plan also makes available significant areas for a new police station complex, a recycling center and a disinfestation facility.

Table 7.

Property Tax Revenue Projections
Based on 1993 Tax Rates and Projected Amfac Buildout
($000s Constant 1994 Dollars)

Project Years:	Tax Rate (1)	1 to 5	6 to 10	11 to 15	16 to 20
Residential:					
Affordable SF @	$4.20				
(by period)		$55,266	$87,533	$84,881	$55,784
(cumulative)		$55,266	$142,819	$227,699	$283,463
Gap SF @	$4.30				
(by period)		$83,771	$132,633	$128,614	$84,495
(cumulative)		$83,771	$216,404	$345,019	$429,514
Market SF @	$4.40				
(by period)		$86,878	$137,551	$133,384	$87,628
(cumulative)		$86,878	$224,429	$357,813	$445,442
Multi-Family @	$4.50				
(by period)		$36,331	$57,521	$55,779	$36,645
(cumulative)		$36,331	$93,852	$149,631	$186,276
Subtotal (by period):		$262,268	$415,236	$402,658	$264,532
Subtotal (cumulative):		$262,266	$677,504	$1,080,162	$1,344,694
Commercial:					
Buildings SF Cost @	$7.59	$56,324	$79,739	$100,842	$93,034
Land Acre Cost @	$7.99	$45,979	$53,081	$80,103	$57,206
Subtotal (by period):		$102,303	$132,819	$180,945	$150,240
Subtotal (cumulative):		$102,303	$235,123	$393,068	$546,308
Industrial:					
Buildings SF Cost @	$7.59	$191,948	$146,422	$155,124	$155,124
Land Acre Cost @	$7.99	$117,359	$89,523	$94,844	$94,844
Subtotal (by period):		$309,308	$235,945	$249,968	$249,968
Subtotal (cumulative):		$309,308	$545,252	$795,219	$1,045,187
Residential Bldgs/Land		$262,266	$415,236	$402,658	$264,532
Commercial/Industrial Bldgs/Land		$411,609	$368,765	$410,913	$400,208
Total (by period):		$673,876	$784,003	$813,571	$664,740
Total (cumulative):		$673,876	$1,457,878	$2,271,449	$2,936,190

Note: (1) a blended rate for residential properties based on $3.94 for building and $4.93 for land
Source: County of Kauai (tax rates); Arthur Andersen & Co.

Fiscal Impact on the State of Hawaii

This section examines the projected fiscal impacts of the proposed Project Area development program on the State of Hawaii. Projected expenditures are projected and compared with projected revenues to the State of Hawaii.

Expenditures

The State of Hawaii provides the following services to local residents which could be directly impacted by the proposed development: education; highways; and hospitals.

Education

Lihue and Hanamaulu are currently served by existing elementary schools (Wilcox and Kaumualii) which provide for grades K to 6. Intermediate and high school students in grades 7 to 12 are served by Kauai High and Intermediate School in Nawiliwili. 1994 enrollment at the three schools and the Department of Education's estimate of capacity for the three schools is presented below. Based on the Department of Education's capacity estimate Wilcox Elementary school has a limited amount of unused capacity, but Kaumualii Elementary and Kauai High and Intermediate are over their estimated capacity.

School	1994 Enrollment	DOE Capacity Est.	Above/(Below) Capacity
Wilcox	1,004	1,066	(62)
Kaumualii (previously Hanamaulu)	835	713	122
Kauai High & Int.	1,775	1,718	57

The Department of Education has plans for three new schools to alleviate current capacity problems. A new elementary school near the Coco Palms Hotel will alleviate capacity problems at Kaumualii Elementary School. A new intermediate school in Kapaa may alleviate enrollment pressures at Kauai High and Intermediate School. A new elementary school associated with Grove Farm's Puakea project in Puhi will alleviate capacity problems at Wilcox Elementary School.

Projections by the Department of Education for the Project Area at the end of the 20 year period, as shown in Table 8, indicate that approximately 596 students would be added to the school system, representing between 43 and 48 students per grade level.

With regards to operating costs, the State spends $5,246 per student for teaching and related overhead expenses[1]. This figure does not include capital costs. Annual operating costs for education at the end of the 20 year period could approach $3,126,616 annually.

Highways

No major highway construction will be required to accommodate the Project Area Master Plan, but planned improvements to Ahukini Road will be required to allow for the use of portions of the Ahukini Makai project area. Department of Transportation plans as of April 1994 call for the initiation of improvements to Ahukini Road during the near to intermediate term.

Possible improvements required by the implementation of the Project Area Master Plan include left-turn stacking lanes and signalization on Ahukini Road between Kuhio and Kapule highways. It is anticipated that the construction of these improvements would be implemented as warranted.

Hospitals

Medical services are provided to Lihue and Hanamaulu by the privately-owned Wilcox Hospital. While no plans exist to expand these facilities, it is likely that additional hospital capacity will be required at this facility as a consequence of area development and buildout of the Project Area. Funding for any required expansion would be the responsibility of Wilcox Hospital and would likely be based on anticipated future revenues derived from hospital operations and other funding sources available to the hospital.

Revenues

Recurring revenues generated to the State of Hawaii by the project will include moneys from the following major sources:

[1]Based on a statewide average of annual operating expenditures for the 1991-1992 fiscal year. Source: Department of Business Economic Development and Tourism, State Data Book, 1992, Table 97.

- General excise tax revenue from various businesses located within the commercial center and industrial park; and
- Personal and corporate income tax collected from persons and businesses residing in the development.

General Excise Taxes

General excise taxes from the retail facilities are projected to reach $3,815,711 on an annual basis, as shown in Table 8 below. This projection is based on assumptions regarding the number of square feet of leasable area, sales per square foot, and the application of the 4.0 percent general excise tax.

Income Taxes

While the analysis of income tax revenue generation is difficult even when reviewing historical information, it may be possible to identify the general magnitude of potential future income tax revenue generation. Table 8 includes projections of income tax generation based on the projected population of the Project Area at the end of the 20 year period, the projected per capita income and a factor representing an average portion of per capita income paid in state income taxes. This projection does not include income taxes derived from business activities in the Project Area.

Income tax revenues to the State of Hawaii from Project Area residents are projected to approach $5,520,169 by the end of the 20 year period.

Revenue Summary

The projected generation of general excise taxes and state income taxes from residents and activities in the Project Area by the end of the 20 year period are projected to reach $9.3 million in annual revenues and may offset required State of Hawaii expenditures serving the Project Area.

In addition, the master plan calls for the contribution of up to 12 acres of land to the State of Hawaii for use as a school site as part of a "fair share" contribution.

SUMMARY

The following summarizes the projected impacts and benefits of the Project Area development by the end of the 20 year period:

Impacts

The impacts of the development of the Project Area are related to accommodation of projected population and economic growth for the County of Kauai and the Lihue District.

- 4,475 residents
- 596 students
- 3,410 workers

Benefits

As with the impacts of the development of the Project Area, benefits of the development include accommodation of projected growth, but also include specific elements that will benefit the community.

- A substantial body of new residential dwelling units oriented towards Kauai residents that will be served by sanitary sewers rather than cesspools
- Provision of both new homes and new employment center areas in close proximity to each other to foster short commutes and to relieve traffic congestion along the belt highways
- Opportunities for the growth of the existing Lihue town area
- Revenues to the State of Hawaii and the County of Kauai may generally offset expenditure requirements based on recent per capita expenditure levels
- Payment of infrastructure improvements by the applicant (or applicant will cause for payment to be made)

- A site for a new public school
- Sites for new public parks and for the expansion of the Hanamaulu Park
- A site for recycling programs by the County of Kauai
- A site for a new police facility
- A site for a YMCA teen center-type facility
- A site for a disinfestation facility

Table 8.

Projected Average Expenditures for Students
Projected General Excise Tax Revenues
Project Area
($000s Constant 1994 Dollars)

Project Years		1 to 5	6 to 10	11 to 15	16 to 20
Student Expenditures					
Student Enrollment		176	117	289	16
Cumulative Total		176	293	582	598
Avg. Cost/Student	$5,246	$5,246	$5,246	$5,246	$5,246
Projected Expenditures (Current Dollars)		$923,296	$1,537,078	$3,053,172	$3,126,616
General Excise Tax					
Retail GLA		43,724	69,092	94,996	85,704
Cumulative Retail GLA		43,724	112,816	207,812	293,516
Sales/SF GLA (Current Dollars)		$325	$325	$325	$325
Total Sales ($000s)		$14,210	$36,665	$67,539	$95,393
General Excise Tax @	4.00%	$568,415	$1,466,613	$2,701,558	$3,815,711
State Income Tax					
Project Area Population (cumulative)		671	2,253	3,597	4,475
Per Capita Income (1990 Dollars)		$20,266	$21,141	$22,016	$22,845
1990 to 1994 Conversion Factor (est.)		1.08	1.08	1.08	1.08
Project Area Income ($000s)		$19,059	$51,445	$85,527	$110,403
Average Effective Income Tax Factor (est.)		5%	5%	5%	5%
Income Tax (est.)		$952,936	$2,572,264	$4,276,332	$5,520,169

Note: Student count projections from Department of Education

Source: Arthur Andersen & Co.

END

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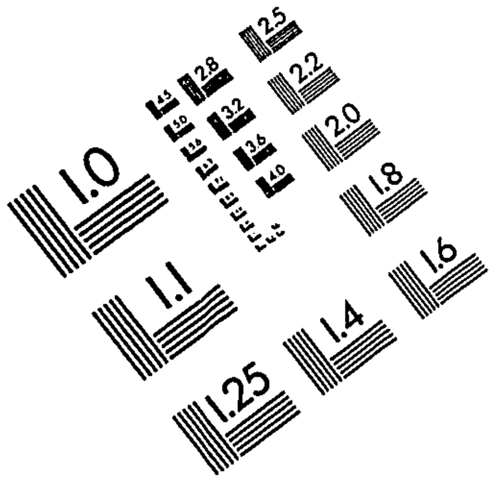
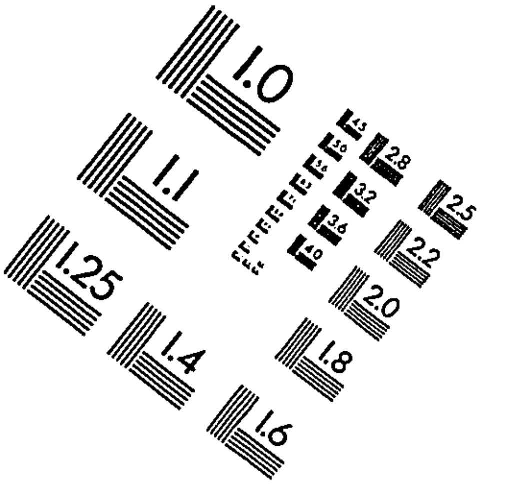

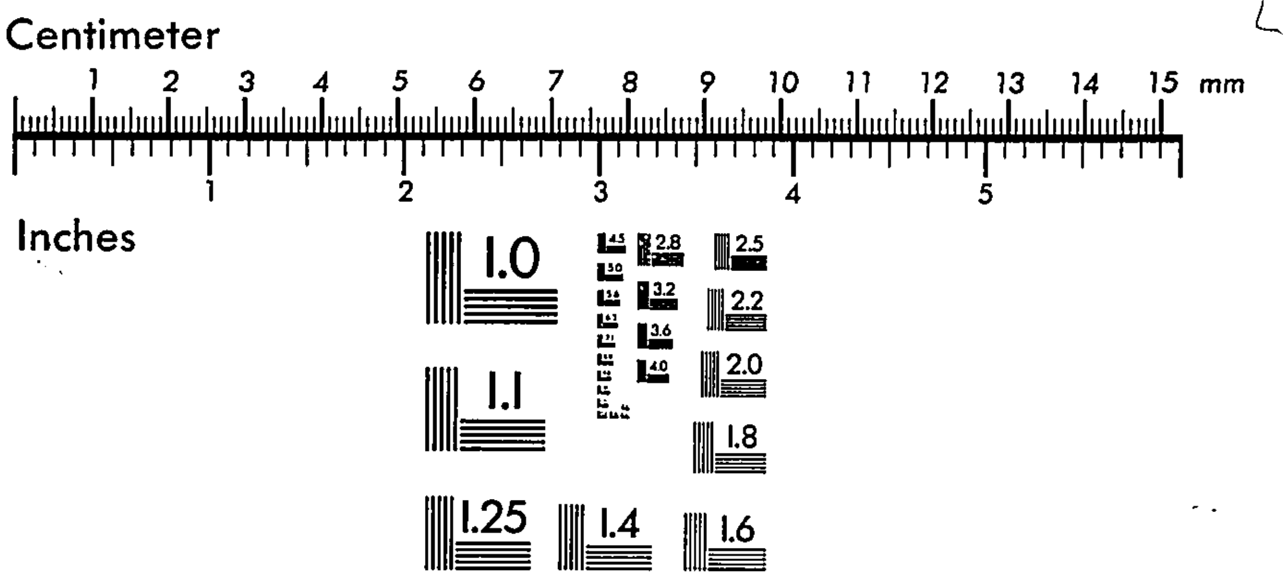

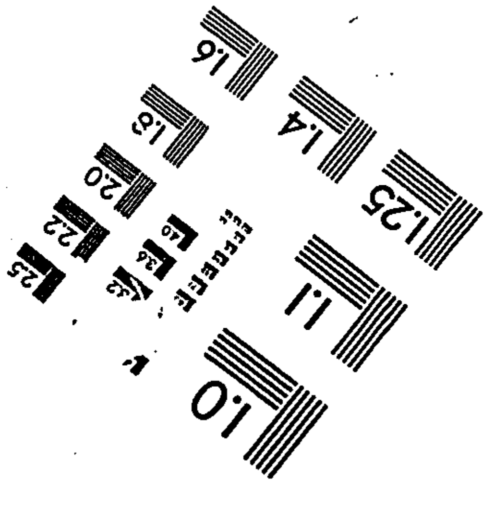
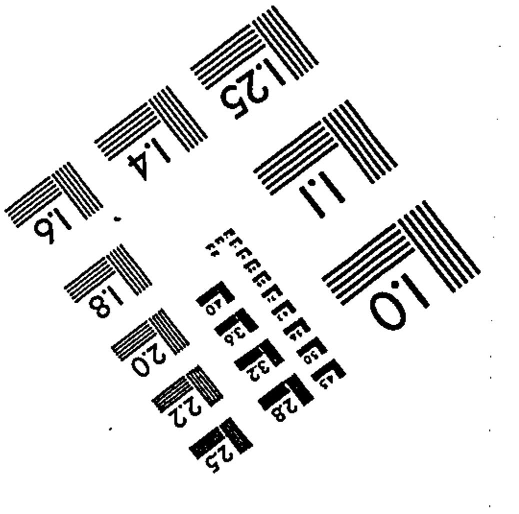

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