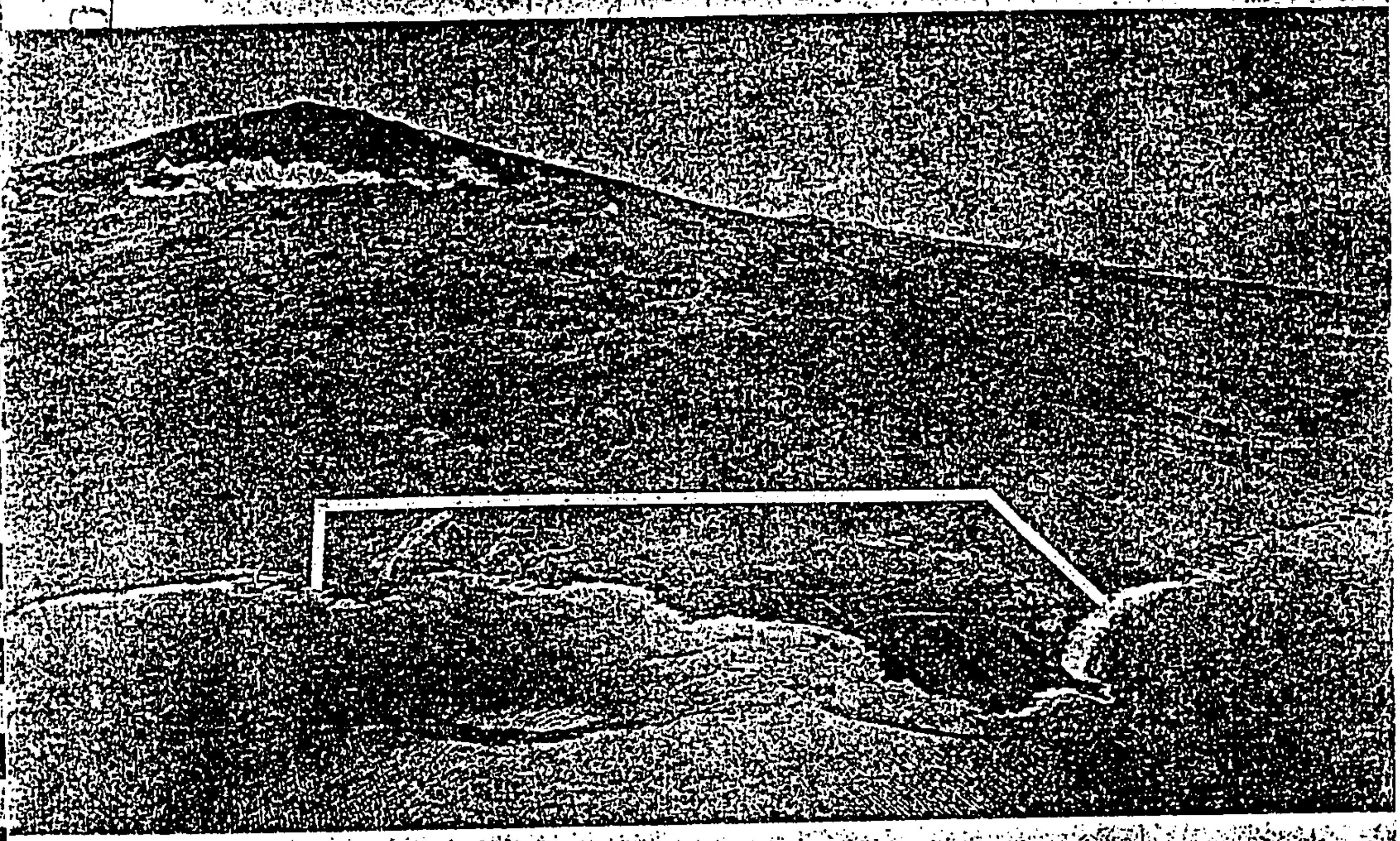
SEIBU MAKENA MASTER PLAN

~~Draft~~ Revised EIS

Makena, Maui

4/75

SEIBU MAKENA MASTER PLAN



ENVIRONMENTAL IMPACT STATEMENT

SEIBU REAL ESTATE COMPANY, LTD.
1-16-15, MINAMI-IKEBUKURO
TOSHIMA-KU, TOKYO 171

NEIGHBOR ISLAND CONSULTANTS • 80 PAUAHI ST. • HILO, HAWAII • PH: 935-6654

A Revised ~~DRAFT~~ ENVIRONMENTAL IMPACT STATEMENT
IMPLEMENTATION OF THE PROPOSED SEIBU MAKENA MASTER PLAN

MAKENA, MAUI, HAWAII

SEIBU REAL ESTATE COMPANY, LTD.
1-16-15, Minami-Ikebukuro
Toshima-Ku, Tokyo 171

NEIGHBOR ISLAND CONSULTANTS

Suite 104, 80 Pauahi Street
Hilo, Hawaii 96720

Phone: (808) 935-6654

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Continued)

CHAPTER I

INTRODUCTION

STUDY PURPOSE

The purpose of this environmental impact statement is to provide Seibu Real Estate Company, Ltd. and local decision-making bodies, i.e. Maui County, with data and analyses required for the initial evaluation of the proposed Seibu Makena Master Plan. Data and analyses presented in this report include:

A description of selected aspects of the Makena-Ahihi Bay area environment;

A general analysis of short and long term environmental impacts resulting from proposed developments in the Makena-Ahihi Bay area;

Recommendations for minimizing short and long term environmental effects;

Recommended methods for assessing certain impacts which cannot be adequately assessed until additional baseline information is obtained or until preliminary design drawings are available;

A determination of the type and amount of irretrievable resources required to accomplish the proposed development program; and

A general analysis of alternative actions which could be implemented to accomplish the goals and objectives of the proposed development program.

Should the Master Plan eventually be acceptable to these agencies in light of proposed amendments to County and State General Plan and zoning designations, it is assumed that this report would subsequently serve as a guide for the planning, design and development of the Makena-Ahihi Bay area. Utilized in this fashion, it is envisioned that this document would, in the future, be refined and supplemented by more detailed environmental impact analyses for specific aspects of the project, i.e. sewage treatment plant.

Act 246, enacted into State law in June, 1974, requires (in part) the preparation of an environmental impact statement (EIS) for projects involving an amendment to any existing County general plan. In addition, this law also mandates the formation of an "environmental quality commission" which has the responsibility of establishing rules and regulations for implementing the State's new EIS law, i.e. content of an environmental impact statement. In the absence of these regulations, this document was initially prepared in Summer, 1974, in consultation with Mr. Marvin Miura, environmental coordinator for Maui County and in accordance with the State Office of Environmental Quality Control Manual for the Preparation and Processing of Environmental Impact Statements (final draft, October 4, 1972).

Subsequent to the initial drafting of this environmental impact statement, proposed Rules and Regulations were prepared by the State Environmental Quality Commission. At the time of this report, public hearings regarding the proposed Rules and Regulations have been conducted throughout the State; however, such rules and regulations have not been approved by the Governor. In light of these conditions, an attempt has been made to adhere to almost all the content requirements suggested by the proposed Rules and Regulations. Those proposed content and procedural requirements which have not been met include:

1. Proposed mitigative measures to minimize impact--In this regard, mitigative measures have been recommended in this report; however, SRECL has not committed itself to the implementation of these measures at this time. Alternative mitigative measures were considered for each section but are not discussed in this report.

2. Coordination with community groups--A number of governmental agencies and private individuals have been contacted for the purpose of obtaining data required for the EIS and disclosing the existence and timing of the proposed project. However, such discussions have not been summarized in this report, or have unresolved issues been discussed.

3. Alternatives--A possible alternative is discussed in Chapter VI; however, it is not discussed to the scope indicated by the proposed Rules and Regulations.

SCOPE OF STUDY

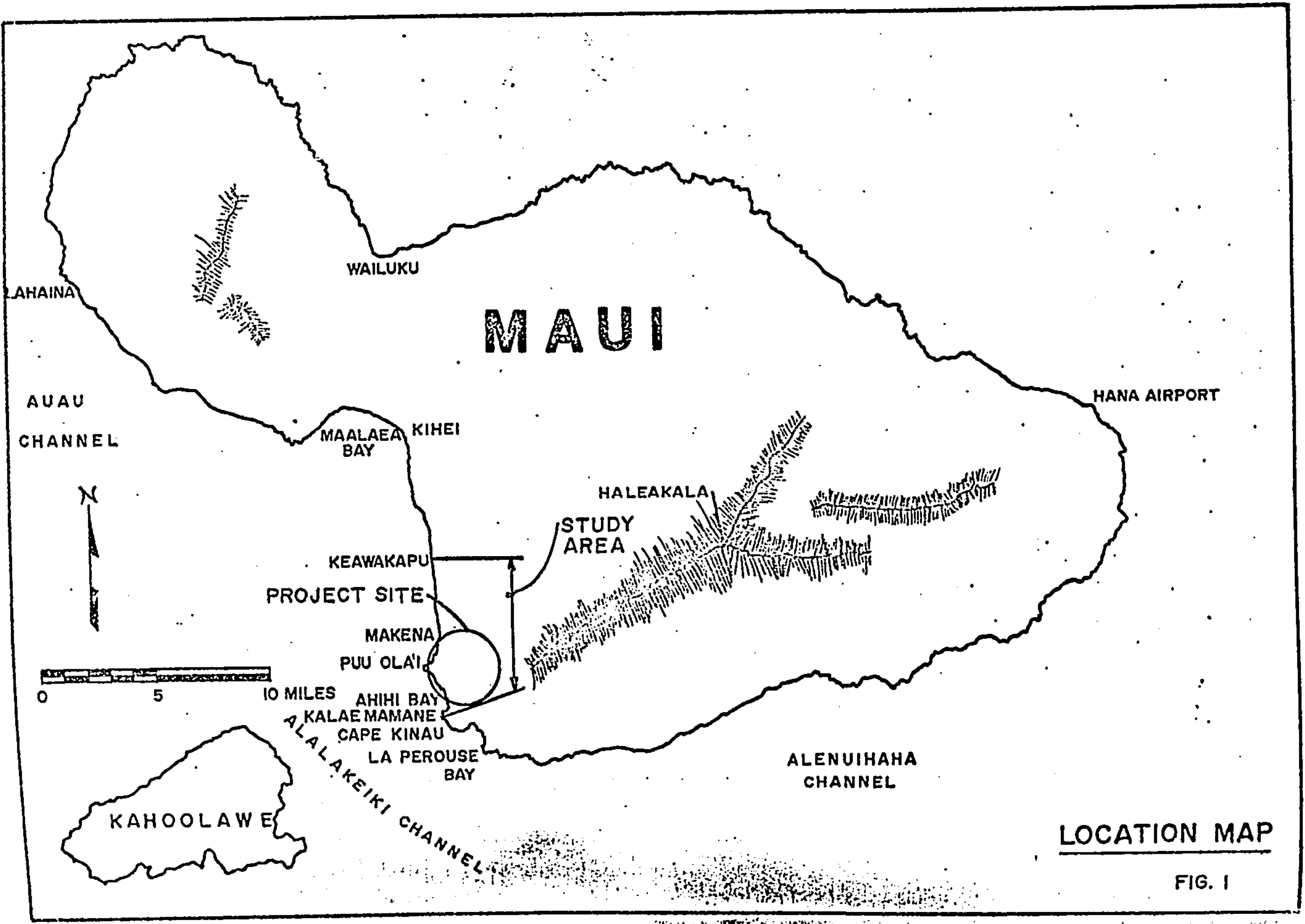
The tributing area, study area and project site are three geographical locations which are continually referred to in this environmental assessment.

The tributary area is depicted in figure 1 and encompasses the project site, the study area and the remaining environment of the Island of Maui. Consideration of the tributary area is primarily in terms of regional cultural characteristics, such as land use and the Island economy.

As shown in figure 2, the study area includes the area from Keawakapu to Ka Lae Mamane and extends mauka from the -30-foot contour to the +800-foot elevation. This area is primarily referenced for the discussion of physical, chemical, biological and cultural characteristics.

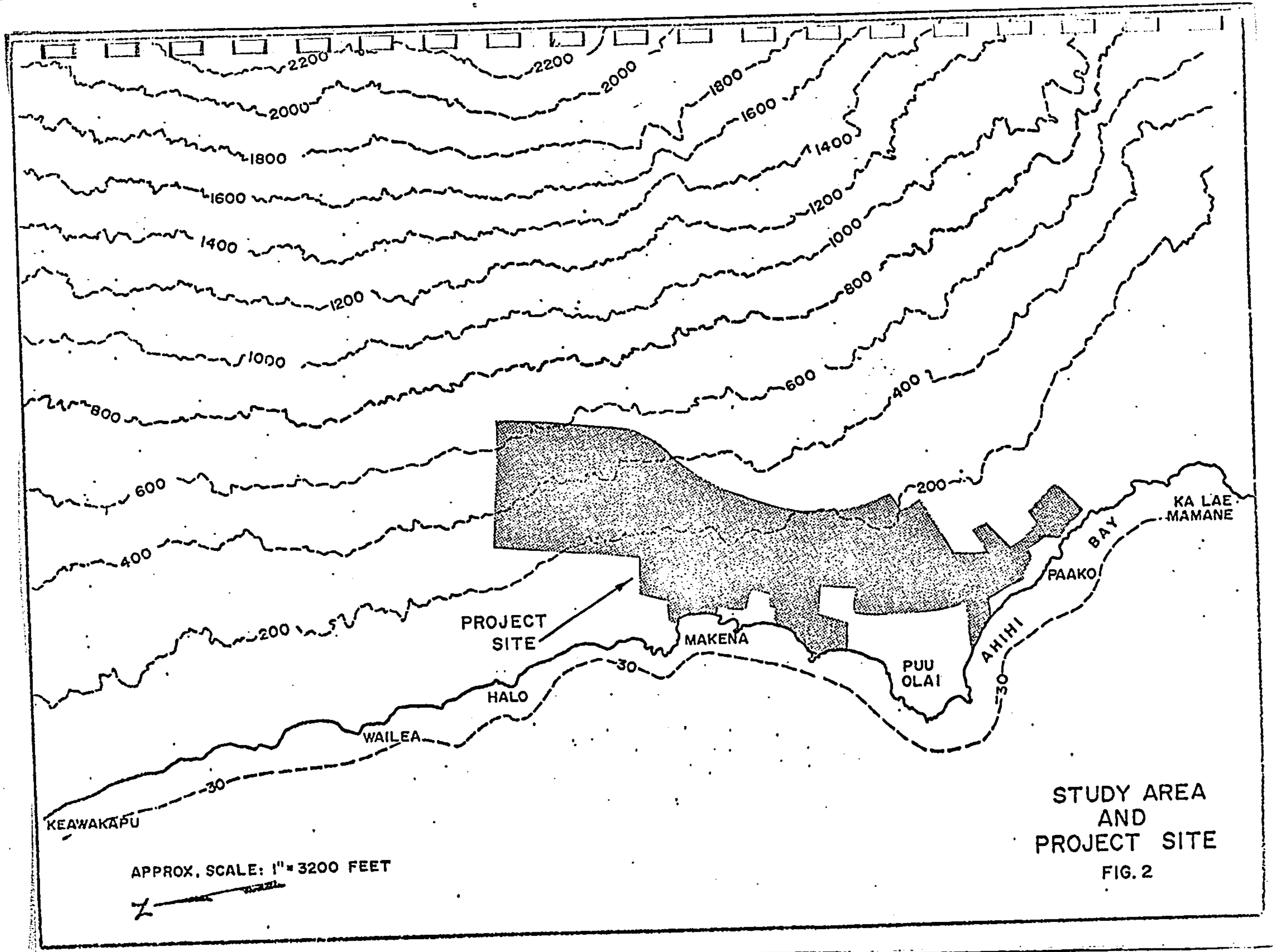
The project site (figure 2) is a sub-region of the study area and consists of all lands which would be developed by implementation of the proposed development program. Physical, chemical, biological, and cultural characteristics are also addressed in context of the project site.

The basis for discussion of the proposed development program and the evaluation of potential environmental impacts is the "Proposed Amendment to the (Maui County) General Plan for the Makena District" (June 24, 1974) by Seibu Real Estate



LOCATION MAP

FIG. I



STUDY AREA
AND
PROJECT SITE
FIG. 2

Company, Ltd. Since no detailed site planning has been performed or preliminary design drawings been prepared, evaluation of environmental impact has been evaluated in terms of proposed maximum allowable densities and preliminary design proposals, i.e. roadway widths, placing of all utilities underground, recommended by SRECL's "Proposed Amendment to the General Plan." Such available data has been augmented by the experienced gained from prior assessments of environmental impact by the Neighbor Island Consultants staff and its environmental associates.

LIST OF CONTRIBUTORS

Neighbor Island Consultants

Staff

James Pedersen
Environmental Planner

David Gustafson
Civil/Sanitary Engineer

Fred Zobrist
Civil/Ocean Engineer

William Ebersole
Marine Geologist

Leonard Ah Sing
Graphics and Report Production

Environmental Associates

Bill Albrecht
Economist

Andrew Berger

Bird Ecologist

Ralph Bowers

Fish Specialist

Ron Darby

Noise Specialist

Eric Guinther

Invertebrate Specialist

James Maragos

Coral and Reef Specialist

Bill Richards

Fish Specialist

Ron Walker

Terrestrial Biologist

CHAPTER II

OBJECTIVES OF THE PROPOSED DEVELOPMENT PROGRAM

The purpose of the proposed development program is to accomplish each of the following objectives:

> To develop a resort/condominium/residential community which reflects consideration of the physical, chemical, biological, and cultural aspects of the environment;
>
> To undertake the project with full discussion with County authorities and to cooperate in development of roads, water, sewage treatment, and utilities.
>
> To improve the image of Maui Island as an international tourist resort development in cooperation with the Maui visitor industry.
>
> To maintain cooperative and friendly relations with local residents and contribute to local industry by creating job opportunities.

CHAPTER III

PROJECT DESCRIPTION

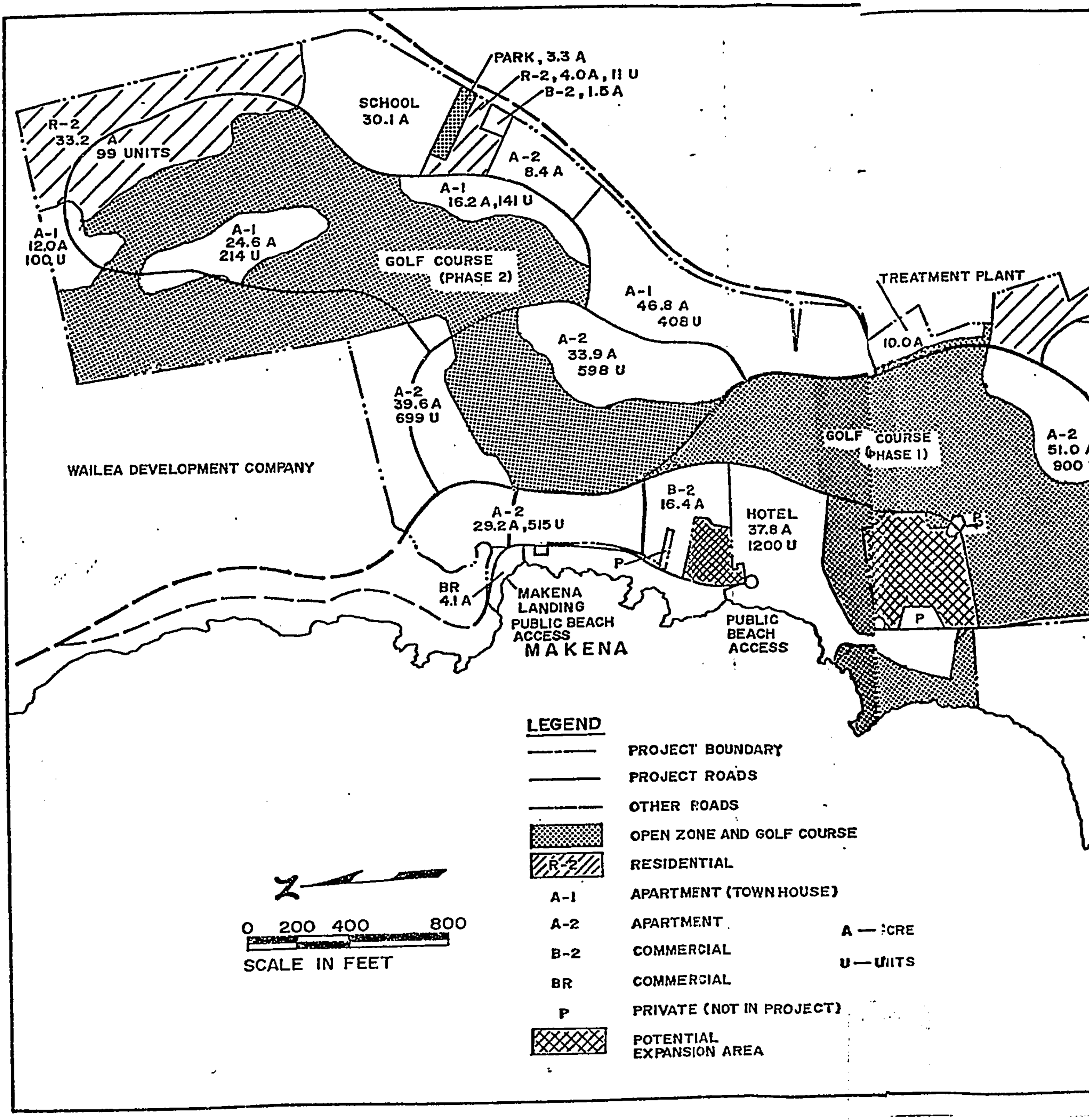
PROJECT ORIGIN

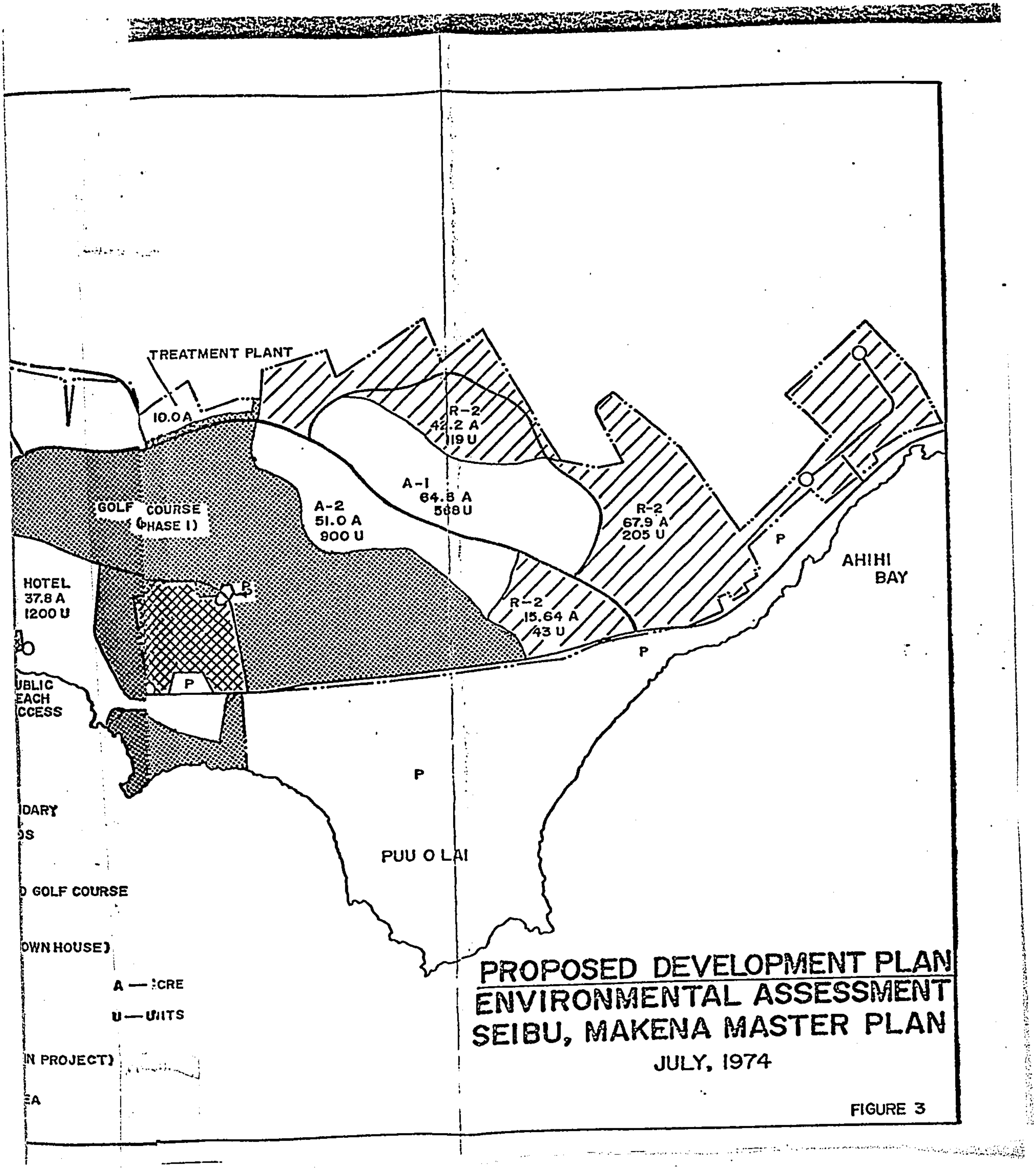
As of January, 1974, Seibu Real Estate Co., Ltd. (SRECL) purchased or acquired rights to purchase the following parcels of land from Ulupalakua Ranch and other landowners in the Makena area:

Tax Map (Zone, Section, Plat & Parcel)	Approximate Acreage
2-1-05-86	11.400
87	7.400
81	16.300
26 (portions of)	452.000
2-1-06-36	7.531
37	5.794
58	4.523
59	6.450
2-1-07-60	1.149
59	1.024
2-1-08-01 (portions of)	507.162
	1020.733

At the time of purchase, SRECL intended to invest in these lands for the development of a resort/condominium/residential complex in the Makena-Ahihi Bay area.

However, it should be noted that SRECL is presently undertaking purchase of exchange negotiations with the owners of several other land parcels adjacent to the proposed Hotel Village Center area (figure 3). Such land, if obtained, would be utilized for commercial or golf course uses. Specific land parcels under consideration for future incorporation into the project site include:


PARK, 3.3 A
R-2, 4.0 A, 11 U
B-2, 1.5 A
SCHOOL 30.1 A
R-2 33.2 A 99 UNITS
A-2 8.4 A
A-1 16.2 A, 141 U
A-1 12.0 A 100 U
A-1 24.6 A 214 U
GOLF COURSE (PHASE 2)
A-1 46.8 A 408 U
TREATMENT PLANT
10.0 A
A-2 33.9 A 598 U
A-2 39.6 A 699 U
GOLF COURSE (PHASE 1)
A-2 51.0
900
WAILEA DEVELOPMENT COMPANY
B-2 16.4 A
A-2 29.2 A, 515 U
HOTEL 37.8 A 1200 U
P
BR 4.1 A
MAKENA LANDING PUBLIC BEACH ACCESS
MAKENA
PUBLIC BEACH ACCESS
LEGEND
PROJECT BOUNDARY
PROJECT ROADS
OTHER ROADS
OPEN ZONE AND GOLF COURSE
R-2 RESIDENTIAL
A-1 APARTMENT (TOWN HOUSE)
A-2 APARTMENT
B-2 COMMERCIAL
BR COMMERCIAL
P PRIVATE (NOT IN PROJECT)
POTENTIAL EXPANSION AREA
A — ACRE
U — UNITS
N
0 200 400 800
SCALE IN FEET



PROPOSED DEVELOPMENT PLAN
ENVIRONMENTAL ASSESSMENT
SEIBU, MAKENA MASTER PLAN

JULY, 1974

FIGURE 3

Tax Map (Zone, Section, Plat & Parcel)	Approximate Acreage
2-1-05-82	1.000
83	4.000
84	2.000
85	21.210
2-1-06-84	0.840
	29.050

DEVELOPMENT COSTS/SOURCE OF FUNDS

Since no detailed site planning has been performed or preliminary design drawings been prepared for the proposed project, the total construction cost cannot be reliably estimated at the time of this report. With the exception of the development or installation of utilities such as water supply, sewage treatment and underground street lighting, telephone, electric power and cable TV systems, the costs incurred by implementation of the proposed development program would be completely borne by SRECL.

DEVELOPMENT PROPOSAL

The proposed development program (figure 3) would consist of the development of a hotel; two 18-hole golf course; tennis courts, bicycle paths, picnic and playground areas and horse trails; three commercial areas; a boat launching ramp; multi-unit and single-family residential areas; a neighborhood center and a related residential/multi-unit area; a sewage treatment plant; a primary and secondary road system; underground street lighting, telephone, electric power and cable TV systems. Each aspect of the proposed development program is discussed conceptually in the following paragraphs.

Hotel-Village Center

The focus of the resort community would be the hotel and an adjacent community-business (B2-commercial) area which would be developed as a Village Center. The combined complex, totaling 54 acres, would be situated centrally within the site immediately adjacent to Makena Beach. The hotel would have an ultimate capacity of 1,200 rooms as phasing of hotel construction would be determined by market factors. In addition to overnight facilities, the hotel would also contain a banquet hall, meeting rooms, a coffee shop, a swimming pool, arcades, parking facilities for visitors and local residents, and a main golf clubhouse for use by visitors and local enthusiasts. The management and operation of the hotel would be performed by Prince Hotels of Hawaii, Inc., which is one of the affiliated corporations of Seibu Real Estate Company, Ltd.

The Village Center would be a shopping and commercial area serving both visitors and local residents. The Center would be designed with plazas and pedestrian ways oriented to its location adjacent to the shoreline.

Makena Landing

The historical Makena Launching area would be developed as a mini-business area to house a restaurant, a bar, and a store for retail marine supplies. All building heights in this area would be two stories or less and public beach access would be provided mauka of the area. In addition, SRECL would work together with the State Harbors Division in the development of a one or two-lane boat launching ramp along the Makena shoreline between Apuakehau and the old landing.

Neighborhood Center

A neighborhood center is planned adjacent to a residential area on the northeast slope of the site. The Center would include 11 single-family residential units and 149 condominium units. Supplementing this residential area would be a 3.3-acre park, a 30.1-acre school site, and a small shopping complex.

Residential Areas

The proposed residential areas include the following three densities for single-family and multi-units:

A-2	20-30 DU/acre
A-1	8-15 DU/acre
R-2	4- 6 DU/acre

The number of proposed units on figure 3 indicate the proposed maximum allowable density for each area. Since the market demand would primarily dictate the extent of feasible development, the number of units permitted by the proposed maximum densities may not be constructed to that extent.

As shown in figure 3, the higher-density units (A-2) are clustered around the hotel and the Village Center while lower-density apartments (A-1) are situated within and along the perimeter of the golf courses. Residential areas (R-2) are distributed on the higher slopes of the project site as well as near the shoreline of Ahihi Bay.

Circulation

Vehicular

The Kihei Civic Development Plan proposes the realignment of the existing coastal road to the upper slopes of the proposed project site. It is proposed that the realigned Kihei Road would serve as one of the two major 120-foot arteries through the site and connect with the original alignment along portions of the Ahihi Bay shoreline.

The existing Makena Road would be resurfaced, widened and realigned and would serve as the other major 120-foot arterial entering the site. The new alignment would provide direct access to the hotel and Village Center, and would connect to the future State highway which is expected to be completed by 1980. However, until the State's Kihei-Ulupalakua Road is completed, a proposed two-lane paved road would be constructed from the south end of the Wailea Development to Makena--a distance of approximately 6,000 feet.

A secondary two-lane road system of 60-foot wide right-of-ways would be developed for each housing area.

In summary, approximately 47,000 linear feet of primary and secondary roadways would be developed. Major culvert crossings or bridges would be constructed at several locations along these roadways in order to allow passage of storm run-off from upper slopes.

The existing alignment of the Kihei Road through the project site would be discontinued for thru-traffic by terminating that portion of Kihei Road at both ends of the hotel site. All other portions of the existing road within the project site would be widened and resurfaced in order to serve private owners in the area and provide public access to nearby beaches.

Pedestrian

A separate system of paths for pedestrians, bicycles and golf carts would link all areas within the development as access would be provided to the hotel and Village Center, Makena Landing, the Neighborhood Center, all residential areas, and all recreational areas within and adjacent to the project site, i.e. beaches.

There would also be three beach access points within the development:

1. Pedestrian right-of-way adjacent to the hotel site;
2. Makena Landing area; and the
3. Beach frontage south of Puu Olai.

Access to the beach adjacent to the hotel site would be at least a 15-foot wide paved walkway which would be landscaped along both sides. Parking areas for this beach access would be in the commercial area adjacent to the hotel.

Utilities

Water System

Off-Site Municipal Facilities

The rapid growth in development of the Kihei-Makena area indicates that the water supply and transmission capacities of the existing Kihei-Makena area are reaching their maximum limits. As a result, a water source and transmission system development program is being implemented by the County to meet the rising demand of the Kihei-Makena area. Seibu Real Estate Company, Ltd., along with other developers in the Kihei-Makena area, would make a financial contribution for this program (see Chapter IV section concerning water).

Within Wailea, a 30-inch transmission main is presently being constructed to a proposed 10 million gallon reservoir situated approximately 3,000 feet north of the proposed SRECL project. From this point, Maui County, with financial participation from Wailea, plans to extend a 24-inch main to the northern limits of the project site.

Within the project, 8 to 20-inch pipelines would service the project site. An ultimate maximum day water demand of approximately 4.23 million gallons per day projected for the proposed development program. However, this requirement does not include irrigation water needed for the golf courses which would be supplied by proposed on-site brackish water irrigation wells and treated sewage effluent.

On-Site Water System

Within the project site, a complete water distribution system consisting of storage reservoirs with a total of 4.0 million gallons, at least two booster pump stations, and approximately 54,000 linear feet of waterlines varying in size from 8 to 24 inches would be developed. After construction, the entire on-site water system would be dedicated to the Maui County Department of Water Supply for operation and maintenance.

Wastewater/Sewage Disposal System

Municipal Facilities

At the present time, a municipal wastewater system to serve Makena is not available. A wastewater treatment plant in Kihei, as well as several lift stations from the treatment plant to Wailea, are presently being constructed by the County of Maui. However, neither of the developments were sized to include the Makena area. Thus, a treatment plant is proposed within the Makena site to serve the development since the cost of constructing a separate transmission system from Makena to the Kihei wastewater treatment plant would be economically infeasible.

On-Site Wastewater System

A complete wastewater collection, treatment and effluent disposal system would be constructed for the proposed development by SRECL. The effluent from the treatment plant would be pumped to storage lagoons located within the golf courses and utilized for irrigation. Emergency injection wells would be provided at the treatment plant. However, the final size, number and depth of wells are not known until necessary subsurface investigations, including possibly the drilling of test wells, is completed. Upon development of the wastewater system, SRECL would dedicate the entire wastewater system to the County of Maui.

Drainage

Major design concepts and parameters for drainage have not been established at the time of this report. However, SRECL generally proposes to utilize the golf course and depressions as retention or settling basins to reduce the discharge of runoff into the inshore waters of the study area. On-site storage would be provided, wherever feasible, including the possible use of permeable asphaltic concrete pavements and roof top ponding.

Underground Street Lighting, Telephone, Electric and Cable TV Systems

All street lighting, telephone, and electric systems would be installed underground. Should suitable reception be afforded by a cable TV system, this utility would also be installed underground.

SRECL would bear the total cost of the street lighting system and the cost of its maintenance, including all energy costs from the time the first unit in the development is occupied, up to the date of dedication and acceptance of the development.

The cost of the telephone manholes and duct system would also be borne by SRECL. Hawaiian Telephone Company would need 18 months advance notification of the development requirements as it takes a year to design and purchase the cables which would be installed at no cost to Seibu Real Estate Company, Ltd. If required, Hawaiian Telephone Company may purchase a small parcel of land, i.e. 10,000 square feet, within the Makena site for the development of a switching station.

The electric manholes and duct system are also a SRECL expense. In addition, SRECL would also pay for the difference in costs for installing underground power lines instead of overhead. If required, a new substation would be constructed by Maui Electric Company (MECO) to meet power requirements of the proposed development program. MECO needs 18 months to design and construct this substation since it takes approximately one year to purchase the transformers. The extent of power requirements and potential substation location are not known until more detailed engineering studies are undertaken.

Due to its physical location with respect to existing TV signal sources, Makena cannot receive a direct signal of sufficient strength and quality. A cable TV system is being considered for the project should suitable reception be afforded the area. As a result, a TV underground conduit would be placed together with telephone, electric and street light ducts for the installation of a potential TV cable system.

PROPOSED CONSTRUCTION SCHEDULE

At this time, the proposed construction schedule indicates that the proposed project would be developed in two phases over a six-year period.

The first phase is a three-year construction program, beginning in January, 1976, which would include the construction of one 18-hole golf course; the hotel; all commercial areas except for the B-2 area adjacent to the proposed school area; approximately 2,916 multiple dwelling units (within A-1 and A-2 zoned area), approximately 477 single-family residential lots (within R-2 zoned areas); as well as roadways and utilities to service the preceding developments.

The second phase of the proposed development program, beginning in July, 1979, is also a three-year construction program and would include the development of a second 18-hole golf course; approximately 1,376 multiple dwelling units (within A-1 and A-2 zoned areas); a small community park and small shopping area within the Neighborhood Center; as well as roadways and utilities to service such developments.

As stated earlier, the number of residential lots and multiple dwelling units has been expressed in terms of maximum densities which may be developed. Thus, phase one and two of the proposed development program may not include densities to the extent suggested by the proposed construction schedule.

CHAPTER IV

DESCRIPTION OF THE ENVIRONMENT

PHYSICAL CHARACTERISTICS

Location

The proposed project site is adjacent to the southwestern coast of Maui and is situated in the Makawao judicial district. From the Wailuku-Kahului area, the proposed site is presently accessible by automobile via Honoapiilani Highway and Kihei Road by State Highways 35 (Puunene Avenue) or 38 (via Honoa-lani Highway) and Kihei Road. However, just after entering the Wailea Resort development area, Kihei Road temporarily terminates and vehicles must proceed mauka on Wailea Alanui. Upon reaching the Wailea Golf Course, Wailea Alanui continues south (roughly parallel to the shoreline). Approximately two-thirds of the way through Wailea, Wailea Alanui proceeds makai and vehicles return to Kihei Road which continues to the project site.

Geology

Lava flows, related tephra cones and ash deposits that erupted after the long period of erosion which formed Haleakala Crater, are named the Hana Volcanic Series (Macdonald and Abbott, 1970). The project site is situated near the southwestern rift zone of Haleakala and contains volcanic rocks and subtrate of the Hana Volcanic Series which were produced by prehistoric aa and pahoehoe flows of basalt, picritic basalt, basaltic andesite and andesite (Stearns, 1942; Stearns, 1946). Similar to other recent lava flows, the aa and pahoehoe substrate is believed to be quite permeable.

Adjacent to the project site (within the study area) is the recent tephra cone called Puu Olai and a portion of the 1790 Kanahena flow. Puu Olai is located on the makai portion of the Mooiki area (figure 4) and Stearns, 1942 indicates that this cone carries little water, even though it consists of very permeable cinders, tephra and thin layers of lava. The 1790 flow, situated in the Cape Kinau area (figure 1), represents the latest volcanic activity on the Island of Maui.

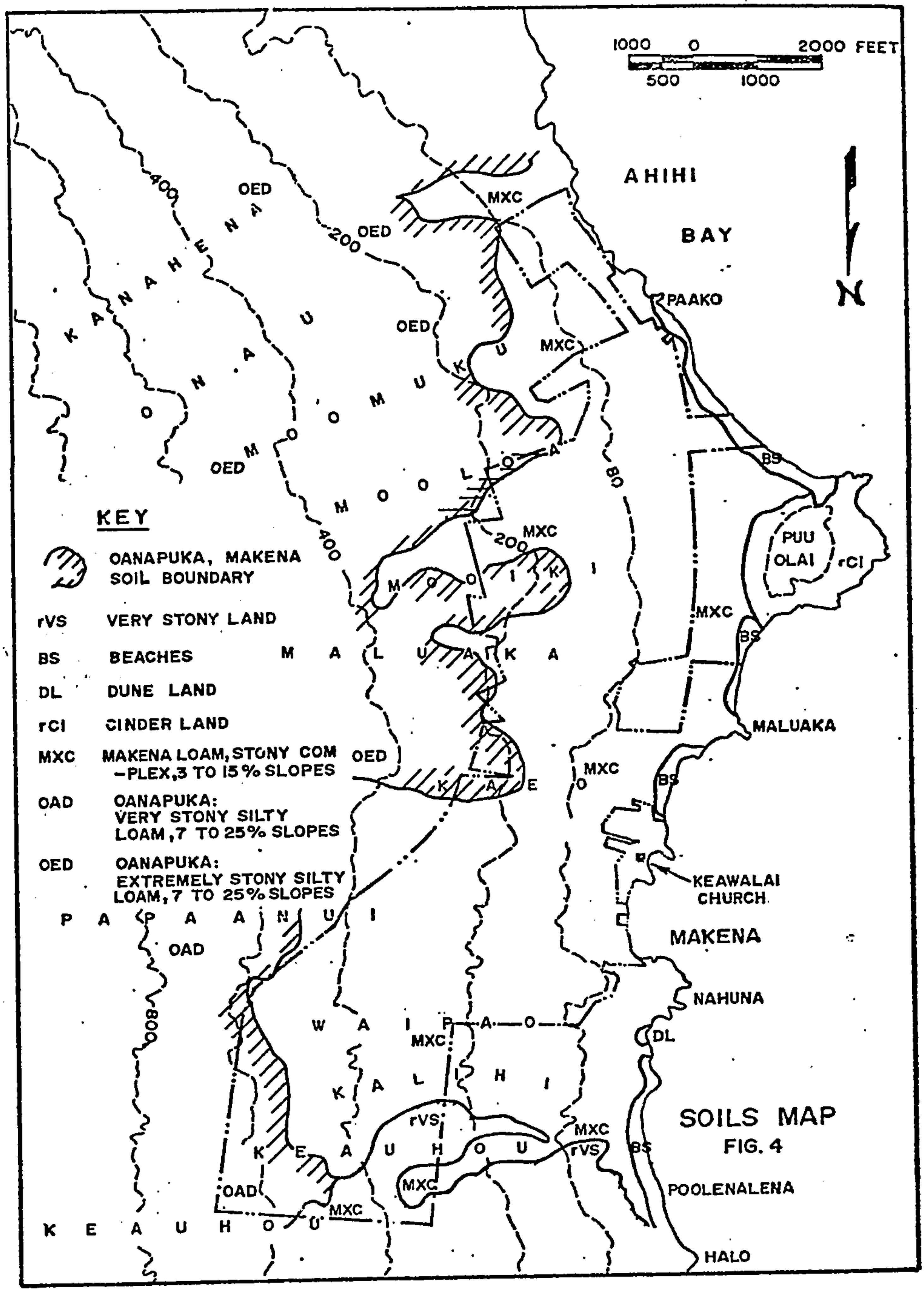
Soils

As shown in figure 4, the project site contains soils from the Makena and Oanapuka series. The characteristics of each of the three general soil types found on the project site are discussed as follows:

Makena Loam, Stony Complex, 3 to 15 Percent Slopes (MXC)

This soil is the predominant type and is typically found on gently sloping areas of the project site. The permeability of the Makena soil is moderately rapid at 2.0 to 6.3 inches/hour, runoff is slow to medium, and its erosion hazard considered slight to moderate (Soil Conservation Service, 1972). However, more recent analysis by SCS indicates that this soil has one of the highest erodibility factors (K=0.49) in the State. Because of its characteristics, this soil serves as a good topsoil and fair source for fill except in its stony areas; however, it, in itself, is not highly conducive for development purposes because of its erodibility and poor compaction characteristics (Soil Conservation Service, 1966).

Within the project site, Makena soils have most recently "supported" pasture and wildlife habitat containing various introduced grasses and trees such as Kiawe and Haole Koa.



SOILS MAP

FIG. 4

Oanapuka Very Stony Silt Loam (OAD)/Oanapuka Extremely Stony Silt Loam (OED), 7 to 25 Percent Slopes

These two similar soil types are both stony silt loam which are found in the upland areas of the project site. The primary difference between the two soils is that stones cover approximately 3 to 15 percent of the Extremely Stony Loam surface area. Other than this difference, both of these Oanapuka soils are characterized by a moderately rapid permeability of 2.0 to 6.3 inches/hour, slow runoff and a slight to moderate erosion hazard. Uses of these soils for construction are limited because of their stoniness and erodibility; moderate compaction ability for embankment and foundations; moderate compressibility; as well as being only a fair source of road fill.

Similar to Makena soils, these soils have been most recently used for supporting pasture and wildlife habitat containing various exotic grasses and trees. In the past, however, both of these Oanapuka soil types (as well as Makena Loam) formerly supported acres of sugar cane on the northern portion of the project site throughout most of the 1800's.

Topography

The project site has an average slope of appoximately 12 percent to the 250-foot elevation and an average slope of appoximately 8.2 percent to the 275-foot elevation. North and east of Keawalai Beach are found the greatest slopes. Within this portion of the project site, slopes are between 10 and 20 percent, with slopes greater than 20 percent being along the gulch east of Nahuna Point.

Climate

Rainfall

Table 1 shows that the rainfall along the Makena shoreline averages from 10 to 30 inches per year with the greatest amount of rainfall occurring from the months of November through January. Other data obtained by Ulupalakua Ranch (table 2) also indicates that rainfall, within the project site and the upper drainage basin, occurs in large amounts within a short period of time. Such rainfall is usually delivered through major Kona storms.

Mr. Pardee Erdman, owner and rancher at the Ulupalakua Ranch for the past 12 years, indicates the project site lands on the Ahihi Bay side of Puu Olai do not receive as much rain as the lands on the Makena side. For this reason, a correlation was made with the Ranch's Makena shoreline station and Moomuku (which the Ranch records refers to as Kanahena) station at approximately the 800-foot contour. Table 1 indicates that from 1965-1973, project site lands on the Makena side of Puu Olai received greater rainfall at least 15 percent of the time. If a rainfall station had existed on the Ahihi Bay side of Puu Olai during the same period, a greater percentage would have probably been produced for the lands on the Makena side of Puu Olai; however, it is believed that such data would not indicate any substantial difference in the amount of rainfall being received in the northern and southern portions of the project site.

TABLE 1

CORRELATION OF ULUPALAKUA RAINFALL RECORDS

MAKENA SHORELINE (NEAR KEAWALAI CHURCH) AND MOOMUKU (AT 800-FOOT ELEVATION)

1965-1973

(EXPRESSED IN INCHES)

		1965	1966	1967	1968	1969	1970	1971	1972	1973
JANUARY	Makena	2.32	----	1.10	4.72	10.01	4.97	12.47	0.85	0.28
	Moomuku	3.05	0.41	1.83	6.60	10.96	6.31	11.04	0.81	1.31
FEBRUARY	Makena	1.77	----	0.80	9.69	0.20	0.50	0.45	3.81	----
	Moomuku	3.89	1.70	0.53	8.65	0.09	0.17	0.47	3.51	----
MARCH	Makena	0.90	----	8.28	1.75	0.55	0.20	2.80	2.70	----
	Moomuku	3.63	0.84	6.83	1.85	2.30	0.32	1.80	0.92	----
APRIL	Makena	1.30	0.06	0.70	2.75	----	1.31	2.41	0.25	----
	Moomuku	2.04	0.29	0.45	10.00	0.20	1.65	4.14	2.45	----
MAY	Makena	5.00	0.10	0.45	1.50	0.15	----	0.10	----	0.30
	Moomuku	3.17	0.98	0.95	2.25	0.20	0.27	0.72	----	1.50
JUNE	Makena	0.70	----	3.50	----	0.17	0.28	0.10	1.30	----
	Moomuku	0.17	None	3.40	None	0.80	----	0.18	2.12	2.02
JULY	Makena	0.10	----	3.38	----	0.50	0.30	----	0.05	----
	Moomuku	1.29	None	4.07	0.50	3.65	0.81	----	----	----
AUGUST	Makena	0.55	0.90	3.12	2.35	0.28	0.02	0.53	0.41	----
	Moomuku	3.01	0.42	3.88	0.99	1.33	0.75	0.71	0.56	0.50
SEPTEMBER	Makena	0.42	0.13	0.15	4.20	0.10	1.11	0.55	0.61	----
	Moomuku	1.25	0.37	2.18	4.27	0.57	2.49	0.61	2.50	1.56

TABLE 1 (Continued)

CORRELATION OF ULUPALAKUA RAINFALL RECORDS

MAKENA SHORELINE (NEAR KEAWALAI CHURCH) AND MOOMUKU (AT 800-FOOT ELEVATION)

1965-1973

(EXPRESSED IN INCHES)

		1965	1966	1967	1968	1969	1970	1971	1972	1973
OCTOBER	Makena	1.20	1.53	0.25	0.60	0.20	0.50	0.05	0.60	----
	Moomuku	2.67	2.05	0.40	1.89	0.69	1.37	0.05	0.65	1.20
NOVEMBER	Makena	5.21	2.19	0.80	5.05	----	4.50	0.05	----	0.68
	Moomuku	5.45	2.77	2.47	1.67	----	6.83	----	----	----
DECEMBER	Makena	----	1.50	5.82	8.80	0.20	----	----	1.69	7.44
	Moomuku	0.20	1.26	7.77	6.99	1.78	0.58	----	0.76	6.48
TOTAL ANNUAL (Recorded)	Makena	19.47	6.41	28.35	41.41	12.36	13.69	19.51	12.27	8.70
	Moomuku	29.82	11.09	34.76	45.66	22.57	21.55	19.72	14.28	14.57

---- Not Recorded

Source: Ulupalakua Ranch, 1974

TABLE 2

MAXIMUM 24-HOUR RAINFALL AT MAKENA SHORELINE AND ULUPALAKUA RANCH OFFICE (ELEVATION 1,900 FT.)

1965-1974

Year	MAKENA	ULUPALAKUA RANCH OFFICE (ELEVATION)
	Maximum 24-Hour Rainfall (inches)	
1965	1.50	3.35
1966	1.30	2.60
1967	3.75	3.65
1968	3.24	3.75
1969	4.25	4.07
1970	2.60	3.08
1971	3.75	6.02
1972	1.50	2.37
1973	5.45	2.95
1974 (as of 6-1-74)	2.30	3.60

Source: Ulupalakua Ranch, 1974

Correlating the annual amounts of rainfall recorded at the 800-foot elevation and near shoreline also indicates that the amount of rainfall within the study area is approximately 40 percent greater at the 800-foot contour than along the shoreline.

Temperature

Although no temperature data is available for the project site, the Soil Conservation Service reports mean annual temperatures in Maui County vary between 72 and 75 degrees Farenheit near sea level and decrease approximately 2 or 3 degrees for each 1,000 feet of elevation. Daily temperature variations range from 10 to 20 degrees Farenheit. Seasonal variations are approximately 5 to 8 degrees from the warmer months of August and September to the cooler months of January through March (Soil Conservation Service, 1971).

Wind

Average monthly wind directions and velocities at Keawakapu (figure 2) from July, 1973 to June, 1974, are summarized in table 3. The monthly data, which is further segregated by three selected times of day, indicates that Fall winds at Keawakapu blow from WSW to NW while Winter "brings" winds from SSW to WSW; during Spring, winds appear to vary the most as winds vary from SSW to NW; however, table 3 indicates that Summer winds are more consistent, being from W to NW. With the exception of Summer, when winds reach velocities of 15 to 18 knots, winds are generally less than 10 knots at Keawakapu.

TABLE 3

AVERAGE MONTHLY WIND SPEEDS & DIRECTIONS

	8:00 A.M.		2:00 P.M.		8:00 P.M.	
MONTH	DIRECTION (DEGREES)	SPEED (KNOTS)	DIRECTION (DEGREES)	SPEED (KNOTS)	DIRECTION (DEGREES)	SPEED (KNOTS)
1973						
July	272	4.4	298	17.6	296	7.7
August	231	4.5	297	14.7	286	5.5
September	244	2.8	296	15.1	286	4.1
October	277	3.3	273	13.2	296	4.6
November	230	2.3	271	9.5	276	2.8
December	263	2.7	230	10.5	212	2.9
1974						
January	233	5.4	232.3	10.3	203	6.0
February	228	1.2	245	7.8	227	1.8
March	215	3.6	232	10.0	306	3.3
April	264	3.2	257	10.3	260	2.6
May	255	4.7	275	13.6	286	3.6
June	277	3.2	260	10.5	301	7.8

Source: Allen L. Corell, National Weather Service at Keawakapu Beach, Maui, Hawaii, 1974

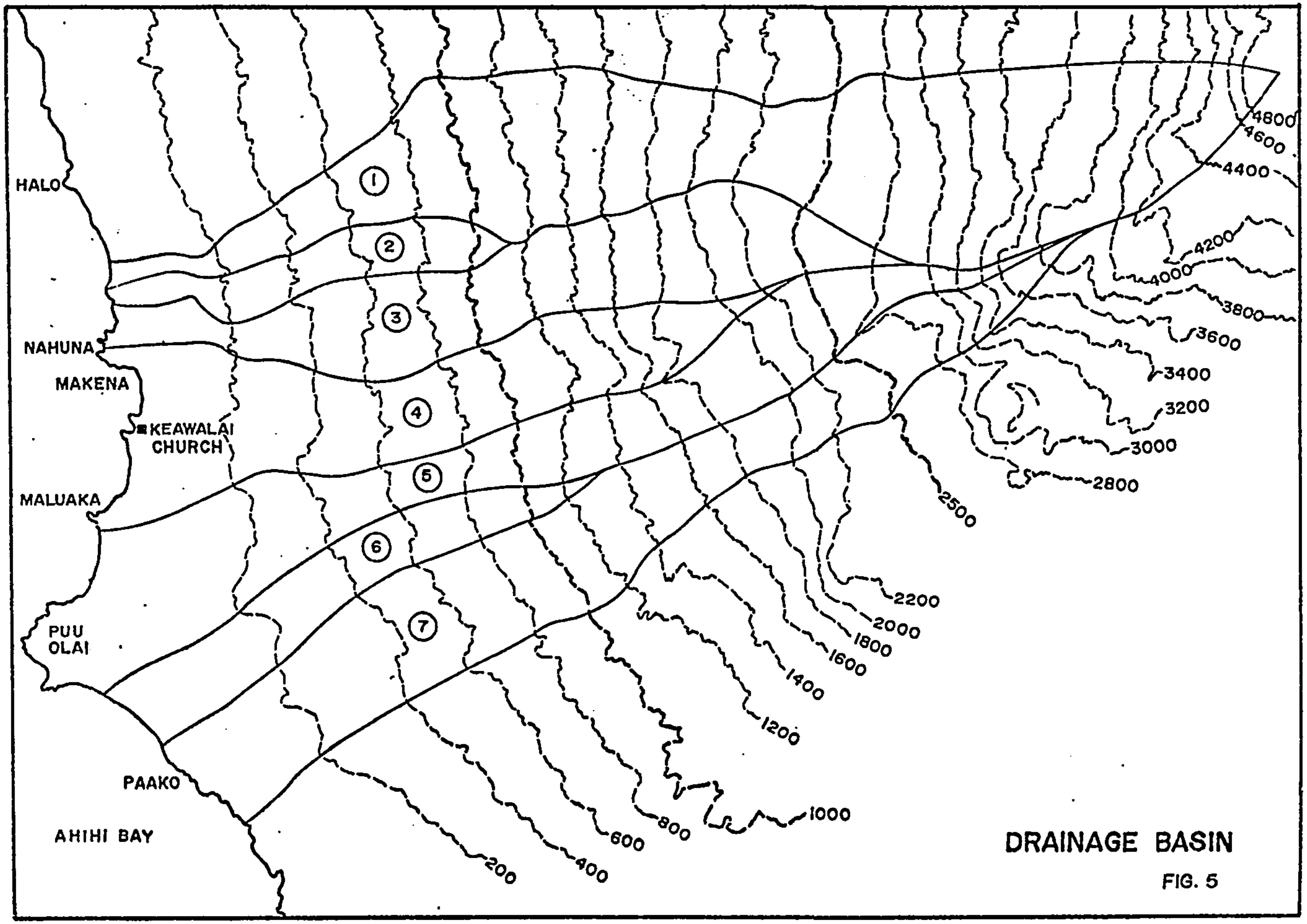
Correlation of the same data (table 3) over the three different times of day shows that winds at Keawakapu are generally from SW to W in the morning while afternoon and evening winds tend to shift from WSW to NW. Velocities of the wind are greatest, especially in the Summer months, in the afternoon hours while morning and evening winds are substantially less.

From discussions with residents of the study area and observations during the study period, it appears that the preceding data from Keawakapu may be quite similar for the project site. The only exception may be that the project site is less influenced by the West Maui mountains, and probably more subject to conditions of the Alalakeiki Channel than is Keawakapu.

Drainage

Storm Runoff

The project site is located on the southwestern slopes of Haleakala. As shown on figure 5, the project site is situated within a total drainage basin which begins at the 5,300-foot elevation and extends downward to sea level. Within this drainage basin is only one well-defined natural water course, located north of Nahuna Point, which is dry throughout most of the year. All other storm runoff "sheet flows" toward the sea and usually settles in the low lying areas until it either infiltrates into the ground, evaporates, or in extreme cases, overflows into the coastal waters. The mean annual rainfall for this area is about 20 inches per year. Since the area is in the leeward side of the island, it is protected from heavier orographic or mountain caused rains. As a result, it is believed that the project site receives the greatest amount of precipitation from Kona (southerly) storms which are typically heavy rain carriers. These storms, though infrequent, have unloaded tremendous amounts of rainfall within short time spans, creating enormous amounts of runoff and resulting in flood conditions along the nearby Kihei Coast in the past. Such a storm occurred on March 24, 1967, in which 6 inches of rain fell in 4 hours over the Kihei area causing extensive damage to the then relatively unpopulated area. In fact, the whole Kihei coast area can be considered a flood plain extending inland in some places to 3/4 of a mile. Flash flooding has caused road washouts, water main disruption and undermining of foundations. In addition to the volume and velocity of the runoff water, the problem of runoff waters reaching



DRAINAGE BASIN

FIG. 5

the ocean, due to the lack of natural drainage channels, is added. County of Maui drainage plans and Corps of Engineers' flood control surveys have concluded that effective measures for flood control, i.e. lined drainage channels, outlet structures and lateral interceptor ditches, are needed for the Kihei-Makena area. Also, the requirement for presenting an individual hydrologic/hydraulic report for each planned development is especially applicable to this area.

The total drainage basin for the drainage area consists of approximately 6,650 acres of which only approximately 1,000 acres are within the project site. The area soils from elevation 1,000 feet to about 5,000 feet consist mainly of Io, Uma soils and other very stony areas. The Uma soil which extends down to about 2,500 feet is an excessively well-drained, sandy soil with a very rapid permeability (greater than 20 inches/hour) whose runoff, if any occurs, is slow. The Io soil, a well-drained silty loam with a permeability which is moderate to rapid (2 to 6.3 inches/hour) has a slow to moderate runoff characteristic. Directly above the project site (figure 4), the major soil type is the Oanapuka soil, a well-drained and very stony silt loam soil with a permeability of moderate to rapid (2 to 6.3 inches/hour) with a slow runoff characteristic. Soils within the project are discussed in a previous Chapter IV section.

For a 50-year, 24-hour storm, the peak runoff rate for the total drainage is in the neighborhood of 2,400 cubic feet per second of which only about 400 cfs is handled by the natural channel. This involves a volume of water of about 210 million gallons.

Soil Loss

Soil loss involves the movement of soil or soil erosion by water or wind. In Hawaii, this natural process has not received much attention in the past, but is now coming under scrutiny by various agencies such as the State Department of Health and the Soil Conservation Service. On June 15, 1974, the Hawaii State Legislature enacted the Soil Erosion and Sediment Control Act (Act 249) which requires the County Governments to enact ordinances for the purpose of controlling soil erosion and sediment within one year of the signing of the Act. In view of this concern and recent legislation by the Legislature, an overview of the soil loss situation was undertaken utilizing the preliminary information copy of the Soil Conservation Service's "Guidelines for the Use of the Universal Soil Loss Equation in Hawaii." The soil loss equation has been in use on the Mainland for over 30 years where it has provided valuable guidelines for conservation planning and assisted in estimating gross erosion in watersheds. Since no detailed development plans were available at the time of this report, the quantities calculated are understandably rough and should not be considered suitable for design work. However, they can be considered a rough estimate of the soil movement possible and used as an indicator as to the magnitude of a possible problem area.

The amount of soil loss presently occurring within the project site is approximately 5,300 tons/year or approximately 5.3 tons/acre. The assumptions and methods utilized for these calculations are discussed in Chapter V in the section concerning drainage. The Soil Conservation

Service regards 10 tons/ acre as a "reasonable" amount of soil loss which should occur on all developed or undeveloped lands in Hawaii.

Utilities

Access and Traffic

As stated earlier, present access to the project site is generally via Kihei Road except for a temporary termination of the road as it proceeds on "Wailea Alanui" (now under construction) through the adjacent Wailea Resort development. "Wailea Alanui" eventually returns to Kihei Road at the south end of the Wailea Resort. A 1971 State Department of Transportation projection for 1973 traffic on the proposed Kihei-Ulupalakua Road indicate that a minimum of 120 vehicles per hour (VPH), peak hours presently travel along Kihei Road to and from the Wailea Resort area.

Mauka of the study area, the State plans to have a Kihei-Ulupalakua Road constructed between 1980 and 1985. The 1971 State Department of Transportation "Traffic Assignment Study" for the proposed project also indicates that, in 1993, 3,000 vehicles per day (VPD) would enter the Wailea area via Kihei Road while 3,400 VPD would travel the proposed mauka road to Makena Road and Kula Highway. Considering morning peak hour volumes, 290 VPH would enter the Wailea area via Kihei Road while 320 VPH would travel the proposed mauka road to Makena Road and Kula Highway.

Water

Potable water is currently piped to the area from the Kula Transmission system. The source of this water is the Waikamoi area.

An attempt to develop a potable basal water supply was made by the State of Hawaii in 1964 with the drilling of exploratory well No. 68 on the project site. This well is located in Kaeo at an elevation of 352 feet above sea level and drilled to a depth of 382 feet. Production was 216,000 gpd (gallons per day) but the waters contained approximately 600 mg/l (milligrams/litter) of chlorides.

Chlorides in reasonable concentrations are not harmful to humans, but above 250 mg/l, they give a salty taste to water which is objectionable to many people. For this reason, the U. S. Public Health Service recommends that chlorides be limited to 250 mg/l in supplies intended for public use. In addition, because of the dryness of the area, no surface water is available for a water supply system.

Because of the future high-demand for water in the Kihei-Makena area, the Maui Board of Water Supply has decided to form the Central Maui System for the purposes of locating sources of pure water and transmitting such water to the Kihei-Makena area. Kahului Development Company, Wailuku Sugar Company, Wailea Land Corporation and SRECL have joined in a joint venture to develop water sources. The cost for exploration, test drilling and source development is estimated to be in excess of $2 million. This does not include the value of any water located nor the cost of any land which would be needed to extract such water. In addition, Wailea Land Corporation and SRECL have entered into a transmission project agreement with the Maui Board of Water Supply for the transmission of approximately 19 million gallons a day of water from sources in the West Maui mountains to the Central Maui area, including Kihei and Makena. The estimated cost of designing and constructing the water transmission system is $11 million. Wailea Land Corporation and SRECL together will advance approximately 7/11ths of the total amount. These advances by Wailea Land Corporation and SRECL will be subject to reimbursement by the Maui Board of Water Supply from normal revenues derived from the system supplying the Maalaea, Kihei and Makena areas. The portion advanced by the Maui Board of Water Supply for the costs of the transmission system, approximately $4 million, shall be paid for by a "grant-in-aid" charge to all developers in the Kihei-Makena area, from $500 to $800 per hotel or multi-dwelling unit constructed.

Wastewater

At the present time, a municipal wastewater system to serve the Makena area is not available. A wastewater treatment plant is being constructed in Kihei approximately 5.5 miles from the northern boundary of the Makena project. A collection and transmission system consisting of several lift stations are also being constructed by the County between the treatment plant and Wailea. This system was sized to include only the Wailea development. Also, within Wailea, a collection and transmission system, including two lift stations, is under construction, which is capable of serving the Wailea development.

Within the Makena area, wastewater disposal is presently handled by cesspool systems.

Power and Communication System

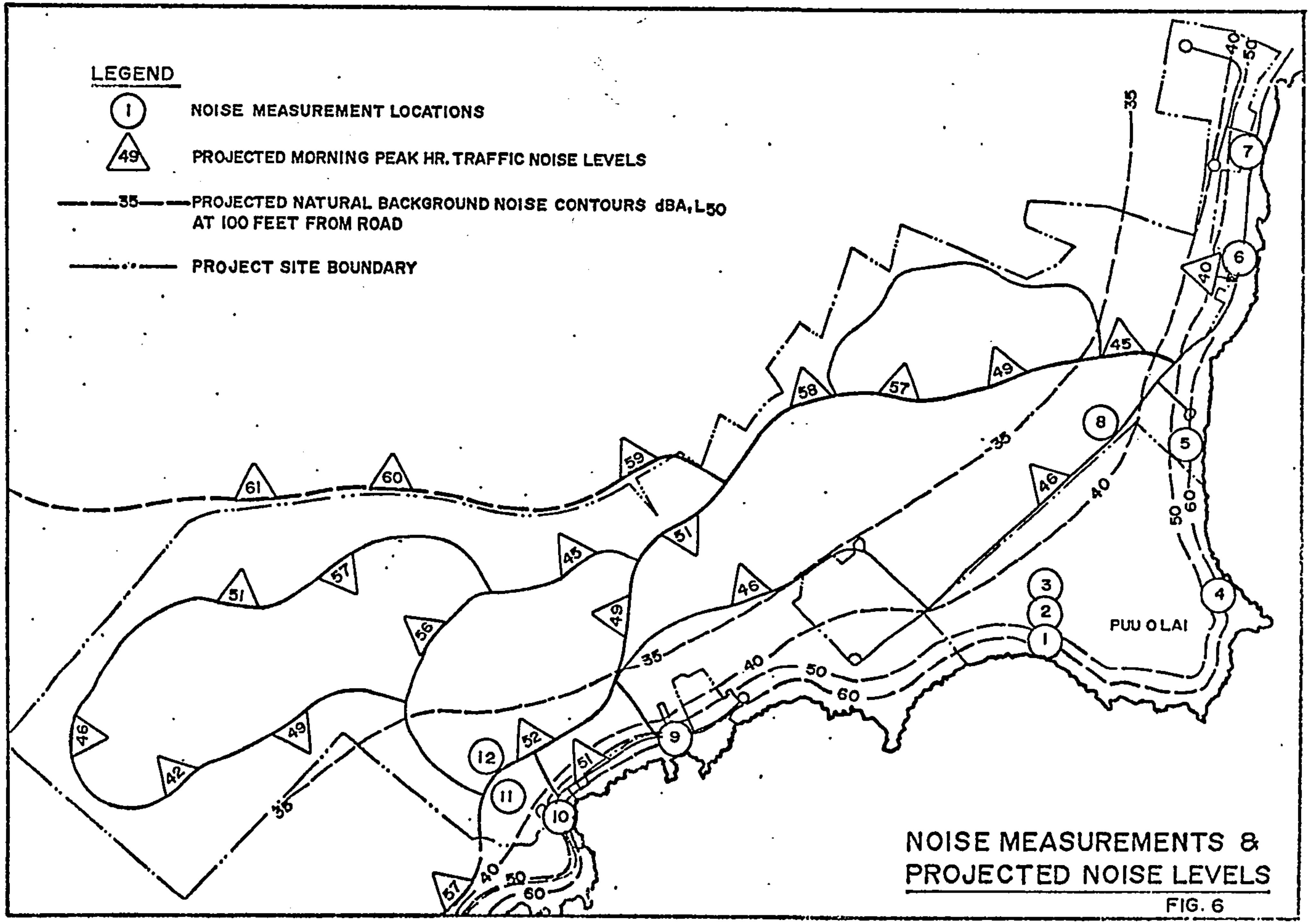
The Makena area is currently served by a 4 kv (kilo-volt) distribution system owned by Maui Electric Company (MECO)--the only power producing utility on the Island. Power transmission is by overhead service. A new substation scheduled for completion in October, 1974, is currently under construction in the adjacent Wailea Resort area to serve that development.

Telephone service is also currently available in the Makena area; however, television signal is obtained by private antenna.

Sound Levels Within the Project Site

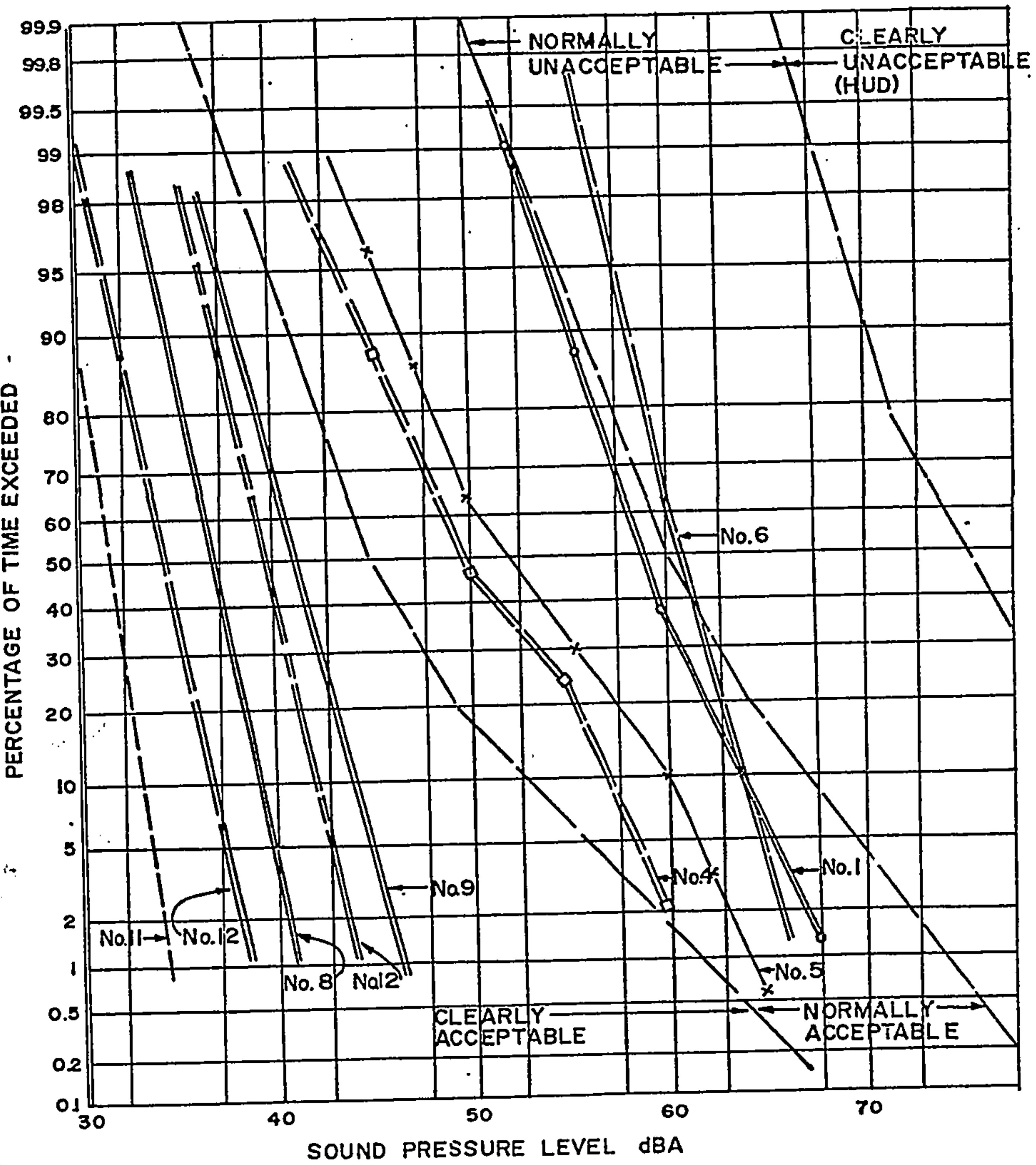
Sound pressure levels were recorded on June 14, 1974, at the locations shown in figure 6. Because background noise levels constantly fluctuate, the calibrated tape recordings were played back through a statistical distribution analyzer. Figure 7 shows the resulting cumulative probability plots of the measurements. The sound pressure levels are expressed as dBA wherein the "A" weighing attenuates the lower frequencies and relates better to the human hearing mechanism. The levels which were exceeded 50 percent of the time are called L_{50}, dBA and will be used in this study.

The measured background noise at the project site was completely dominated by nature--the surf at locations 1, 4, 5, 6, 7, and 10; birds and the breeze in the trees at locations 11 and 12; and combinations of these sound sources at locations 2, 3, 9, 11, and 12. During the five-hour measurement period, only two aircraft overflights occurred and about five motor vehicles were audible in the area.



NOISE MEASUREMENTS & PROJECTED NOISE LEVELS

FIG. 6



LEGEND

No.11 LOCATION READINGS

——— PROPOSED H.U.D. CRITERIA

CUMULATIVE PROBABILITY PLOT FOR BACKGROUND NOISE LEVELS

FIGURE 7

dBA VS. TIME PLOTS SHOWING VARIATION IN NATURAL BACKGROUND NOISE

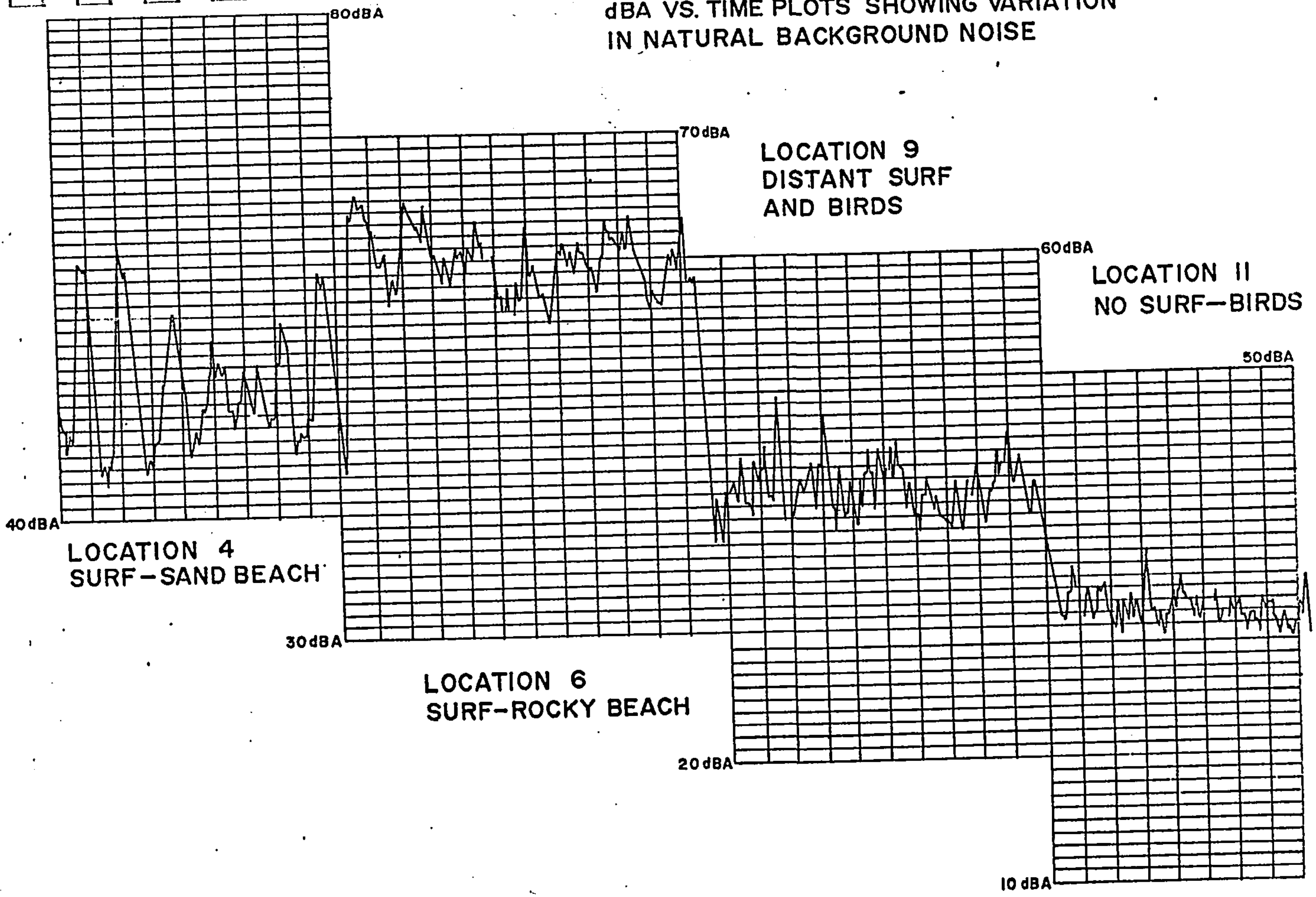


FIGURE 8

The basic distribution of background noise is shown by the dashed dBA, L_{50} contour lines in figure 8. Near the shore, L_{50} is approximately 60 dBA, depending on the nature of the surf and the beach. Theoretically, the surf noise diminishes about 3 dBA for each doubling of the distance from the surf line. This condition would be closely approximated by listeners in high rise buildings with direct line of sight to the surf. However, at ground elevation the sound levels decay more rapidly as one leaves the beach, depending on the amount of topographical shielding. The scattering and absorption of sound by plantings is a second order phenomena compared to shielding.

Most of the existing neighboring residences are near the beach where relatively high background sound levels exist, e.g. 45 to 60 dBA, L_{50}. It is also understood that practice bombing on nearby Kahoolawe Island is audible at the project site, but no operations were apparent during the measurement period.

Coastal Processes

Introduction

The evaluation of the general oceanography and five beach systems, within and makai of the project site, is based on field observations made on June 26, 1974. The oceanographic conditions on this day were representative of trade winds and trade wind waves as windward coastal regions experienced 15 to 20-knot winds from the ENE with seas of 4 to 6 feet high, and channels were characterized by 20 to 25-knot winds from ENE with accompanying seas of 6 to 8 feet. However, in the survey area, winds were light and variable, seas were calm, and a shore break was being generated by a persistent 12-second swell.

Even though trade winds and waves are the dominant regime in Hawaii waters (Moberly & Chamberlain, 1964), such conditions represent only one of 360 possible directions of wind, and only one of four major Hawaiian wave types. As a result, descriptions of conditions offshore and on the beach during other conditions of wind and sea are speculative and can only be partially interpolated from Moberly's work at Makena and "Big" (Puu Olai) Beach.

General Oceanography

Sea Conditions

The Makena coast, lying in the lee of East Maui and shielded seaward by the relative positions of West Maui, Molokai, Lanai, and Kahoolawe, is one of the most protected coasts in the Hawaiian Islands. The only directions of wave approach not wholly or partially protected are those from the due west down the Kealaikahiki Channel, or, for the case of Naupaka and "Little" Beaches, seas from the south or southwest. North of Puu Olai, the beaches are shielded from direct southerly seas by the lie of Puu Olai cinder cone (figure 9).

Offshore bathymetry is very subdued consisting of the gently sloping seaward flank of Haleakala. The 30-foot contour is in all cases more than 1,000 feet offshore. Wave refraction over these gentle offshore slopes is nearly complete such that waves from any direction tend to approach parallel to the coast.

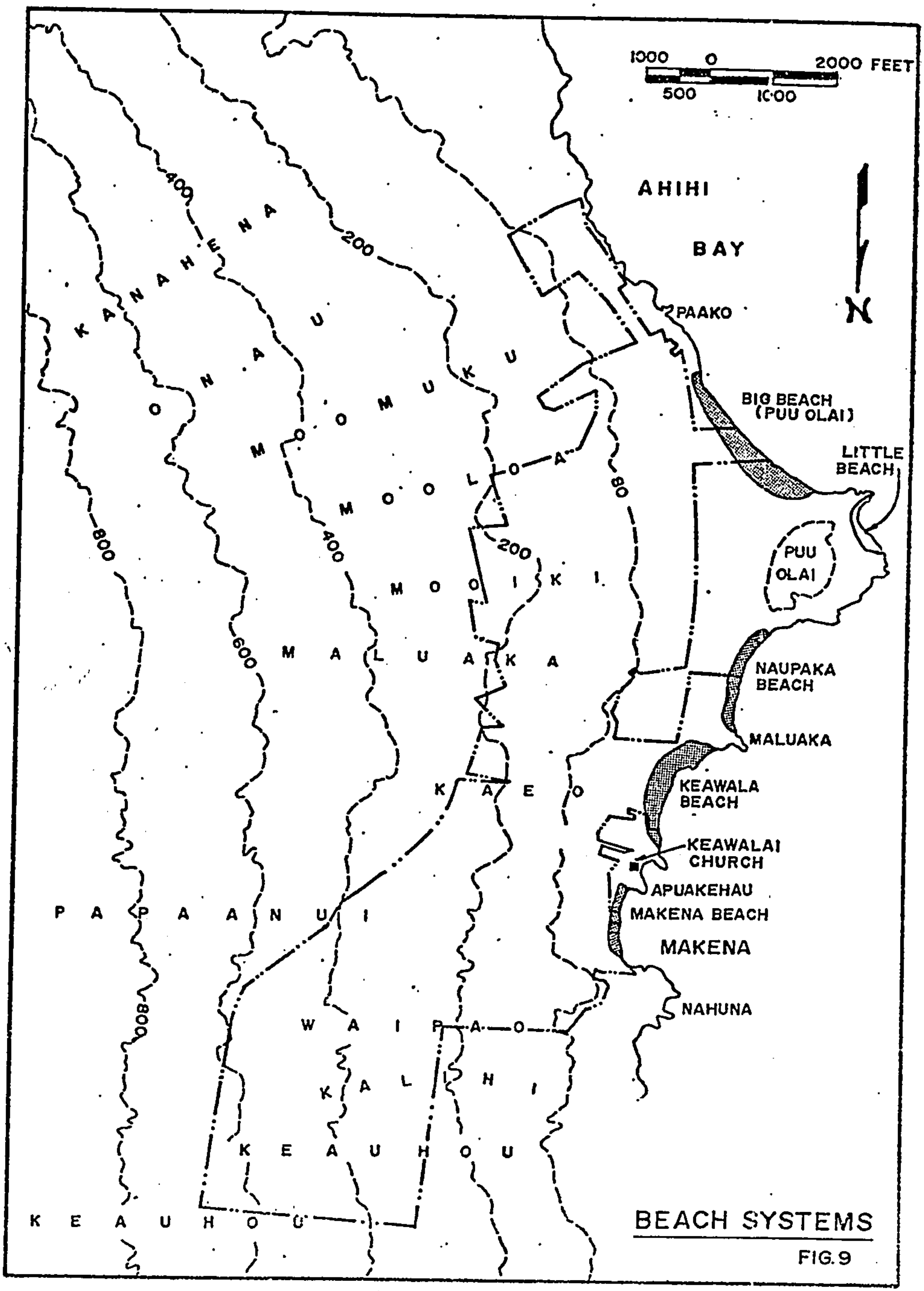
A good example of the effectiveness of coastal configuration and offshore bathymetry as a modifier of seas and winds in the offshore area makai of the project site existed on the day of field observations. On this day, near gale force trade winds and seas existed in the Alenuihaha Channel (only a few miles to the south), while the offshore Makena area was flat and calm, with a 1-foot, 12-second refracted trade wave approaching parallel to the coast.

The offshore current regime is predominantly tidal in origin moving water approximately parallel to the coast, to the north on a flooding tide, and to the south on the ebb.

Tsunami Inundation

Historical data on tsunami inundation along the Makena coast from the waves of 1946 and 1960 show runup conditions at Makena of 11 feet and 10 feet, respectively. At Wailea, runup conditions for the same tsunamis were 7 feet and 9 feet, while at Paaka (Ahihi Bay) the runup was 9 feet in both cases (Adams, 1968).

More recent computation of conditional tsunami forecasts (Adamas, personal communication) indicates runup from a magnitude 4 tsunami generated in the Alaska-Aleutians regions to be 7.3 feet at Makena,



BEACH SYSTEMS

FIG.9

6 feet at Kihei, and 5.7 feet at Paako. Conversations with David Lono, a long time resident in the Makena area, indicate that inundation from intense kona storms may exceed tsunami inundation.

Note: Tsunami magnitude is defined as the logarithm to the base 2 of runup from an earthquake within a few hundred kilometers of the source, measured in meters.

Beach Systems

Introduction

A preliminary survey of five beaches makai of the project site was carried out to determine some of their gross characteristics. Estimates of the following were attempted: 1) general size, shape, and composition; 2) source of beach material; 3) evidence of seasonal adjustments in width and volume; 4) offshore bottom conditions; 5) sand transport; and 6) offshore sources of energy.

Makena Beach

> "Makena Beach is a slightly arcuate beach, about 1,000 feet long. Points of lava terminate the beach at either end. During the period of observation (1962-1964) the beach gained in width only during the early summer, the rest of the year its width remained about the same. Onshore, the beach sand is only three feet thick, overlying rock. The sand is entirely calcareous, well sorted, and coarse in grain size. Extensive dunes covered with Kiawe trees occupy the backshore.
>
> The offshore area is rocky, with sand overlying rock in a thin veneer or in scattered sand pockets." (Moberly & Chamberlain, 1964)

Keawalai Beach

Keawalai Beach is located south of Makena Beach and separated from it by a rocky headland behind which stands the old Keawalai Church. The beach lies between this headland and the rocky headland capped by Maluaka Point to the south. The beach is backed for most of its length by a single large sand dune 20 to 40 feet high and covered by Kiawe trees. The beach has a slightly arcuate form that extends for 1,200 feet along the coast, and at the time of the survey, was on the average of 100 feet wide. Cusps were evident in the swash zone. The beach profile was irregular along most of its length particularly in the central and northern sections where, at the upper limit of the swash zone, a vertical and sand scarp 2 to 3 feet high was encountered. From the top of the scarp, the beach sloped inland at about 10 degrees toward the backshore dune.

The beach material was a well sorted, medium fine calcareous sand composed of Foraminifera and broken shells of other calcareous marine organisms derived from offshore.

Offshore a sand bottom was observed for at least 200 feet seaward with occasional exposed patches of basalt. The sand was characterized by ripples of oriented parallel to the beach with heights of 6 to 8 inches and wavelengths of 1 to 2 feet. This sand layer, like that of Makena Beach, may be no more than a veneer of sand overlying a gently seaward sloping basement of basalt.

Naupaka Beach

This beach occupies a pocket bounded to the north by Maluaka Point and, south, by Puu Olai cinder cone. There are actually two volcanic sand beaches at the location which are separated by a section of exposed basalt and beach rock.

The first beach (North Naupaka Beach), adjacent to Maluaka Point, is the smallest and consists of a 200-foot long lens of sand piled up behind a ledge of basalt slightly below sea level.

The beach profile is fairly uniform as the beach face slopes up at 20 to 30 degrees to the berm crest at a height of six feet above sea level. The backshore continues inland at slopes of 10 to 20 degrees to the vegetation line (10 to 12 feet above sea level) which gives the beach a total width of 60 to 80 feet. Three broad cusps occupied the length of the beach face. Sand consisted of a poorly sorted fine to medium coarse volcanic sand with about 20 percent organic shell debris. North Naupaka Beach is bounded to the south by an exposure of beach rock and basalt. Many large irregular blocks of beach rock were strewn about through this section indicating that wave energy here can be quite high.

Offshore, the bottom is exposed basalt, coral heads, and pockets of dark sand.

The larger of the two beaches, South Naupaka Beach, stretches for over 600 feet to the base of Puu Olai cinder cone. This is a pocket beach lying mostly above sea level with basalt exposed near the base of the swash zone. Cusps were absent here. During the time of field observations, waves were very subdued, breaking with a maximum height of 1 1/2 feet in very shallow water near the beach face, and a very pronounced wave reflection was occurring off the steep beach face.

From the waterline, the beach slopes up to 20 to 30 degrees over a distance of 10 to 20 feet to a berm crest 6 to 8 feet above sea level. Shoreward, the beach continues, at slopes of 10 to 20 degrees, for 10 to 20 feet to the winter berm/vegetation line and then flattens out for 100 feet to the Kiawe tree line. Dunes of volcanic sand characterize the backshore. During field surveys, these sands consisted of a poorly sorted, rather coarse dark sand with about 5 percent organic shell debris. Such composition indicates that the eroding seaward cliffs of Puu Olai has "supplied" volcanic material for the beach deposits of South Naupaka Beach.

Offshore the bottom consists of shallow volcanic sand and coral heads on a basalt platform sloping gently seaward.

"Little" Beach

This beach lies at the base of Puu Olai cinder cone along its southwestern flank in a small pocket bounded by lava flows. It is an arcuate pocket of sand 300 feet long and 100 feet wide at its center, with its back against the slopes of Puu Olai.

The beach profile is rather uniform, the beach face sloping up at about 20 degrees to the berm crest at 6 feet above sea level, then flattening out in the backshore to the confining slope behind. No cusps were evident.

The beach material is a poorly sorted fine to medium coarse calcareous sand.

Offshore, sand of unknown thickness was observed for at least 200 feet seaward and overlies a gently sloping basalt platform.

"Big" (Puu Olai) Beach

This beach lies immediately south of Puu Olai, It is over 3,300 feet long and extends as a straight beach from lava outcropping, southeast, to the cliffs of Puu Olai.

Large cusps predominated along the length of the beach. The beach profile was broken near the top of the swash zone to form vertical cliffs in the sand 3 to 5 feet high. Such cliffs are a reminder of the erosive power of kona storms. Three berms were obvious, the highest located 120 feet inland. Dunes are covered with Kiawe trees from the backshore.

The sand is a poorly sorted mixture of predominantly calcareous grains with a full range of sand fragments present.

Offshore the bottom is predominantly rock with occasional pockets of sand.

Seasonal Variations in Beach Width and Volume

Beaches exposed to the direct attack of waves often undergo a distinct change in profile and volume from winter to summer conditions. In the winter, local storms provide steep short period waves that have the effect of transporting sand from the beach into deeper water. The amount of the loss seems to be linked with deep water wave steepness and the ratio of wave height to medium sediment size. Studies of sand transport (Kraai, 1969) suggest that the basic mechanism for this offshore transport is a bottom current resulting from the wind set up experienced during intense local storms in the winter. Normally, the sand removed from the beach is deposited offshore as a bar parallel to the coast in water depths unaffected by the short period winter seas. Along the Makena coast, the waves capable of the most intensive winter erosion of beaches are generated by local kona storms normally out of the west or southwest. In the summer season, the steep short period winter seas give way to smaller waves and to long period swell generated by distant storms.

The orbital currents associated with these low steepness waves pick the sand up, move it forward, and set it down. Thus, the sand removed from the beach and deposited offshore in winter moves landward to re-join the beach deposit. Through this action large quantities of sand may be transported on or offshore during the course of a year with resultant large seasonal changes in beach width and volume. Two beaches in the survey area--Makena and "Big" (Puu Olai) Beach--have received study over long enough periods so that changes in beach profile can be documented (see Moberly & Chamberlain, 1964 and Campbell, 1972). Makena Beach may be typical of conditions at both Keawalai and Naupaka beaches since they have the same approximate exposure.

Observations at Makena showed the beach gaining in width only during the early summer; the rest of the year its width remained about the same. The danger of interpolating seasonal beach changes at Makena to any other neighboring beach, however, is considerable. Each beach is a unique system unto itself, and it will respond to seas in a unique manner such that only long term observations of a particular beach (over at least one complete seasonal cycle) can supply any but the most cursory information. However, from the preliminary data of this survey, it appears that large seasonal fluctuations in beach width and volume are the norm along this coast. The irregularity of arrival of kona storms from one winter to the next also suggests that the amount and nature of winter erosion and transport offshore is highly variable from year to year.

"Big" (Puu Olai) Beach seems to suffer the most from seasonal beach adjustment due to the fact that it is exposed directly to seas from the southwest, precisely the direction of approach of the larger kona storms. Moberly (1964) and Campbell (1972) have documented changes in beach width here of 100 feet from early summer to late winter, and absolute changes in beach volume of up to 80,000 cubic yards.

Sand Transport

Littoral current systems makai of the project site were absent and may only develop during storms when a breaking wave can form offshore. In the absence of surface, littoral currents cannot be generated.

Longshore sand transport appears to be largely to the north. This can be deduced at "Big" (Puu Olai) Beach by a general widening of the beach toward Puu Olai cinder cone, which seems to act as a sediment trap to northward moving grains. Further evidence of this northerly transport is the fact that the erosion of Puu Olai cinder cone is only nourishing Naupaka Beach immediately to the north.

The energy necessary to provide this transport is probably provided by the wave approach at Makena. The dominant wave reaching the Hawaiian Islands is raised by trade winds and approaches generally from the northeast. The refraction of this wave along the Makena coast brings it in nearly parallel to the shore, but not completely such that a northerly component of wave energy must exist to supply some energy toward longshore sand transport.

From the evidence gathered along this coast, i.e. the presence of beach cusps, sand ripples parallel to shore, the dominant approach of waves parallel to the coast, and the absence of significant currents offshore, the major amount of sand transport is probably onshore-offshore, normal to the shoreline.

Conclusions

Some general conclusions that can be made about the coastal processes makai of the project site are as follows:

1. The danger of major inundation from distant source tsunamis seems unlikely at Makena. Based on historical data and computations from hypothetical tsunamis, inundation of more than 15 feet above mean sea level is unlikely. A more real danger may exist in flooding associated with storm waves and storm surges accompanying local kona storms.
2. The backshores of all of the beaches except "Little" Beach consists of sand dunes which may be quite extensive. These beaches have experienced a net loss of beach sand to the land. The nature of present losses is unknown.
3. The beaches all experience seasonal variations in width and volume in response to seasonal variations in wave parameters and direction of approach. The beach most affected by such changes is "Big" (Puu Olai) Beach, due to its exposure to more direct wave attack than the other beaches.
4. Sand transport appears to be largely onshore-offshore in response to changing wave climate from winter to summer. In addition, there is some evidence for a longshore transport of sand to the north. The nature of this longshore transport is poorly understood as are the seasonal variations in its efficiency and its direction. Divers reported sand accumulation both north and south of Puu Olai, so the direction of transport may in fact reverse at times.

5. The source of the beach sand is offshore except at Naupaka Beach which is fed mainly by the erosion of Puu Olai. Most of the calcareous sand here is composed of the shells of forminifera along with other shell and coralline fragments. The exact source area for these new beach materials is unknown.

CHEMICAL CHARACTERISTICS

Use of Herbicides and Fertilizers

Ulupalakua Ranch

Mauka of the project site are pasture lands owned and utilized by Ulupalakua Ranch for the raising of beef cattle. Makai of Kula Highway, between Keauhou and Kanahena, are roughly 3,000 acres of pasture land which support approximately 1,000 to 2,000 head of cattle, depending upon the condition of grasses and other plants for grazing. The Ranch considers these lands as "marginal" pasture lands which cannot be feasibly developed into high productivity for pasture or other agricultural lands (see section on Land Use). For this reason, the Ranch does not apply any fertilizers to these 3,000 acres. Herbicides are applied selectively (by hand) to these lands about once every two years. Ranch management reports that the major effort against "undesirable" plants is in the form of bulldozing large tracts of Kiawe trees.

Mauka of Kula Highway, between Keauhou and Kanahena, are some 5,000 acres of pasture land which do receive annual herbicidal applications of 2-4,D and 2-4,5t, as well as annual fertilizer applications of sulfate ammonia and urea.

Residential Area

Makai and within the project site are approximately 25 to 30 single family residential units which are situated intermittently along or near the 3.5 mile shoreline between Keahou and Onau. The majority of these

TABLE 4

SELECTED WATER QUALITY DATA FROM AHIHI BAY SHORELINE

OBTAINED BY STATE DEPARTMENT OF HEALTH

1971-1974

Date	Total Solids mg/l	Salinity g/l	Total Nitrogen mg/l	Total Phosphate mg/l	Temp. °C	Total Coliform MPN/100 ml	Total Coliform MPN/100 ml
6-08-71	37,600	---	<0.01	0.022	25.0	4	<3
9-07-71	41,100	33.5	0.05	<0.005	27.0	4	4
5-02-72	---	34.0	0.11	0.010	24.0	<3	<3
8-01-72	---	---	<0.01	0.017	---	---	---
11-15-72	---	---	0.05	0.005	---	<3	<3
2-05-73	---	32.0	0.16	0.012	24.3	---	---
5-01-73	---	31.5	<0.01	0.034	24.8	<3	<3
8-14-73	38,840	---	0.02	0.012	25.8	<3	<3
2-11-74	27,560	29.5	0.23	0.020	25.2	<3	<3
5-06-74	34,760	---	0.14	0.012	---	4	<3

are inhabited throughout the year while the remainder are vacation beach houses which are utilized infrequently. Few gardens and orchards were observed to be near any of the residential units; as a result, the extent of chemical usage is probably limited to small applications of fertilizers on lawns and gardens. No interviews with residents were made to confirm this estimate.

Water Quality

The concern of the present study of water quality was to 1) correlate State Water Quality Standards for Class A water with existing water quality data and 2) generally assess the location and/or amount of freshwater within the inshore waters makai of the project site.

Available water quality data for the inshore waters makai of the project site include State Department of Health sampling results from a shoreline station along Ahihi Bay. Sampling at this station has included the quarterly analyses of pH, turbidity, dissolved oxygen, total solids, salinity, total nitrogen, Nitrite and Nitrate, Kjeldahl nitrogen, total phosphate, temperature, as well as bi-monthly analyses of total and fecal Coliform bacteria. Selected physical, chemical and microbiological results for this station are summarized in table 4. In an attempt to learn more about the amount and location of freshwater along the shoreline, a one-day sampling of salinity and temperature at 28 stations along the shoreline was made. Unfortunately, a meter malfunction made such information questionable and not usable for the present analyses.

The information available indicates that the inshore waters of Ahihi Bay probably are, at least, of Class A quality and that the amount of brackish water entering this area may be quite seasonal. In this regard, a Maui resident familiar with this area reports that the two brackish ponds mauka of Ahihi Bay normally overflow during the winter months. Such conditions provide some explanation to the lower salinity reading obtained on February 11, 1974. In terms of microbiology, existing data also indicates the shoreline waters of Ahihi Bay are quite pristine in comparison with other beaches on Maui. Whether or not the conditions at Ahihi Bay are somewhat comparable to other portions of the shoreline makai of the project site obviously cannot be extrapolated without further study. Recommended future water quality studies are discussed in Chapter V.

Migration of Chemical Ions and Compounds

Even though no substantive data, i.e. seasonal trends of nutrient load, are available regarding water quality and the influence of brackish water on the inshore waters makai of the project site, there are a number of related factors which made a general assessment of this subject possible.

Under existing conditions, the migration of chemical ions and compounds is caused through two processes--soil erosion by water and winds, and the natural leaching of metals and nutrients in soils into the ground water. As suggested by previous sections in the discussion of chemical characteristics, the soils of the project site have in recent times been primarily influenced by natural chemical processes, and, to a much lesser extent, the excretion of cattle and the use of fertilizers by residents living within and makai of the project site.

Combined with these characteristics is the fact that the project site receives little rainfall and a "reasonable" amount of soil loss (approximately 5.3 tons/acre). In this regard, the only known aspect of the existing environment which would enhance the migration of chemical ions into coastal waters is through the sporadic, but heavy amount of rainfall which infrequently characterizes the area. Such rainfall probably carries a limited amount of nutrient ions to the inshore waters via the gulch east of Nahuna Point. However, this conclusion could only be substantiated by actual field testing under varied climatic conditions.

Air Quality

No ambient air quality data is available for the project site or study area. Due to its geographical location, the project site is apparently affected by southwesterly to northwesterly winds which, for the most part, maintain a relatively "clean" lower atmosphere under existing land uses. However, these same winds are also responsible for transporting pollutants from Maui's Central Valley. An example of such conditions occurred during the study period when smoke from burning sugar cane fields in Pauwela was observed throughout the project site. Visual observations indicated that such conditions were caused by trade winds which "reversed" off the West Maui Mountains and eventually formed northwesterly winds carrying pollutants to the project site.

BIOLOGICAL CHARACTERISTICS

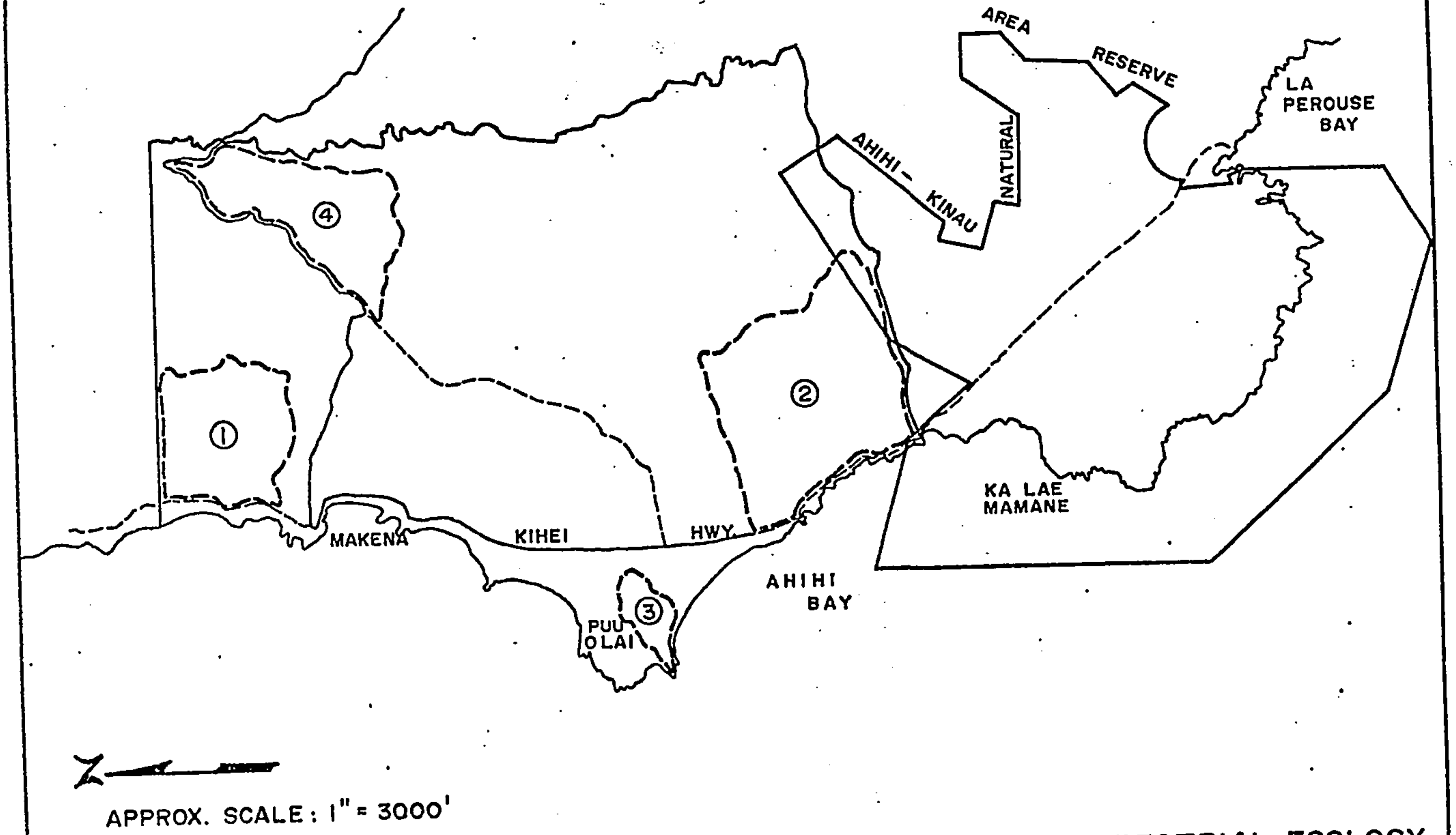
Terrestrial Ecology of the Project Site

Introduction

In order to assess the terrestrial ecology of the project site, field trips to the project site were made on June 15, 22, and 23, 1974. On each of these dates, four transects were traversed in order to generally investigate different elevations and habitat types (figure 10). Each transect was walked in its entirety verifying location using field maps, an altimeter and pedometer. Several surveys were made at random, particularly along Kihei Road, to gather additional data. On transects, all birds seen or heard were recorded, and plants not immediately identified and noted were collected for keying out later. Binoculars were used to identify birds where necessary, and efforts were made to gather evidence of nesting activities. Traps were set in representative habitats to capture small mammals. Reptiles and amphibians were actively searched for during the field trips and at night in the residential areas.

Field studies were supplemented by a review of existing vegetation maps and aerial photographs of the Makena area. A literature search was also made to determine known information on the flora and fauna of the Makena and Ulupalakua areas of Maui, but little published data were found.

Since a minimum of field work was conducted and a short time-frame imposed on the study, the present survey should be considered only a reconnaissance, and the information presented representative only of conditions and species present at this time of the year.



TERRESTRIAL ECOLOGY
SURVEY AREA
FIG. 10

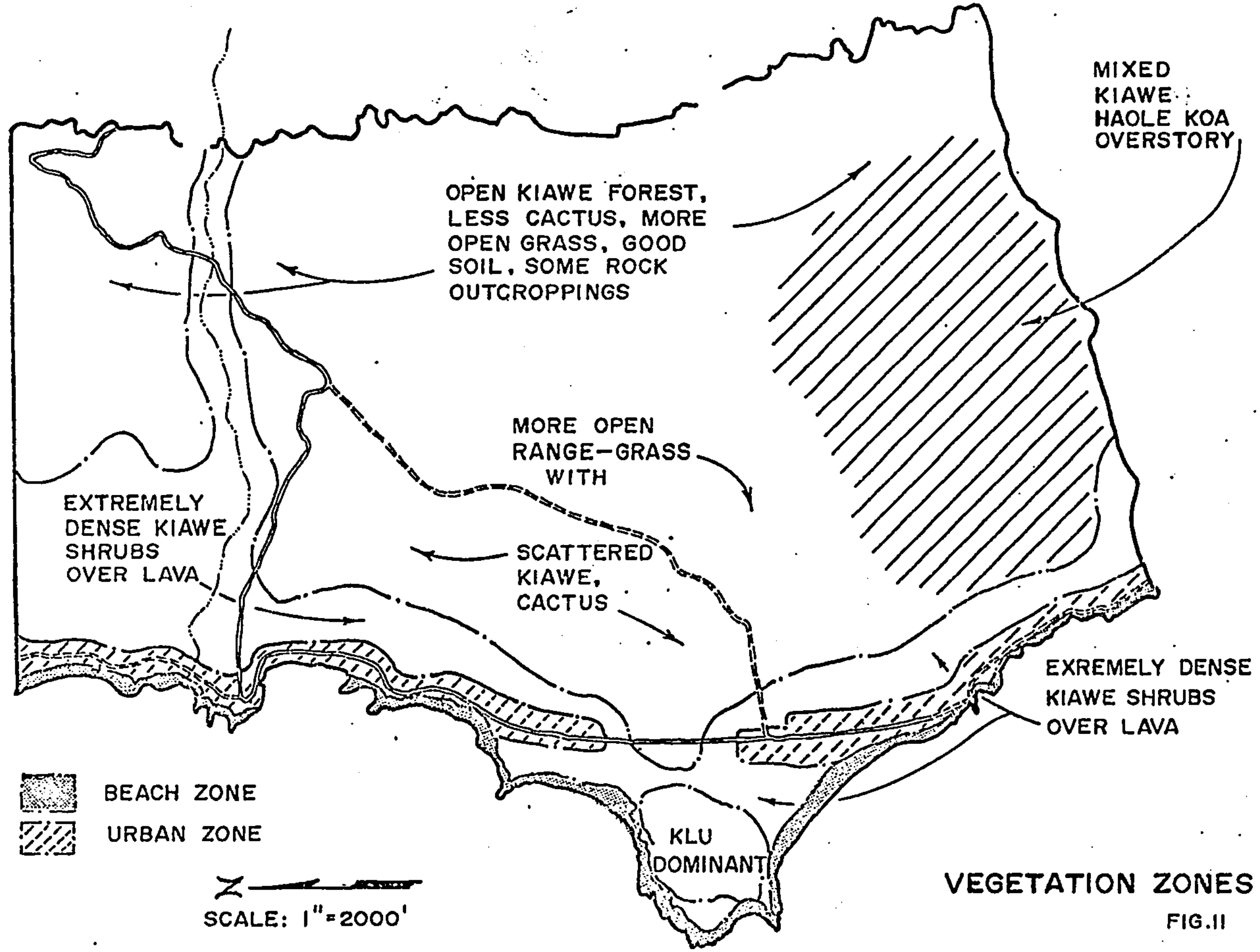
Flora

General Description

The project site lies within "vegetative Zone A," as proposed by Ripperton and Hosaka (1942), and is characterized by

> "Ground cover sparse and conditions semi-desert. Algoroba, kao haole, and klu grow well where their roots penetrate ground water. Ilima and uhaloa are common shrubs. Annual grasses and herbs are scarce except following rains."

Jones and Stokes and the Hawaii Division of Fish and Game also mapped the general area adjacent to the project site, and the project site includes three of their "habitat classes": the kiawe forest information, dry shrub formation, and dry grassland formation. They indicate that the kiawe forest formation is dominated by mesquite (Prosopis pallida), the dry shrub formation by klu (Acacia farnesiana), cactus (Opuntia megacantha), ilima (Sida fallax), koa haole (Leucaena leucocephala), lantana (Lantana camera), the dry grassland formation by pili grass (Heteropogon contortus), Natal redtop (Rhynchelytrum repens), swollen fingergrass (Chloris barbata), molasses grass (Melinus minutiflora) and several species of planted pasture grasses. Little extensive grassland remains in the area at the present time, however. Native plant species such as pili grass, nehe (Lipochaeta sp.) and 'auhuhu (Tephrosia purpurea), although not identified during the current survey, undoubtedly occur in the project site. Appendix A-1 lists all species of plants identified during the survey.



VEGETATION ZONES

FIG.11

Types of Plant Communities

Proceeding from the ocean edge to mauka of the project site at the 800-foot elevation, the plant communities can generally be classified as (1) beach zone, (2) urban zone, (3) dense kiawe forest zone, and (4) open kiawe forest zone (see figure 11).

1. Beach Zone Sandy beach areas above the high tide line support several species of indigenous plants which are widely distributed on Pacific islands. Beach morning-glory (Ipomea pes-caprae) dominates, and other species include hau (Hibiscus tiliceous), scaevola (Scaevola sp.), tree heliotrope (Messerschmidia argentea) and beach vitex (Vitex trifolia). Introduced plants such as saltbush (Atriplex sp.), false mallow (Malvastrum coromandelianum), tomato (Lycopersicon esculentum), vervain (Stachytarpheta cayennensis), sandbur (Cenchrus echinatus) and sow thistle (Sonchus oleraceous) have invaded almost down to the high-tide mark. Animals typical of this vegetative community include migratory shorebirds, the endangered Hawaiian stilt, and an occasional seabird.
2. Urban Zone Formerly dense kiawe thickets, the areas above and below Kihei Road have been lightly urbanized and the vegetation partially replaced with a wide variety of exotic fruit and ornamental trees, shrubs and flowering plants, as well as introduced weed species. Some of the more common include: mango (Mangifera indica), banana (Musa sp.), papaya (Carica papaya), several species of palm (Palmae),

plumeria (*Plumeria acuminata*). oleander (*Nerium indicum*), bougainvillea (*Bougainvillea spectabilis*, *B. glabra*), poinsettia (*Euphorbia pulcherrima*), hibiscus (*Hibiscus sp.*), African tulip (*Spathodea campanulata*), beach verbena (*Vitex ovata*), hairy abutilon (*Abutilon grandifolium*). Be-still (*Thevetia peruviana*), octopus tree (*Brassaia actinophylla*), crown flower (*Calotropis gigantea*), castor bean (*Ricinus communis*), golden crown-beard (*Verbesina encelioides*), fleabane (*Pluchea odorata*), morning glory (*Ipomea cairica*), and citrus (*Citrus sp.*). English sparrows, common mynahs and white-eges are common bird species while rats, mice and mongooses are common mammals. The fox gecko is an abundant reptile particularly around residences.

3. *Dense Kiawe Forest Zone* Algaroba dominates this zone creating a closed canopy which limits understory growth to a few vigorous annual shrubs and forbs, which become more widespread on the edges of the forest where light is available. The introduced weed species include: koa-haole (*Leucaena leucocephala*), apple of Peru (*Nicandra physalodes*), wild zinnia (*Zinnia pauciflora*), beggar tick (*Bidens pilosa*), spiny amaranth (*Amaranthus spinosus*), hairy merremia (*Merremia aegypti*), morning glory (*Ipomea cairica*), cocklebur (*Xanthium strumarium*), and ilima (*Sida fallax*). Typical birds include the white-eye, linnet and cardinal. House mice are abundant in the little covering the ground.

4. Open Kiawe Forest Zone Except for gulch areas where the dense kiawe forest zone extends far into the uplands, due presumably to the presence of underground water, the open kiawe forest predominates at elevations from approximately 100 to 800 feet. It is the most extensive plant community in the project site. However, an exception to the kiawe as the dominant overstory tree occurs on the southern third of the area where haole koa has reached tree proportions. In some instances, kiawe trees are found in dense stands a few feet apart, but for the most part they are separated by grassy areas which in the central portion of the area are heavily grazed by cattle. A wide variety of introduced grasses, shrubs, forbs and vines are found throughout this zone. Some of the more common are: buffel grass (Cenchrus caliarus), Natal redtop, swollen fingergrass, sour grass (Trichachne insularis), beggar tick, wild zinnia, spiny amaranth, prickly pear cactus, hairy merremia, morning glory, klu, yellow star thistle (Centaurea nelitensis), Flora's paintbrush (Emilia sonchifolia), wild cucumber (Cucumis dipsaceous), lantana, coffee senna (Cassia occidentalis), rattlebox (Crotalaria mucronata), tree tobacco (Nicotiana glauca), bermuda grass (Cynodon dactylon), and several unidentified pasture grasses. Four species of endemic plants are found here: ilima, hialoa (Waltheria americana), prickly poppy (Argemone glauca), and wiliwili (Erythrina sandwicensis). The wiliwili is widespread throughout this zone, and specimens ranging from seedlings to aged

trees were noted. The grey francolin (an introduced partridge-like game bird), barred dove, lace-necked dove, as well as several exotic passerine birds including the cardinal, mockingbird and ricebird, are abundant in this zone.

Fauna

General Description

Animal life generally consists of species well adapted to a dry environment but which thrive where water produces a vigorous plant growth and thus abundant food supply. The majority of the birds found in the project site are introduced, with possibly one exception, while the mammals have all been introduced directly by man or his agencies. There are no endemic or indigenous reptiles. Most of the birds, mammals and reptiles adapt well to man's activities and alterations of the natural habitat. Appendix A-2 lists all species of birds seen during the survey while Appendix A-3 summarizes all species of mammals and reptiles observed.

Birds

Three general groups of birds are found in the project site: (1) endemic species, those that are unique to Hawaii and are found nowhere else in the world; (2) indigenous or native species, those whose total range in the Pacific Basin includes Hawaii (seabirds) and migratory shorebirds that spend only their non-breeding season in Hawaii; and (3) exotic or introduced species, those brought to the

Hawaiian Islands by man or with man. The vast majority of all birds found in the project site are introduced species as, historically, there is no evidence that the endemic forest birds were ever found in this lowland dry area. As a result of the introduction of hundreds of exotic plants and several herbivorous animals, very few native plants can be found in lowland areas where man has had an influence. Thus, endemic forest birds are not found in the Makena area because they are largely dependent upon the native ecosystems in which they evolved.

Endemic Species

1. Aeo or Hawaiian Black-necked Stilt (Himantopus himantopus knudseni). The Stilt is endemic to all of the main islands except for Lanai and is considered endangered by both the State Division of Fish and Game and the U. S. Department of the Interior. Kanaha Pond and Kealia Pond on Maui both provide important feeding and nesting habitat for the Stilt. Just makai of the project site, this species is confined to two small brackish water areas to the south of Puu Olai and north of Paako point. One was seen on June 15th at the northernmost pond, and two were noted on June 22nd on the pond to the south.
2. Pueo or Short-eared Owl (Asio flammeus sandwichensis). This owl occurs on all of the main islands but little is known about its abundance on any one of the islands. The Pueo differs from most species of continental owls in

that it is primarily diurnal in habits, and, therefore, is much easier to observe than nocturnal owls. No Hawaiian owls were noted during the field survey, but it may be present on occasion, and, thus, it is included in this discussion.

Indigenous Species

1. Common Noddy (Anous stolidus pileatus). Also called the brown noddy, this medium-sized seabird is very common throughout the tropical pacific and nests in the leeward Hawaiian islands, as well as small islands off Kauai and Oahu. It probably nests on Molokini islet three miles due west of Puu Olai which may account for the fact that one was sighted on June 22nd on rocks jutting from the water along the coast of the study area near Kanahena. It is probably not a common bird to this area, however.
2. Kolea or Pacific Golden Plover (Pluvialis dominica). This is a common winter resident on all main Hawaiian islands and is found from sea level to at least 10,000 feet on the mountains of Hawaii and Maui. A few Golden Plovers usually can be found during the summer months, but these birds rarely attain the full breeding plumage. It is found in a variety of habitats including upland pasture areas, urban lawn areas, and shoreline mudflats and brackish water ponds. A single Golden Plover was recorded at the southernmost pond near Makena beach on June 22nd, feeding in the shallow water area under the

kiawe canopy. In winter months, this species is probably common in the upper grasslands, mauka of the project site, as well.

3. Akekeke or Ruddy Turnstone (Arenaria interpres). This species of shorebird is also a common winter migrant, and occasionally it is seen during the summer months. Although it prefers the coastal beaches, mudflats and brackish-water pond areas, it is occasionally seen in rather large flocks feeding in upland areas as well--usually in cultivated fields which harbor insects. Five turnstones were seen in the larger pond just south of Puu Olai on June 15th feeding with the Hawaiian Stilt. They seem oblivious to the human activity associated with the recreational beach nearby.

Other migratory shorebirds which might be expected along the shore areas, especially during the winter, include the Wandering Tattler (Heteroscelus incanum) and Sanderling (Crocethia alba).

Introduced Species

More than 150 different species of foreign birds have been introduced to Hawaii since about 1796 (Berger, 1972). Of these, approximately 50 species have become established. The following species were either seen in the project site or very likely occur there at one time or another during the year:

1. Ring-necked Pheasant (Phasianus colchicus torquatus). The pheasant was first introduced about 1865, and

several later importations were made. Schwartz and Schwartz (1949) indicated a low density of from 1 to 25 pheasants per square mile in the Makena area. A few were seen and heard during the survey, primarily associated with pasture areas. No young of this species were noted.

2. Indian Gray Francolin (Francolinus pondicerianus interpositus). This species was imported from India and released on Maui between 1958 and 1961 by the State Division of Fish and Game. It is found primarily in the Kihei-Makena areas, in kiawe forests to the ocean's edge but is widespread in central Maui. It prefers dry areas and has adapted to a variety of ecological niches including cattle rangelands and semi-urban areas such as in the project site. This species was seen and heard frequently throughout the survey in pairs, singles, and flocks of adults and young, varying from recently hatched to almost full-grown.

3. Chukar Partridge (Alectoris graeca chukar). First introduced to the Hawaiian Islands in 1923, it was only after several additional stockings of fairly substantial numbers that it became established on the Islands, including Maui. Most abundant on the upper slopes of Haleakala as well as in the crater itself, its range extends down to sea level in suitable habitats.

It favors rocky, brushy areas and is well adapted to margins of lava flows. None was actually seen during the brief field survey, but local residents reported seeing several near the southern boundary of the study area adjacent to the Ahihi-Kinau Natural Area Reserve in June of this year.

4. Rio-Grande Turkey (Meleagris gallopavo). This large game bird was introduced to Maui from Texas in 1962 and 1963 by the State Division of Fish and Game. It is found on the lower slopes of West Maui down to sea level in open kiawe forests, in brushy areas, or in waste lands. The Division (Medeiros et. al., 1970) reports that the range includes the Makena and Ulupalakua areas, but no turkeys or their sign were noted during the survey. It is likely that this species frequents the project site at times, however.
5. Spotted or Chinese Dove (Streptopelia chinensis). This asian dove was an early introduction to the Hawaiian Islands and said to have been very common on Oahu by 1879. The species is now found on all the islands and is classified as a game bird. Although it also occurs where rainfall exceeds 100 inches per year, the highest densities are found in drier areas where kiawe is one of the dominant plants. Schwartz and Schwartz (1949), for example, found densities as great as 200 birds per square mile in dry areas on Molokai. This species

is common in the project site, but in relatively low densities as compared with the more abundant barred dove.

6. Barred Dove or Zebra Dove (<u>Geopelia</u> <u>striata</u>). A native to the Orient and Australia, this game bird species is said to have been introduced to Hawaii sometime after 1922 (Bryan, 1958). It is now common to abundant on all of the main islands in the chain, also preferring drier areas. Schwartz and Schwartz (1949) reported densities of up to 800 birds per square mile in some areas on Oahu and Molokai in 1947. On transect censuses, the barred dove was by far the most abundant species, and it is likely that densities in the project site approach 500 birds per square mile. It was seen from sea level to the upper limit of the project site in all habitat zones.

7. Barn Owl (<u>Tyto</u> <u>alba</u> <u>pratincola</u>). This large owl was imported from California and first released in Hawaii in 1958. Although there are no records of its introduction on the Island of Maui, Berger found a dead owl at Kealia Pond on August 6, 1972, and Walker noted a Barn Owl on June 16, 1974, at an elevation of 200 feet, near Kihei. Although not actually seen in the Makena project site during the survey, this species probably is found there on occasion as the habitat is suitable.

8. Mockingbird (Mimus polyglottos). A native of North America, the mockingbird was first released on Maui in 1933 (Elepaio, 21:81). Udvardy (1961) first reported its widespread establishment on this island and found it to be a "very common resident, with pairs occurring on every 4-5 acres of kiawe forest, in all the dry, kiawe-covered habitats that I visited." The mockingbird also has been reported up to 9,000 feet on Haleakala. This species is common in the project site at all elevations.

9. Common Mynah (Acridotheres t. tristis). Native to Ceylon, India, Nepal and adjacent regions, this species "was introduced from India in 1865 by William Hillebrand to combat the plague of army worms that was ravaging the pasture lands of the islands. It has spread and multiplied to an amazing extent; reported to be abundant in Honolulu in 1879, it is now extremely common throughout the Territory" (Caum, 1933). In the project site, the mynah is abundant in residential areas, particularly along Kihei Road and occasional to common in the more rural areas.

10. Japanese White-eye (Zosterops j. japonica). Caum (1933) wrote that the Japanese White-eye was first imported from Japan to Oahu by the Territorial Board of Agriculture and Forestry in 1929. Later importations were made by the Hui Manu and private individuals. The

White-eye is now undoubtedly the most common bird species in Hawaii (Berger, 1972) as it is found from sea level to tree line (on Maui and Hawaii), and in the driest and the wettest areas in the Hawaiian Islands. The White-eye is one of the most abundant species in the project site. Singles and pairs and large groups were widespread throughout both the closed and open kiawe forests.

11. House Finch or Linnet (Carpodacus mexicanus frontalis). The Linnet was introduced from California "prior to 1870, probably from San Francisco" (Caum, 1933), and is now an abundant species in both urban and rural areas on all of the Islands. Although Linnets eat overripe and other soft fruits at times, it is predominantly a seed eater and is considered a pest on grain crops as well. The Linnet is an abundant species in the Makena to Ulupalakua area being found along the coast, in the lower kiawe thickets, and scattered in the open kiawe forest areas mauka.

12. Ricebird or Spotted Munia (Lonchura punctulata). This Asian species was released in Hawaii by Dr. William Hillebrand about 1865 (Caum, 1933). Caum wrote that the Ricebird "feeds on the seeds of weeds and grasses and does considerable damage to green rice." Although rice is no longer grown in Hawaii, the Ricebird has recently become a serious pest in sorghum plantations.

The Ricebird is an abundant species in very dry and very wet habitat on all of the major islands. Although not particularly abundant in the project site, it was seen frequently feeding on seed heads of grasses such as Sour grass and Buffel grass.

13. House Sparrow (Passer domesticus). Also called the English Sparrow, this weaverbird was first imported to Oahu in 1871 from England by way of New Zealand. Caum (1933) wrote that "whether or not there were further importations is not known, but the species was reported to be numerous in Honolulu in 1879." The House Sparrow apparently has never become a serious pest in Hawaii and may be somewhat beneficial in that it eats weed seeds as well as insects. House Sparrows are particularly common around homes within and makai of the project site, but were also recorded on transects up to 200-foot elevation.

14. Cardinal (Cardinalis cardinalis). Also known as the Virginia Cardinal and Kentucky Cardinal, this attractive bird is native to the eastern part of mainland United States. The Cardinal was released several times in Hawaii between 1929 and 1931 (Caum, 1933). The species is fairly common in leeward lowland areas of most islands, as well as in much wetter windward areas. On Maui, it is characteristic of the dry areas of exotic vegetation from sea level well up the slopes of Haleakala. Next to the barred dove and white-eye, the Cardinal was the most ubiquitous species in the study area.

Relative Abundance

The relative abundance of birds varied with the different plant communities and zones. For instance, in the urban zone, mynahs and sparrows which associate with human activities were more abundant than francolins and cardinals which favor open kiawe forest zone. But in considering the project site as a whole, the following list of species in order of abundance is probably representative at this time of year:

1. Barred Dove
2. Cardinal
3. White-eye
4. Linnet
5. Gray Francolin
6. Lace-necked Dove
7. Ricebird
8. Sparrow
9. Mockingbird
10. Mynah
11. Ring-necked Pheasant
12. Ruddy Turnstone
13. Hawaiian Stilt
14. Golden Plover

Mammals

The only species of endemic mammal which might be expected in the project site is the Hawaiian bat; all others have been either accidentally or intentionally introduced by man. The exotic mammals are for the most part pestiferous, but the Axis deer, which has been reported in the project site, would provide recreation for hunters if it were to become abundant. Because of the highly exotic nature of the vegetation in the Makena-Ulupalakua region, introduced mammals which have adapted to this habitat can be expected to continue to thrive. The species discussions which follow include mammals which were not actually seen in the project site, but which no doubt exist there, based upon historical evidence.

Endemic Species

Hawaiian bat (Lasiurus cinereus semotus). This endemic subspecies of the hoary bat might be found occasionally makai of the project site, particularly along the coastline. Kramer (1971) wrote that "to date, it appears that the Hawaiian bat occurs primarily on the island of Hawaii, and appears only irregularly on the islands of Maui, Oahu, and Kauai." For Maui, Oahu and Kauai, "the bats seem to appear only during the months from August to December." Tomich (1969) considers it present on Maui "sporadically." It was not seen during the course of the survey.

Introduced Species

1. Roof Rat or Black Rat (Rattus rattus). The nocturnal Roof Rat was transported to (obviously unintentionally) the Hawaiian Islands on sailing ships, presumably during the 18th century. The Roof Rat is a very common rodent on Maui from sea level well up the slopes of Haleakala. Although none was caught in traps during the survey, it is likely that this is a common species in the project site, as Tomich (op. cit.) states that

> "Rattus rattus in Hawaii is adapted especially to wooded gulches, sugar cane fields and dry, wet or even extremely wet forests..." and "frequents ornamental vegetation, stone walls, buildings and other structures."

Berger and Walker (1974, unpublished) caught several roof rats in the nearby Kihei area in June of 1974.

2. Polynesian or Hawaiian Rat (<u>Rattus exulans</u>). The early Polynesian settlers in Hawaii presumably brought this rat with them as a "stowaway." Little is known of its distribution on Maui, but it occurs in both native and introduced forested, grassed and shrubby areas. It is nocturnal in habit. None was seen or trapped during the survey, but may very well be present in the project site.

3. House Mouse (<u>Mus musculus</u>). The date of the introduction of this species to Hawaii is not known, but it is said to have been common by 1825. It "can be found inhabiting almost every biotic community that occurs from sea level up to at least 6,500 feet" (Kramer, 1971). It is found in residential areas, sugarcane fields, fallow fields, forests and scrublands including fairly wet areas. House mice are common to abundant in the project site and mauka from sea level to 800 feet. Seven out of twelve traps set produced mice. The residents of nearby Kihei reported an unusual abundance of house mice several years ago during which "thousands" were seen in and adjacent to the urban area. This is by far the most common mammal in the project site.

4. Small Indian Mongoose (<u>Herpestes auropunctatus</u>). The mongoose was first imported to Hawaii in 1883 and to Maui in about 1888. Although originally intended as a predator on rats, the mongoose became a pest on all of the islands

(except Kauai) and is now found from sea level to "approximately 10,000 feet on Maui and Hawaii" (Kramer, 1971:122). As they are diurnal by nature, they are easy to observe, particularly crossing roads. Several were noted along Kihei Road and it is probably quite common in the project site, particularly at lower elevations.

Reptiles

There are no native reptiles in the project site. All have been introduced by man and are commonly associated with his activities.

1. Mourning Gecko (Lepidodactylus lugubris). Presumably brought to Hawaii by the early Polynesians, this species is found in all habitats from mountain forests to dry urban areas on most islands. Although none was identified in the project site, this species should not be eliminated as a possible resident.
2. Fox Gecko (Hemidactylus garnoti). Oliver and Shaw (1953) wrote that "this species is found in more or less forested areas throughout the islands and seems to be equally abundant in the drier coastal regions and higher elevations of more abundant rainfall. It is normally most active at night when it may be found foraging for food on the trunks of trees, on the sides of buildings and on fences or walls." At Makena, the fox gecko can be considered the most common reptile, particularly in the residential areas. Several were caught during the survey.

Summary and Discussion

The biota of the project site is typical of the leeward coastal areas of most of the major islands as well as the coast of Maui from Maalaea Bay to La Perouse Bay. Introduced animals are associated with exotic plant communities, and the few native animal forms present have adapted to an environment highly altered by man and his activities. Because of the diversity of introduced grasses, shrubs, forbs and trees which yield abundant seeds and fruits and a plentiful supply of insects, birds, mammals and reptiles thrive. Amphibians such as toads and frogs and freshwater fish are either scarce or not present due to the lack of standing fresh water. Although rainfall is low, apparently enough falls and is stored underground to produce the vigorous plant life upon which the animals depend. The diversity of plant and animal life does not approach that of the upland forest areas where water is abundant, however, species of animals which can survive in relatively dry areas such as francolins, doves, cardinals and rodents are most abundant in the project site. The predacious mongoose has a ready food supply in that large insects and ground-nesting birds are available. In residential areas and ranch lands the presence of artificial water supplies enhances living conditions for both plants and animals. Plant vigor and diversity are greatest in the urban areas and along gulches. The northern third of the study area has a denser plant cover due either to higher rainfall or greater underground water storage capacity. Bird life is accordingly more abundant there than in the central portion or the southern third. The two brackish-water ponds and mudflats south of Puu Olai (adjacent to the project site) afford the only available habitat of this type for the endangered Hawaiian stilt and migratory shorebirds for miles along the coast in either direction, and as such, takes on added importance. The edge of the Kalua o Lapa lava flow which forms the southern boundary of the study area marks the beginning of a distinctly different environment for plants and animals, although there is some gradation. A good portion of the foot of this flow, which formed Cape Kinau, is included in the Ahihi-Kinau Natural Area Reserve (Appendix B), which was established in 1973 to protect natural attributes for educational and scientific purposes. The Kalua o Lapa flow is the last known lava flow on Maui (about 1790) as the youngest flow on the island supports a limited, albeit unique, flora and fauna. The brackish-water pools harbors rare crustaceans as well as algae, fish, worms and mollusks. Native plants such as the nehe and 'auhuhu and a few introduced weeds common in the project site occur there.

Historically, the Makena-Ulupalakua area of Maui has gone through several transition stages in terms of flora and fauna. Before man came, the area was probably covered with native bunch grasses and scattered dry-land trees. Migratory and resident waterbirds and seabirds favored the coastal areas, and few land birds frequented the upper areas. With the advent of the Polynesian settlers, rodents, lizards, food, and fiber plants were introduced. Subsequent immigration of settlers in historical times brough the presence of cattle, additional introduced agricultural and decorative plants, and, unintentionally, a myriad of weed species which soon spread rapidly. Kiawe and the later introduced haole koa (introduced for cattle feed around 1920) soon came to dominate the area from sea level to high elevations. The increasing presence of cattle contributed to the continual destruction of many native plants in the area. Introduced songbirds and game birds were brought in to combat agricultural pests, for their song, or to provide sport. The result has been a complex ecosystem in terms of flora and fauna and an area where man's influence is indelible.

Marine Ecology

Introduction

General

During the week of June 24-30, 1974, diving surveys were conducted offshore, makai of the project site in order to assess the proposed development program's probable impact on marine organisms. Surveys were confined to the most conspicuous components of the marine life found in submarine areas shoreward of the 10-meter bathymetric contour. Observations were limited to bottom-dwelling organisms (benthos) and bottom associated fish, i.e. reef fish, which could be detected during SCUBA dives conducted during daylight hours. Observations on planktonic organisms were omitted because of time constraint. Studies of benthic organisms provide adequate information on local environmental conditions because most spend most of their life cycle in one place; in contrast, plankton are carried away from specific areas by currents.

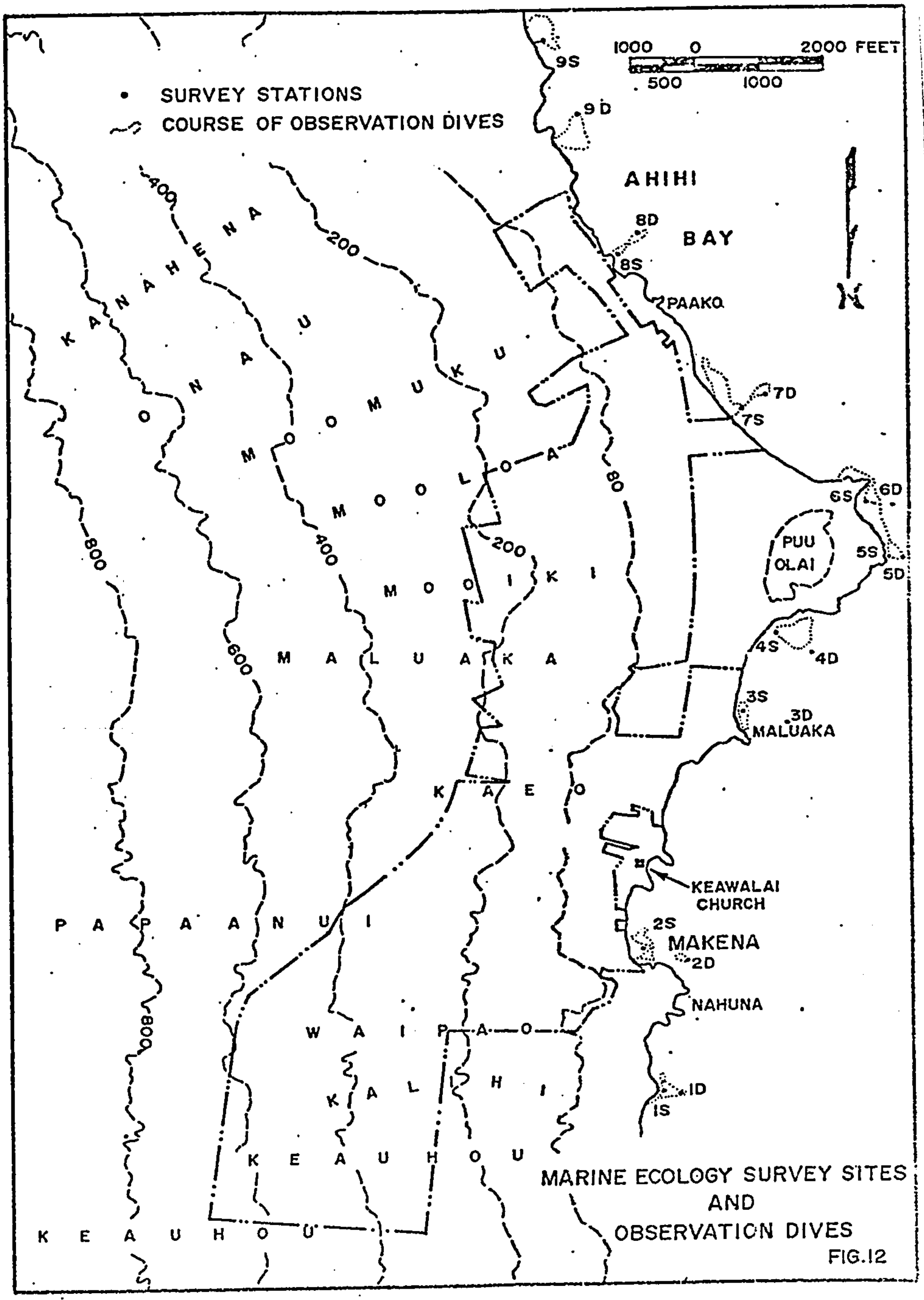
As a result, quantitative sampling of marine organisms were, therefore, confined to the investigation of corals, fish, and urchins at nine survey stations. Each station included a shallow inshore site (designated "S") between depths of 2-4 m (meters) and a deeper offshore site (designated "D") at depths between 8 and 9 m. For most stations, the shallow site was located within 40 m of the shoreline while the deeper site was usually positioned 600 to 1,000 m offshore.

It was also the intent of this study to acquire additional information on other marine organisms. Many species were noted during surveys but were not encountered in quadrat and transect line samples because these species were uncommon or occurred mostly in environments not specifically sampled by the quantitative methods. Thus, a series of observation swims away from the transect areas provided additional data on organisms and the physical environment. Approximately 6 km of swims supplemented the transect surveys and their locations are shown in figure 12.

Survey Methods

Divers using SCUBA were transported to specific locations by boat or swam out from shore. All observations were recorded on underwater writing slates. Data on the physical environment included notes on water motion, horizontal visibility, surface temperature anomalies, depth, and suspended sediments. Data on the substratum (bottom surface) included size and extent of sand ripples, slope (if present), bathymetric relief, size and color of sediments, and substratum category (e.g. live coral, dead coral, rubble, reef rock, algal turf, sand, etc.). The raw data for the physical and geological observations are given in Appendix C-1.

Transect line techniques were employed at stations 1, 2, 3, 4, 7, and 8. A transect line, consisting of a 50-meter long nylon rope of 1/4" diameter, was previously marked at one-meter intervals with lead weights. The transect line was paid out from a spool and stretched straight by divers working on the bottom. The ends



MARINE ECOLOGY SURVEY SITES AND OBSERVATION DIVES

FIG.12

of the line were fastened to the bottom in a north-to-south orientation, parallel to shore. Transect line techniques were not used at stations 5, 6, and 9. At these locations, divers swam in a random fashion recording notes on species and visually estimating the abundance of corals, fish, and other conspicuous organisms. Observation time at each shallow or deep site was approximately 40 minutes.

Corals, Urchins and Substratum

Two different techniques were employed on the transect line to estimate the abundance of corals and substratum categories. The first consisted of a line intercept method and the second involved the use of quadrats. For the line intercept method, a diver would record the substratum type or species of organism which was located directly beneath the lead weights spaced at one-meter intervals along the line. The raw data (Appendix C-2) were later converted into percent cover estimates (table 5).

For the quadrat method, a rigid square frame one meter on a side, subdivided by wires into a grid of 100 squares of equal area, was utilized. The quadrat square was placed over the substratum centered on each of 10 points along the transect line. The points were previously selected from a random table of numbers, the first 10 numbers listed between 1 and 50. The coverage by corals and substratum types was then estimated by counting and recording the number of squares occupied by each species or category. Raw data for the quadrat counts are found in Appendix C-3 while summary data on coral coverage is found in table 6. The quadrat counts also provided estimates of urchin densities. The number of urchins of each species in each quadrat were recorded during surveys. The data were later summarized as mean number per m^2 (table 7).

Fishes

The common reef fishes were censused using a modification of the method proposed by Brock, 1954. Because of the mobility of many reef fish species, care was taken to minimize the disturbance of fishes prior to the actual census. Divers would enter the water, lay out the transect line and then return to make the fish counts. Only after completion of the counts would other divers enter the area.

The distribution and abundance of many reef fishes are highly dependent upon the composition and topography of the substratum. In an effort to maximize the comparison between fish and other data, the fish surveys were conducted along the transect line. The number of each species of fish present within 3 m, on either side of the transect line, were recorded. Many fishes are cryptically colored and/or secretive in their habits. Following the initial slow fish transect swim, divers would execute a random 10-minute search along the line to recheck the identification of species initially recorded, and to list and enumerate additional species not observed during the initial pass.

No attempt was made to count the numerous small and secretive fishes such as gobies, blennies, eleotrids, etc. which abound on the reef but which are almost impossible to count without the aid of poisons or anesthetics. Since observations were conducted during daylight hours, many nocturnally active forms such as cardinal fishes and squirrel fishes were only rarely encountered. The raw data on the fish censuses are found in Appendix C-4 while summary data on fish density and diversity (number of species per transect) are found in table 8.

Sand Dwelling Organisms

Sand cover was common at most of the stations. Reconnaissance of sand bottom in most localities, however, failed to detect sand dwelling organisms. Burrows and mounds in some localities, however, provided evidence of their presence. Sieving sand at one station revealed no organisms of a size retained by a 1/4-inch mesh screen. Divers actively dug into some occupied sand burrows, but likewise failed to reveal the identity of any soft-bottom fauna.

Description of the Survey Stations

The marine areas off Makena-Ahihi Bay lie on the leeward side of East Maui and are protected from swells generated by the prevailing trade winds. For most of the year, sea and wind conditions are mild along the coast except during the southerly Kona storms. The shoreline makai of the project site consists of a series of sandy beaches and rocky basalt headlands. Submarine sand deposits appeared more extensive opposite sandy beaches than opposite rocky coasts or headlands. Conversely, coral reef development appeared greater off the rocky beaches. In deeper water offshore, however, sand coverage was high both off sandy and rocky beaches. The submarine bottom areas seaward of the 20-meter contour apparently contain sand deposits of commercial size (Campbell et al, 1971).

Carbonate sand was found to dominate the bottom at most of the stations surveyed. Generally, sand dominated environments are flat, lack relief, and lack many conspicuous organisms. Hence, an attempt was made to choose rocky or coral-dominated patches for transect surveys; these areas contained substantially greater numbers and kinds of organisms.

Station 1: North Nahuna Point

The shallow transect (1S) was positioned on an elevated lava dike system protruding from shore at the northern end of the rocky headland of Nahuna Point. The deep transect (1D) was located 600 m offshore and south of the shallow transect.

The common Hawaiian littoral marine organisms dominated rocky surfaces between the tide marks and in the splash zone. The snails Siphonaria normalis, Nerita picea, and Littorina pintado were noted clinging to rocky surfaces. Common algae include Ulva, Acanthophora, and Ectocarpus. Thick, yellow sand deposits fanned out into deeper water from the sandy beach located north of the station. Large numbers of the sand dwelling snail Terebra were noted near the beach in shallow water.

A large and diverse population of corals, fish, and invertebrates were reported at the shallow transect. The rose coral (Pocillopora meandrina) and the massive coral (Porites lobata) together accounted for 30 percent of the substratum cover. These same two species were consistently the most common corals reported at most of the shallow transect sites. Other corals were present at transect 1S but none were common. Pink encrustations of the coralline algae Porolithon covered nearly half of the substrate. Several species of sea urchins were very numerous including the heart urchin Tripneustes gratilla, the black urchin Echinothrix diadema, the red slate pencil urchin Heterocentrotus mamillatus, and the white boring urchin Echinometra mathaei. In addition, several species of sponges were located on the rocky ledges near the transect. Also noted were the green sea star Lincka diplax, the hydroid anemone Pennaria tiarella, the cowry Cypraea maculata and the bandana shrimp Stenopus hispidus. A large diverse fish fauna included the common surgeon fish Acanthurus nigrofuscus which was also common at most of the other shallow sites. The wrasse Thalassoma duperreyi was also abundant and was consistently common at all stations. The damsel fishes Chromis ovalis and Pomacentrus jenkinsi were also common at transect 1S.

The dominant benthos at the deep transect (1D) included the coral Porites lobata and the finger coral Porites compressa. The heart urchin Tripneustes was again numerous and was perhaps the most common of the urchins observed during the study, both in deep and shallow water. Other urchins, Heterocentrotus, Pseudoboletia, Eucidaris metularia, and Echinothrix calamaris were also reported. Egg deposits of the snail Conus were reported in the expansive sand deposits north of the transect. Also noted were two species of the sea star Linckia. The most common algae were the arborescent red coralline Porolithon gardineri and dark tuffs of the filamentors blue-green Lyngbya. The six or more species of sponges reported at the site were the highest of any area of the study. The shrimp Stenopus was also noted under ledges. The wrasse Thalassoma duperreyi; the surgeonfish Ctenochaetus strigosus; the damsel fish Chromis leucurus, and the butterfly fish Chaetodon multicinctus were the most abundant fishes.

Station 2: Makena Landing

Shallow transect site, 2S, was located 40 m offshore from the location of the proposed small boat ramp area within the inner bay of Makena Landing. The deep offshore station (2D) was moved north opposite the rocky headland after it was discovered that only sand deposits existed opposite the Landing.

Marine organisms living near the site of the proposed ramp were confined to rocky surfaces within the littoral zone. The typically common littoral algae Gelidium, Ahnfeltia, and Ulva were found distinctly zoned on the rocks. Also present were the algae Enteromorpha and Porolithon. The common purple rock urchin Colobocentrotus atratus and the littoring rock snails Nerita picea, and Littorina pintado were attached above water level among the algae. The common rock crab Grapsus was also noted on the rocks.

Few organisms were observed offshore at site 2S and the transect surveys were abandoned. Substrata were covered by scoured reef rubble and sand shifting in the moderate surge currents. Tripnrustes, Pocillopora meandrina, and Porites lobata were the invertebrates existing closest to the existing boat ramp site--some 60 m offshore. At greater distances, under loose rocks were reported specimens of the brittle star Ophiocoma.

Swims to the south along the shore revealed heavy growths of the red algae Jania and Hemitrema and the green alga Neomeris. Other swims north along the rocky headland revealed several species of coral including Montipora and Palythoa. The sea cucumber Actinopyga and several species of sea urchins were reported in an older privately owned boat ramp. Reef fishes were rare on the sandy bottoms, but widespread along the rocky shore. Abundant species included the common wrasse, surgeonfish and several species of damselfishes. Of interest was the observation of the conger eel Conger marginatus and the strange eel-like Brotula multibarbata in small caves.

Flat coral rock and rippled deposits of black sand dominated substrata at the deep offshore transect 2D. An algal turf dominated by Amancia also covered extensive areas of the bottom. Corals were not common (10 percent cover) but many varieties were noted. A large damaged colony of antler coral Pucillopora eydouxi was found detached on its side providing evidence of the seversity of large waves which strike the coast at times. Other common invertebrates included the sea stars Linckia diplax and L. multifera, the urchins Echinothrix calamaris and Eucidaris, the common sponges Terpios zeteki and

Cliona vestifica, the hydroid Pennaria and the sea cucumber Holothuria atra. Lyngbya and Liagora were the most conspicuous algae. The fish fauna at the site was not particularly abundant nor diverse presumably due to the lack of bathymetric relief. Again common were the wrasse Thalassoma and several damselfishes.

Station 3: Kewalai Beach

The shallow inshore transect (3S) was located offshore from a proposed pulic right-of-way at the north end of Kewalai Beach. The deeper offshore transect (3D) was moved to the north off Maluaka Point after it was discovered that only sand deposits existed deep offshore from the beach.

On rocky surfaces in the tidal zone were found most of the organisms of the common rocky littoral community described previously. Also noted was the small black blenny Istiblennius zebra foregoing on algae in tidepools.

Substrata at the shallow transect (3S) was dominated by shifting yellow sand and consolidated reef rock; visibility was generally poor. Bathymetric relief was high at the transect site. Turf algae, especially Amancia were noted covering some hard surfaces. Coral average was low and limited mostly to the common species Porites lobata and Pocillopora meandrina. Particularly striking were the large urchin populations of Echinothrix diadema and Tripneustes gratilla. Several other specis of urchins were also reported including the large black "Wana" Diadema paucispinosum.

The green sea star Linckia was also noted on the sand. Fish populations were reduced both in numbers and diversity. Most abundant were the wrasses Thalassome duperreyi and Stethojulis axillaris, several species at damselfish including Abudefduf imparipennis and the scorpionfish Scorpaena coniorta. Swims north along the rocky headland revealed dramatic increases in the size of coral and urchin populations. Unusually common were sheet-like expanses of the coral Leptastrea purpurea. On rocky cliffs were noted the snakehead cowrie Crpraea caputserpentis and a nudibranch Phyllidia trilineata.

Finger coral communities of Porites compressa dominated the substratum at the deep offshore transect (3D) and the 8 total species of corals accounted for 66 percent of the substratum coverage. Finger coral rubble and yellow sand were also common. Five species of urchins were reported at the transect--the most common of which was Tripneustes. Under loose rubble was found individuals of the brittle star Opiocoma. The blue sea star Linckia multifera was more common out in the open. The olive colored sponge Terpios was again reported and was also noted at most of the other deep transects. The algae Lyngbya and Liagora were again very common. Thirty-seven species and large populations of small fishes were noted among the finger coral. Several species of surgeonfish were most common. Other abundant species included the damselfish Chromis leucurus, the goatfish Parapeneus multifasciatus, the butterfly fishes Chaetodon multicinctus and C. corallicola and the angelfish Centropyge potteri. Overturned colonies of the coral Pocillopora eydouxi again provided evidence of the severity of waves which sometimes strike the Makena-Ahihi coast.

Station 4: South Naupaka Beach

The shallow inshore transect (4S) was located directly north of Puu Olai cinder cone 25 m offshore from the blacksand beach. The deeper transect (4D) was located 800 m offshore at a depth of 8 m. The blacksand beach abruptly terminates at the water's edge and flourishing reef communities exist within 15 m of the shoreline. The substratum is dominated by basalt and reef rock (50 percent coverage) with live corals (40 percent) and a mixture of black and white sand accounting for the remaining cover. The corals *Porites lobata* and *Porites compressa* were far more abundant than any of the other 15 species recorded. Of interest were unattached specimens of the solitary mushroom coral *Fungia scutaria*, a good indicator of wave protected environments. Sea urchins were common, especially species of *Echinometra* and Tripneustes. Two species of the sea star *Linckia*, a brittle star *Ophiocoma*, and a grey sponge were also observed. Macro-algae were not common near shore but the turf alga *Amancia* was abundant offshore near the transect (4S). The hermit crab *Clibanarius* zebra was more common off this transect that at other sites where it was also observed. Fish populations were of moderate density and diversity. Common species of wrasses, surgeonfishes, damselfishes, and the parrot fish *Scarus sordidus* were conspicuous. Wave surge was hardly detected and visibility was extremely good.

Observation swims south towards the cinder cliff revealed large stands of the algae Gelidium and Turbinaria flourishing on the rocky vertical face. Common corals included rose coral (Pocillopora meandrina) and encrustations of Pavona duerdeni and Psammocora explanatula. Porites lobata and fingercoral dominated substratum cover at the deeper offshore transect (4D). Fingercoral rubble and dark sand were also common. Visibility was extremely good, approaching 20 m. The heart urchin Tripneustes, the purple urchin Pseudoboletia, the white boring urchin Echinometra, two species of the starfish Linckia, and the cushion star Culcita were conspicuous echinoderms. Unusual invertebrates included the black-lipped pearl oyster Pinctada margaritifera and the nudibranch Phillidia trilineata. The olive-colored sponge Terpios and the red boring sponge Cliona vastifica were also widespread. Common algae included the blue green Lyngbya and the red Liagora, and the green sand producing Halimeda. Surgeon fishes, butterfly fishes and damselfishes were again the most conspicuous components of the fish fauna. Also, the puffer Canthigaster jactator was more common than usual. A large specimen of the flatfish Bothus mancus was also detected mimicking the sand.

Station 5: Puu Olai. Point

Surveys off the Point included tidepools, rocky benches, reefs and sand flat habitats. The area is fished frequently from shore by resident fishermen. In addition to all the common intertidal and supratidal organisms described previously, the rose coral and soft coral was observed in shallow tidepools above low tide level. Padina, Turbinaria, and Zonaria also supplemented other common littoral macroalgae. The opihi Cellana sandwichensis, encrustations of the soft coral Zoanthus and the rare wave-resistant rock snail Littorina picta supplemented the more typical and common invertebrates. The rock crab Metagrapsus thukuhar and the tidepool fish Istiblennius zebra were noted in tidepools.

Low temperature anomalies were detected during surveys indicating a local seepage of freshwater off the rock Point.

Reef rock dominated the substrata at moderate depths offshore. The commonest benthic organisms included rose coral, the massive coral (Porites), and coralline algae. In comparison with all other stations, the reef descends more rapidly off station 5. Many varieties and large concentrations of fishes were reported among the reef including wrasses, parrot fishes, surgeonfishes, damselfishes and the fish Caracanthus maculata. Common urchins included Echinometra and Echinothrix in shallow water and Tripneustus at depth. The largest concentrations of the sea star Linckia multifera reported during the study occurred on sandy pockets near the reef margin. At depths of 10 m the reef is replaced by extensive flats of yellow sand broken only by occasional mounds of coral rubble and a few living colonies of Pocillopora and encrusting Porites. The fish population was diverse but few species were common except for the typical wrasses and damselfishes.

Station 6: "Little" Beach

The shallow observation site was located 40 m offshore from the middle of the small beach near the southern end of the headland. The deeper site was located approximately 1,000 offshore. Periodically, large waves would strike the sandy beach which is replaced by a shelf of reef rock only a few meters offshore. Rose coral, coralline algae and filamentous algae dominated substrata on the shelf. The urchins Heterocentrotus and Echinothrix diadema were common on rocky surfaces while the starfish Linckia was reported in sandy depressions. The wrasse Thalassoma duperreyi and several species of damselfishes were the most common of the fishes.

Rippled yellow sand flats dominate the bottom eventually covering 100 percent of the substratum in deeper water offshore. On occasional rubble tracts were seen the corals Pocillopora meandrina and P. eydouxi, the urchin Tripneustes, and the sea star Linckia diplax. Fish populations in deepwater were reduced in abundance and diversity and surgeonfishes were nearly absent. Wrasses, hawkfish, goatfishes and damselfishes were the more common varieties.

Station 7: "Big" (Puu Olai) Beach

The station was located midpoint along the long yellow sand beach south of Puu Olai cinder cone. The shallow transect (7S) was located 30 m offshore near the site of a proposed public right-of-way (figure 3). The deep transect was positioned 800 m from the shoreline. A heavy shorebreak occurred during visits to the beach and offshore visibility was poor due to sediment in suspension and turbulence. Wave action occurs frequently off this beach, according to previous studies (Moberly & Chamberlain, 1966). Sediments would also "creep" along the bottom during the passage of large waves, even on the deep transect.

Offshore from the beach near the shallow transect, substrata was dominated by smooth scoured reef rock. Reef corals may find the environment inhospitable as total coverage by corals was less than 5 percent. Large amounts of fishing line, sinkers and other tackle were entangled in colonies of Pocillopora meandrina. A large number of invertebrates were noted, although none were very common. The common urchins and sponges, the cowrie Cypraea helvola, the brittle star Ophiocoma, the shrimp Stenopus in depressions, and the cone snails Conus miles and C. pulicarius were among those observed. Fish censuses showed that only 25 species occurred in lower densities with the most common being the wrasses Thalassoma duperreyi, Stethojulis axillaris, the damselfish Abudefduf imparipennis, and the blennie Runula ewaensis.

Observation swims past the south end of the beach towards the rocky coast revealed that coral, fish, invertebrates, and algae are found in more flourishing numbers and varieties. Seasonal transport of beach sand onshore and offshore (Campbell, 1972), as well as sediment scour, may be the principal causes for the poor community development off the beach transect 7S compared to the adjacent rocky shoreline.

Substrata appeared barren and dominated by flat reef rock, turf algae, and sand at the deep transect offshore (7D). Visibility was substantially improved due to reduction of wave surge. Reef corals are rare, perhaps due to the lack of suitable substratum for settlement and growth. Rose coral (Pocillopora meandrina) and lobed coral (Porites lobata) were the most common species; the latter assumed an unusual sediment-controlled growth form. Substratum relief, however, is high which perhaps explains the greater population of fish and invertebrates. Echinoderms including the sea cucumber *Holothuria atra* in the sand, the cushion star *Culcita novaeguineae*; the sea star *Linckia diplax* and the urchins *Tripneustes*, *Pseudoboletia* and *Echinothrix calamaris*. Common sponges included *Cliona* and the olive-colored *Terpios*. Cone snails were also conspicuous and included *Conus striatus*, *C. abbreviatus* and *C. pulicarius*. The hermit crab *Clibanarius* and the hydroid anemone *Pennaria* were also seen. The most common algae were *Lyngbya*, *Neomer* and *Liagora*. The most common of the fishes were the wrasse *Thalassoma duperreyi*, the hawkfish *Paracirrhites arcatus*, the damselfishes *Chromis ovalis* and *Pomacentrus jenkinsi*, the puffer *Canthigaster jactator* and the fish *Caracanthus maculatus*.

Station 8: South Ahihi Bay near Paako

Station 8 was located offshore along the rocky coast of Ahihi Bay near the southern boundary of the proposed development. The shallow transect (8S) was located about 50 m offshore while the deep transect was located 1000 m offshore at a depth of 9 m. Wave surge was extremely heavy at the shallow transect (8S) causing difficulty in performing the surveys. A veneer of reef rock covering basalt was the prominent substratum type and many varieties of attached algae were seen near the shore including *Porolithon*, *Gelidium*, *Ulva*, *Sargassum*, *Acanthophora*, and *Grateloupia*. Coral coverage was low, only 10 percent but 17 species were reported in the vicinity of the transect which was the highest recorded for the study. A variety of invertebrates was also present including four species of urchin, the brittle star *Ophiocoma*, several vermetid snails, the top shell *Trochus histrio*, the cone snails *Conus abbreviatus* and *C. moreleti*, the turf snail *Drupa morum* and the soft coral *Palythoa tuberculosa*. The fish fauna was abundant, diverse, and included 11 species of both surgeonfishes and wrasses, four species of damselfishes and one species of scorpionfish.

The physical and biological environment at the deep station 8D nearly resembled that of station 7D. Sediment deposits and algae turf were the dominant substratum types. *Amancia* and *Asparagopsis* were the most common of several species of macro algae. Reef corals accounted for only 4 percent cover and included only 4 species. Conspicuous invertebrates included the cone snails *Conus miles* and *C. ebraeus*, the urchin *Pseudoboletia*, and the sponges *Cliona* and *Terpios*. Both the abundance and diversity of fish were substantially lower than reported for the inshore transect. The most common species were the hawkfish *Paracirrhites arcatus*, the puffer *Canthigaster*, the triggerfish *Rhinecanthus*, the scorpion fish *Scorpaena* and the fishes *Caracanthus maculatus* and *Malacanthus hoedtii*.

Station 9: Waiala Cove near Kanahena Point

Station 9 was located south of the proposed development within the Cape Kinau-Ahihi Bay Natural Area Reserve of the State of Hawaii (Appendix B). Land and submarine areas within the Reserve were covered by a lava flow in 1790. Basalt rock dominates the land and coastal areas but flourishing coral reefs exist offshore. The shallow survey site was located 30 m offshore from Waiala Cove and the deeper site was located approximately 1,000 m offshore and to the north. The large headland of Cape Kinau is located about 1 km to the south of the station.

A well developed littoral algae and molluscan community existed on rocky surfaces at the shoreline. The shallow site (9S) was the most favorable observed with respect to coral growth and diversity. Corals of 17 species and many varieties covered approximately 65 percent of the substratum. Inshore the common forms were Pocillopora meandrina and Porites lobata, but finger coral becomes increasingly more dominant towards deeper water (below 4 m) and covers essentially 100 percent of the substrate at depths below 7 m. Other corals included the mushroom coral Fungia scutaria, the soft coral Palythoa and encrusting forms of Montipora, Cyphastrea, Pavona, and Leptastrea. Sand was almost absent. Coralline algae were also common and included several varieties of Porolithon. Several urchins including Tripneustes, Diadema and Echinometra were common in shallow water, but the red slate pencil urchin Heterocentrotus mamillatus achieved extremely high concentrations on the finger coral thickets deeper offshore. Other common invertebrates included the rock oyster Isognomon perna under rocks nearshore, the brittle star Ophicoma under cobbles, and occasional clumps of a large grey sponge Dysidea herbacea. Fish populations were abundant, and diversity was the highest reported for any station during the study--66 species. The most common species were the wrasse Thalassoma duperreyi, the surgeonfish Acanthurus nigrofuscus and the damselfishes Chromis ovalis and Pomancentrus jenkinsi.

Swims to the south and to the north revealed that the reef develops a more rugged, wave resistant character and corals are probably less developed although still abundant. Visibility became reduced near sites of heavy wave action to the south.

The deeper survey station (9D) was located on the deep outer fringe of the reef at a depth of 9 to 10 m. Visibility was extremely good and sediments were confined to deeper areas beyond the reef. The finger coral Porites compressa achieved almost total substratum coverage with only four other corals (Porites lobata, Montipora verrucosa, M. patula, and Pavona varians) occasionally noted. The urchin Heterocentrotus continued to flourish in densities exceeding $5/m^2$ and other urchins especially Echinothrix were also common. Heavy finger coral growths prevented closer examination of many reef depressions and few invertebrates were noted. The tiger cowrie Cypraea tigris was reported near the deeper reef fringe. Fish abundance and diversity were both high. Abundant species included the common wrasses and damselfishes, the goatfish Mulloidichthys samoensis, the moorish idol Zanchus canescens, the triggerfish Rhinecanthus, and the squirrel fish Myripristis argyromus.

Discussion

Introduction

A partial inventory of marine organisms (Appendix C-5) and a species list of corals (table 6) and fishes (Appendix C-4), provide a complete list of marine species encountered during the study. Despite the variety of habitats surveyed during the study there are a number of generalizations that can be made regarding the abundance and distribution of some of the organisms.

Corals

Approximately 25 species of reef corals were reported during the study which represents about two-thirds of the common species found in Hawaii (Maragos, 1969). However, only a small number of the corals were commonly encountered. Pocillopora meandrina appears to be the most conspicuous form in shallow water; Porites lobata appeared to be the most abundant form at intermediate depths (3 to 6 m), while Porites compressa frequently dominated assemblages in deeper water. The degree of wave action seems to be the principal factor causing the zonation pattern; the more wave resistant forms apparently occur at progressively shallower depths where wave action is heavier.

Coral development was also much greater off rocky coasts than off sandy beaches. Abundant sediments in conjunction with wave generated currents may result in abrasion, reduced settlement, and growth by

TABLE 5

Summary Data on Percent Coverage of Corals and Substratum Types Determined from Line-Intercept Method

	Transect Number										
	1S	1D	2D	3S	3D	4S	4D	7S	7D	8S	8D
Corals:											
P. lobata	12	16	2	0	30	26	14	0	0	0	0
P. compressa	0	16	6	0	4	4	12	4	0	4	2
Poc. meandrina	8	2	0	0	4	0	0	0	2	0	2
M. petula	6	0	0	0	0	0	2	0	0	0	0
M. verrucosa	2	0	0	0	0	0	0	2	0	0	0
L. purpurea	4	0	0	2	0	2	0	0	0	0	2
Palythoa	2	0	0	0	0	0	0	0	0	0	0
Total (excl. Palythoa)	32	34	8	2	38	32	28	6	2	4	6
Consolidated Reef (So, So (S))	52	38	78	68	14	64	34	88	88	90	78
Rubble, boulders (R, R (S), B, B (S)) 14	14	16	10	0	46	2	36	2	2	6	10
Total Solid substrata	66	54	88	68	60	66	70	90	90	96	88
Sand (S, SF, SC) over 1 cm. deep	2	12	4	30	2	2	2	4	8	0	6

TABLE 6

Abundance (% Cover) and Diversity (Number of Species) of Corals Determined from Quadrat Method or Visual Estimates (*). This List Includes All Species of Corals Recorded During the Study.

	Transect Number																	
	1S	1D	2S	2D	3S	3D	4S	4D	5S	5D	6S	6D	7S	7D	8S	8D	9S	9D
Total Live Coral Coverage	42	43	<1	11	9	66	41	36	35	32	32	<1	5	2	11	4	90	99
Species:																		
<u>Cyphastrea</u> <u>ocellina</u>	<1						<1								<1		P	
<u>Fungia</u> <u>(P.)</u> <u>scutaria</u>							P	P									P	
<u>Leptastrea</u> <u>bottae</u>															<1			
<u>Leptastrea</u> <u>purpurea</u>	1			<1	1	<1	3	P	P		P				P	P	P	
<u>Montipora</u> <u>flabellata</u>	P				P		P			P	P				<1			P
<u>Montipora</u> <u>patula</u>	2	<1		P	1	<1	<1	<1		P	P		P	<1	<1	<1	P	P
<u>Montipora</u> <u>verrili</u>							<1						P	P	P			
<u>Montipora</u> <u>verrucosa</u>	<1	2		<1	P	1	1	<1	P	1*	<1*		<1		<1	<1	P	P
<u>Montipora</u> <u>verrucosa</u>, Foveolate	P						P											
+<u>Palythoa</u> <u>tuberculosa</u>	1	P	P		P	<1	P		P						P		P	
<u>Pavona</u> <u>varians</u>	2	<1			P	<1	1								P		P	P
<u>Pavona</u> <u>duerdeni</u>					P	P	P										P	
<u>Pocillopora</u> <u>damicornis</u>															P			
<u>Pocillopora</u> <u>eydouxi</u>				<1	P					P			P		P		P	
<u>Pocillopora</u> <u>liqulata</u>				<1											<1			
<u>Pocillopora</u> <u>meandrina</u>	12	2	<1	2	2	2	4	1	25*	5*	30*	<1*	2	1	2	1	10*	
<u>Pocillopora</u> <u>meandrina</u> (dead)	7	P		<1		2	2	<1			P		1	<1				
<u>Pocillopora</u> <u>molokensis</u>																	P	
<u>Porites</u> <u>compressa</u>		24		3		32	5	20		5*							40*	99*
<u>Porites</u> <u>duerdeni</u>																	P	
<u>Porites</u> <u>evermanni</u>									P		P				P		P	
<u>Porites</u> <u>brighami</u>	<1				P		<1	P							<1		P	
<u>Porites</u> <u>lobata</u>	17	14	<1	5	5	28	24	14	10*	40*	1*	P	1	<1	8	2	40*	P
<u>Psammocora</u> <u>explanatula</u>							P								<1		P	

TABLE 6 (Continued)

	Transect Number																	
	1S	1D	2S	2D	3S	3D	4S	4D	5S	5D	6S	6D	7S	7D	8S	8D	9S	9D
Psammocora (_S._) _stellata_		P																
+_Zoanthus pacificus_									P									
Number of Species	13	9	2	9	11	10	17	9	7	7	8	2	7	5	17	5	17	6

<1 = much less than 1% cover

P = present but not counted

\+ = soft corals

corals. Seasonal transport of beach sand (as off "Big" Beach) may also cause the smothering of corals and poorer reef development off beaches (Campbell, 1972). The most flourishing coral areas occurred to the north of large projecting headlands such as station 4 off Puu Olai and Station 9 off Cape Kinau. Such areas would be protected from large waves generated from the south or southwest, during kona or southern hemisphere storms. The several "uprooted" and damaged colonies of Pocillopora eydouxi observed during the study indicate that the coast is occasionally subjected to considerable wave energy. Coral communities appear to be unstressed by human activities and are comparable in structure and development to those studied previously to the north of the proposed development (Bowers, 1973) and also to the south (State Division of Fish and Game, 1972).

Fish

A total of 101 species of fish were reported during the study, many of which were commonly distributed (table 7). One group appeared to be widespread at all stations and depths (i.e. Acanthurus nigrofuscus, Thalassoma duperreyi, Chromis ovalis, Pomacentrus jenkinsi, and Canthigaster jactator); a second group appeared to be most common in shallow water (i.e. Stethojulis axillaris, Abudefduf imparipennis, and A. abdominalis); and a third group was largely restricted to deeper water (i.e. Pseudocheilinus octotaenia, Paracirrhites arcatus, Chromis leucurus, Dascyllus albisella, Chaetodon multicinctus,

C. corallicola and Centropyge potteri). Shallow environments appeared to harbor larger populations and more species perhaps due to the greater substratum relief and greater populations of macroalgae. The fewest number and types of fishes were reported on sandy expanses where both food and shelter are probably scarce. The partial correlation of fish density to coral coverage may be attributed to the tendency for rapidly growing coral assemblages to offer more diverse habitats and shelter.

Despite the high densities and diversities at some stations, most of the fishes observed were of small size. Some localities (i.e. stations 5 and 7) may be subjected to continuous recreational shoreline and offshore fishing; however, even remote and legally protected environments (i.e. station 9 within the Natural Area Reserve) also exhibited generally small-sized fish. Evidently, the shelter afforded by finger coral and other formations do not contain shelter of sufficient frequency or diversion to support larger reef fish along the Makena-Ahihi Bay coast.

Past studies of fish stocks in marine areas to the south of the proposed development show comparable diversities but much lower densities (Division of Fish and Game, 1972) than reported in the present study. The discrepancy could be attributed to differences in sampling procedures and personnel. In other studies of fishes conducted north of the proposed development at Wailea, comparable fish densities and diversities were reported (Bowers, 1973). It

TABLE 7

Summary Information of the Density (Number of Individuals per m^2) and Diversity (Total Number of Species) of Fish Encountered Along the Transects or During Random Swims (*).

	Transect Number																	
	1S	1D	2S*	2D	3S	3D	4S	4D	5S*	5D*	6S*	6D*	7S	7D	8S	8D	9S*	9D*
# Species	48	38	33	34	26	36	35	36	50	43	29	39	25	36	46	24	66	50
Density	3.19	1.89	1.93	1.14	1.49	2.79	1.52	1.64	1.81	1.06	0.75	0.83	1.03	1.00	1.65	0.50	1.95	1.59

Total Number of Species, All Transects - 101 is concluded that the fish fauna is representative of the coast and not significantly stressed by recreational fishing activities.

Algae and Invertebrates

Although these organisms were incompletely studied and sampled, some obvious distributional patterns were evident. A majority of the approximately 25 species of common macroalgae reported were confined to rocky substrata, especially in shallow water. The littoral algae Gelidium, Ahnfeltia, and Ulva showed consistent zonation patterns along most rocky beaches. In areas subjected to heavy wave action, coralline algae dominated substrates between 0 to 3 m. In deep water where sediment and rubble were more common, an algal turf dominated by the alga, Amancia, frequently covered much of the substratum.

Echinoderms proved to be the most conspicuous of the invertebrates. Sea urchins were reported all stations with one species (Tripneustes gratilla) ubiquitous. Some species were more confined to sandy areas (Echinothrix calamaris) while others flourished on hard surfaces in shallow water (Echinothrix diadema, Diadema, Heterocentrotus, and Echinimetra). Sea cucumbers and starfish were generally found on sandy deposits or rubble covered surfaces. The densities of the common urchins (table 8) show values similar to those reported for an earlier study conducted offshore at Wailea (Bowers, 1973). Thus, the urchin fauna is probably well-developed and representative of the coast.

TABLE 8

Densities (expressed as number per square meter) of Echinodermata, Echinoidea (sea urhcins) determine from quadrat counts and/or visual estimates.

	Transect Number																	
	1S	1D	2S	2D	3S	3D	4S	4D	5S	5D	6S	6D	7S	7D	8S	8D	9S	9D
Species:																		
Echinometra mathaei	0.6	P	<1		P	<1	P	<1	P				P		P		P	
Echinothrix diadema	4.2		P		2.2		P				1.5*						P	
E. Calamaris	P	P			<1					P		P	P					
Heterocentrotus mammillatus	0.4	P			0.3						P				P		8*	5*
Diadema paucispinum					P					P					P		P	
Colobocentrotus atratus			P						P									
Tripneustes gratilla	1.5	2.3	P		2.0	1.8	P	0.5		P	P		P			P	P	
Pseudoboletia indiana		P				<1		P						P		P		

P = present but not counted in quadrats

<1 = much less than $1/m^2$

* = visual estimate

Despite the secretive habits of many molluscs during daylight hours, a large number of species were recorded (Appendix C-5). In shallow water, the littorine snails were the most consistently observed while the cones and cowries (*Conus* and *Cypraea*, respectively) seem to have been common at many sandy and rocky substrata in deeper water.

Sponges, especially species of *Terpios* and *Cliona* were unusually conspicuous and common at most deep stations. The arthropods (crabs, lobsters, shrimp, etc.) proved to be too cryptic or motile for more than just a few species to be observed. The littoral rock crabs *Grapsus grapsus* and *Metagrapsus thukuhar* were reported along most rocky tidal areas while the hermit crab (*Clibanarius*) and the bandana shrimp (Stenopus) were reported at several offshore stations.

CULTURAL CHARACTERISTICS

Archaeology and History of the Project Site

Introduction

Physical archaeological information available for the project site is primarily in the form of field reconnaisance data obtained by the Bishop Museum. Such data has been gathered as part of the Museum's on-going contract with the State of Hawaii for a "Maui Inventory of Historic Places" and a separate contract with Seibu Real Estate Company, Ltd. for a reconnaisance survey of SRECL's Makena properties. The location of a number of historical archaeological sites within the project site is also known by a few older and/or former residents, i.e. Inez Ashdown, of the Makena-Ahihi Bay area; however, only a limited amount of this information has been collected or recorded. Other sources of more recent historical sites are two maps which were prepared by L. L. Torbert and W. D. Alexander, respectively, in the mid- and late 1800s.

At the time of this report, Inez Ashdown, a local Historian, is presently contracted by SRECL to prepare a document which summarizes what is known historically through legends, a recent archaeological survey, her own experiences as a former resident of the area near the turn of the Century, and other sources of historical and prehistorical data concerning the project site. As a result, the following section is presented without the benefit of this uncompleted study of the area.

Physical Archaeological Data

The following paragraphs are selected portions from the Bishop Museum report which discusses the results of the January, 1974 reconnaissance survey of SRECL's Makena properties. The results of the reconnaissance are described with respect to five major land parcels which make up the majority of the project site (figure 13). Bishop Museum usually describes the condition of sites in terms of one of four categories--excellent, good, fair or deteriorated. Excellent indicates no damage; good indicates slight damage; fair, moderate damage; and deteriorated, extensively to total damage. Recommendations given by Bishop Museum should not be misconstrued to be the recommendations of this report.

Parcel I

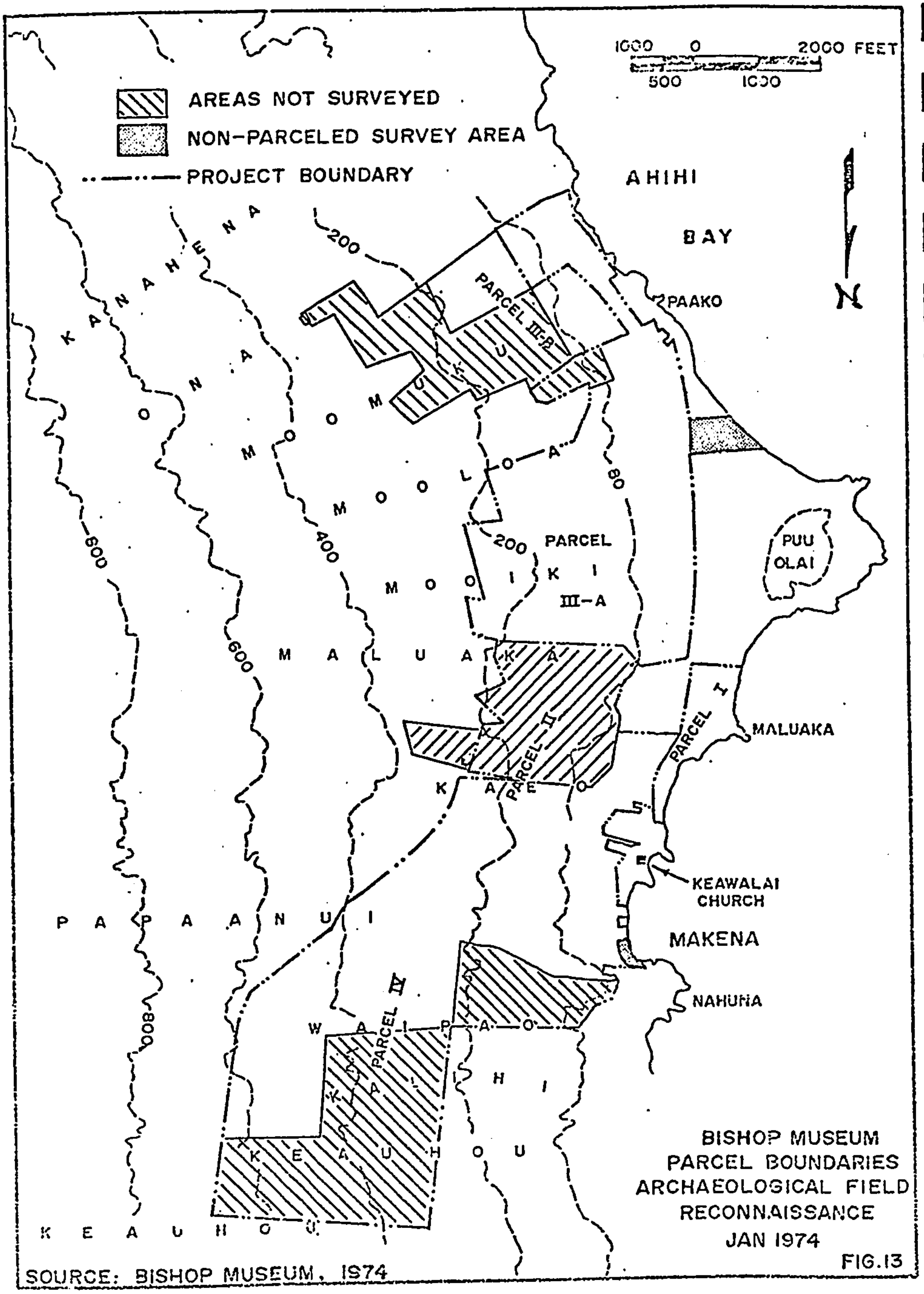
Description

"This parcel consists of two sections, opposite each other on Kihei Road, about 0.4 mile of Keawalai Church in Makena; it covers approximately 40 acres.

The 29 sites located in Parcel 1 include: six platforms (including two house platforms), 17 enclosures, two isolated walls, one rock shelter, a possible burial, a well, and a small complex consisting of three pens, eight agricultural terraces, and a house platform. Most of the remains are situated in the makai (seaward) portion, along the coastline. The conditions of the sites are generally fair to good, with moderate deterioration. Surface midden (Cowrie, cone and drupe shells) was seen on many of the sites. No artifacts were found." (Clark, 1974)

Recommendations

"Phase I and II--including survey, detailed recording and mapping, and at least test excavation--is recommended for this area. Many of the sites--including the house platforms,



BISHOP MUSEUM
PARCEL BOUNDARIES
ARCHAEOLOGICAL FIELD
RECONNAISSANCE
JAN 1974

FIG.13

SOURCE: BISHOP MUSEUM, 1974

the rock shelter, and the enclosures--are potentially informative as to both early and recent Hawaiian history in the area. Phase I (survey and detailed recording) is recommended for the mauka section of Parcel I. Excavation and literature research should determine if additional work is necessary." (Clark, 1974)

Parcel II

Description

"This parcel covers approximately 300 acres, in which the sites were not recorded in detail. Instead, an approximate count of the various types of features was taken--23 enclosures, seven platforms, three ahu, three isolated walls, three possible burials, seven cave shelters, three terraces and one possible house site--for a total of 50. The sites are not concentrated in any particular area but are scattered throughout the parcel. They are generally in "fair" condition. No artifacts or midden were seen." (Clark, 1974)

Recommendations

"Much or all of this area . . . (may) be under development of the golf courses. With this in mind, the following recommendations are made:

1. The sites in this area should be recorded and sketched (Phase I). Since they presently appear not to be of high value, this will probably be the extent of further research in the area.
2. The areas the survey team did not have time to complete should at least be walked through to determine if there are any remains present." (Clark, 1974)

Parcel III-A

Description

"Parcel III-A covers approximately 250 acres and is situated directly E of the hill known as Puu Olai. The sites in this area were recorded in brief detail. They include: 18 rectangular enclosures, three pens, 24 small circular enclosures, six shelter caves, 18 platforms, four terraces, three possible burial mounds, 14 partial enclosures, five pits, and six isolated walls for a total of 101. Besides these, three sites of fairly high archaeological significance were found--a heiau (religious temple) (Site B8-9), a large platformed enclosure (Site B9-10), and a large house (Site B8-11). Three main concentrations of sites are located 1) below the road into Parcel III-A, the NE section of the parcel, 2) above the heiau (B8-9), and 3) on the S side of the road into Parcel III-A. About half of the sites found in this parcel are deteriorated (because of cattle in the area); the rest are still in fairly good condition. Some surface midden (Cowrie and drupe shells) was seen. No artifacts were found." (Clark, 1974)

Recommendations

"It is realized that this area . . . (may) soon be under development for the golf courses. Thus, the following recommendations are advised:

1. Because of the large number of sites (104) in this parcel, Phase I work (detailed recording and sketch maps) should be undertaken, especially for the heiau (B8-9), to locate and delineate the obscured features of the complex.
2. Phase II work (at least test excavation) can be recommended at this time for the following sites; B8-52 (house site), B8-95 (enclosure), B8-94 (cave shelter), B8-97 (lava-bubble shelter), B8-38 (large platform with three connecting enclosures), B8-29 (possible burial mound), B8-9 (the heiau), and B8-84 (a rectangular enclosure associated with the heiau).
3. The heiau (site B8-9) should also be considered for Phase III work (stabilization, reconstruction). This site will make a beautiful historic place of interest, indeed a tourist attraction. Preservation of this heiau will be of benefit in furthering knowledge of the local cultural heritage. Since it is located on a high knoll, it should not interfere with any planned development in the area." (Clark, 1974)

Parcel III-B

Description

"This parcel covers an area of about 244 acres at the southern end of the survey area. An approximate count was taken of features in this area--a well, 24 enclosures, 20 platforms, 17 possible house sites, three pens, a possible burial, a pit, five ahu, and a large platform with a rock shelter situated on top--for a total of 73. The sites are in fairly good condition and are concentrated within 200 m E of Kihei Road. Surface midden (limpet, cowrie and drupe shells) was seen on many of the sites. No artifacts were found." (Clark, 1974)

Recommendations

". . . because of the concentration of sites in the area, Phase I work is advised. Further the presence of surface midden on many sites indicates that subsurface midden may be found through test excavation. Hence, Phase II work is advised as well. Phase I and Phase II work can usually be undertaken simultaneously. The area this survey did not cover should be reconnoitered to determine the presence of archaeological remains." (Clark, 1974)

Parcel IV

Description

"This parcel covers an area of about 397 acres in the northern part of the survey area, N of the Makena-Ulupalakua Road. This parcel was completely surveyed except for the NW corner and a portion of the NE corner. As this was the first area to be surveyed, the sites all have Bishop Museum site numbers:

B9- 7	a cave shelter
B9- 8	an enclosure
B9- 9	two enclosures (possible pens)
B9-10	enclosure with three possible graves inside
B9-11	a low-walled enclosure
B9-12	an agricultural terrace
B9-13	an agricultural terrace
B9-14	a cave shelter

Sites B9-7 to B9-11 are situated within an area of approximately 200 m square just N of Makena-Ulupalakua Road about 0.7 mile from the junction of this road and Kihei Road. The other sites are situated within 100 m of the W border of Parcel IV. The sites are in fair to good condition. No artifacts were found. Surface charcoal was found in the rock shelter B9-7 and surface midden (cowrie and drupe shells) was found in the rock shelter B9-14." (Clark, 1974)

Recommendations

". . . The sites in this area have been recorded and mapped in sufficient detail. The only work necessary in this parcel is to complete the preliminary survey work that this survey did not cover (figure 13)." (Clark, 1974)

Non-Parcelled Survey Areas

Northernmost Makai Area

"This area consists of 2.17 acres located just S of the junction of Kihei and Makena-Ulupalakua Roads. The only remains in this area are two fairly large historic cattle pens and a small, probably historic circular enclosure. No artifacts or midden were found. This area is of low historic or archaeological value, and no further work is needed." (Clark, 1974)

Southernmost Makai Area

"This area covers approximately 7 acres and is located on the E side of the Road about 900 m off the road into Parcel III-A (figure 13). The survey team found that almost the entire area had been bulldozed and no archaeological remains are present." (Clark, 1974)

Preliminary working maps associated with Bishop Museum's 1973 present "Maui Inventory of Historic Places" indicate that archaeological sites and one complex are situated in the project site. The sites include the Pohakunahaha Heiau, which is mauka of Nahuna Point at approximately the 40-foot contour, and the Kalani Heiau located just mauka of Keawalai Church. The one complex identified by the Museum is a shoreline complex makai of Kihei Road from the Makena side of Puu Olai to the north end of Naupaka Beach.

Since these and other sites have not been formally reviewed by the Hawaii State Register of Historic Places Review Board, no State or National Register designation has been given to any site within the project site.

Historical Data

The following chronology is related to the history of the project site and portions of the study area, and is based on portions of preliminary research findings by the Inez Ashdown. Such research is a product of her own research at the State Archives in Honolulu; her own verbal discussions with former residents of the area, intermittently, between 1908 and the present time; and correlation of such information with an 1866-1879 map of Honuaula prepared by W. D. Alexander and a circa 1846 map by L. L. Torbert.

Date	Historical Event
August 25, 1841	Kamehameha III gives "Konohiki rights" to Michael James Nowlein for management of sugar operations in Honua'ula (the area from Keawakapa to Nuu valley--situated along the south side of Maui) for 10 years. Terms of the Konohiki stipulated that Nowlein would utilize two farms named Mohopio for a fee of $10/year. The cane growing at Paeahu would be delivered to a mill which Nowlein would furnish for the processing of sugar cane for molasses. Kamehameha III would provide carts, oxen, wood, water and pasture area and cultivate 50 acres of sugar cane for the mill. Profits were to be split in half for His Majesty and half for Nowlein.
July 25, 1846	L. L. Torbert had a plantation operation in Kaeo (about 2,600-3,000-foot elevation) where he grew Irish potatoes, fruits, and other vegetables, as well as strawberries, ohelo, poha, and raspberries. Torbert's Landing (Makena Landing) was the shipping point for potatoes--a distance of approximately three miles from the Plantation. Typically, five yoke of oxen drew a cart from the Plantation to the Landing in order to haul potatoes and molasses for shipment.

	A population of 80 persons lived in Honua'ula at this time. A review of the 1866 Alexander map indicates that the population may have primarily lived in the valley of Maluaka, Mooiki, Mohopilo, Mooloa, Moomuku, and Onau. Mr. White, a Maui resident for 46 years, remembers when 2,000 people lived "here."
1846	A map (circa, 1846) of Ulupalakua by Torbert indicates the presence of 10 structures along the shoreline from Halo to Makena; the location of his new road; the landing and shipping area; an aupuni landing and store house in a cove fronting Keawalai Church (which is also indicated); several residences adjacent to the church; several residences at Maluaka Point; two structures near Paako Point; a road called Aupuni Road along same alignment as Kihei Road except for portion of roadway which proceeds directly mauka from Keawalai Church area.
1848 - 1852	Records in State Archives indicate that a number of Caucasians were applying to the Minister of the Interior in order to purchase fee simple land in Honua'ula. Such applications are believed to be the result of the Great Mahele which occurred in 1848.
April 26, 1852	The meeting house (location unknown) in Honua'ula was blown down. In this report, Torbert wanted a New England Village house for a future meeting place. Torbert also wanted a Caucasian preacher in the area since Honua'ula was 22 miles from Wailuku; there were no constables; there were "bad" women; and liquor made of wild gooseberry (Poha) and sugar cane juices.
January 3, 1856	Torbert's Plantation and Landing were auctioned. The Plantation consisted of 1,087 acres of land; a 36 x 38-foot house with thatched roof; a cook house; well house; bath house; stone cistern of 700 bbls capacity; 40 x 40-foot mill house; a 40 x 28-foot drying house; two molasses with a 400 bbls (each) capacity; two 20 x 50-foot trash houses with grass roofs; a 50 x 22-foot carpenter shop; a blacksmith shop; and a 19 x 50-foot beef packing house. The Landing included one round store house (60-feet in diameter); a 10 x 12-foot dwelling; 26 oxen and four horses; carts and yokes; ploughs and agricultural instruments; as well as carpenter and blacksmith tools.

May 31, 1856	A resident of Honua'ula reports that he had no neighbors between their residence and Wailuku or Makawao. He traveled to Keokea in Kula on the Sabbath. Capt. Makee was now owner of Torbertsville. He was building a house and would be ready in two months.
September 10, 1859	On his trip to Ulupalakua, Charles Gordon Hopkins wrote that Torbert's buildings were being utilized by Makee. Approximately 100 acres were in sugar cane. Fine horses and cattle had been imported by Makee for his dairy and ranching operations. Slaughtered approximately 500 cattle that year. Native grasses were being supplanted by Spanish clover which thrived and was excellent feed; however, manienie was best, particularly for sheep. Makee had divided his property with stone fences for pasturing.
July 4, 1860	"Rose Ranch" (formerly Torbert's Plantation) had 175 acres of land in sugar cane. Hundreds gathered for a grand feast which was characterized by gun salutes; Germans, Swedes and Irishmen; horse races by men and women, piano playing and dancing of the quadrille, polka, lancer and schollsche.
1861	"Rose Ranch" consisted of 6,500 acres. 1,200 acres were in cane which was yielding approximately 2 tons/acre. Natives said cane had grown in this same area for the past 20 years. An improved road existed from the mill to the Landing. The road, from approximately the 2,000-foot elevation, was about 3 miles makai from the mill. On this road, two trips by a loaded team of oxen were made daily. A resident of the Honua'ula area visited a subterranean cave, about 50 feet deep, in which he found an uluhee.
July 27, 1862	From mauka springs, a pipe had been level to the Makee house which was some 1 1/2 miles below. No church was within 25 miles of Honua'ula.
July 4, 1866	A midnight salute of 21 guns and serenading by Hawaiians. Three hundred natives of the district (Honua'ula) paraded at 10 a.m. Sunset salute and fireworks for two hours. Fancy dress ball at 10 p.m. and supper at 1 a.m.

August 11, 1866

Resident of Honua'ula went up to the Puu Kaeo, Puu Olai, Keonehelu and other points to survey the Honua'ula lands.

There were approximately 850-900 acres of sugar cane on the Plantation. The 1866 W. D. Alexander map indicates that this cane was primarily grown from sea level to approximately the 3,500-foot elevation in the valleys of Keauhou, Kalihi, Waipao, Papaanui and portions of Kaeo.

A drive of about 500 cattle was made today.

August 14, 1866

With the help of Mr. Painter, who had helped Torbert survey the area 14 years ago, an old (survey) line was rerun again.

February 11, 1869

John Ravanage reported in a letter to his brother that the whole face of nature at Honua'ula seemed to be covered with weeds and rock. No green except for the lands under cultivation.

Mr. Ravanage was apparently a teacher at the school which the 1866 Alexander map locates to have been approximately 1,000 feet south of the Makee (now Erdman residence at Ulupalakua) place. Twelve students had enrolled for school which was to commence in March. Each student had to pay $2.50/month. Capt. Makee had promised to enlarge the school; however, he indicated that he would have to build his billiard room first.

July 27, 1869

The "Mary Ellen" is moored at Makena Harbor (Makena Landing area) and is about ready to sail.

August 14, 1869

The Advertiser reports that the Plantation was suffering from a drought on the lower cane fields while the upper fields were doing well. Nevertheless, 1,000 acres of cane was recently cultivated. Whitest sugar was now being processed at the mill with none found to be finer anywhere. During the past six years, the proprietor, Capt. Makee, had spent over one million dollars on his operation which had averaged 800 tons/year for four years. The fields could have easily yielded 1,200 tons/year if additional laborers would have been available.

Nearly 40 miles of stone and wire fences have been built throughout the Plantation.

August 16, 1871	Capt. Makee reported extensive damages to the mill and sugar operations in the area mauka of the project site by severe winds and rain. Along the shoreline, one store house and all native houses were blown down.
1873	Visitor reports that he arrived at Makena, and went ashore by canoe as the surf was too high for his boats. One of his guides, having been asked the time, drew a crude sundial of a cross in the dirt and placed a small stick upon what he estimated the meridian line. Utilizing these procedures, he observed where the shadow fell and gave the time pretty correctly.
April 7, 1874	Royal Party (Governor Kapena) from Lahaina arrived at Makena. The Party was met at the Landing by 80 torch bearers who escorted them up the hill to the Makee house.
	Plantation now yielding approximately 1,000 tons/year of sugar cane.
April 10, 1874	Capt. Makee, Governor Kapena and 150 men on horses (all bearing torches) assembled at Landing to meet the Kings and Queens of Maui and Oahu (including King Kalakaua and Queen Kapiolani).
September 16, 1879	Captain James Makee, the former seafarer from New England, died.
January, 1908	Eight-year old Inez (MacPhee) Ashdown moved to the Ulupalakua Ranch with her parents, Angus and Della MacPhee of Wyoming.
	The sugar mill was already in ruins and had probably been out of operation since, at least, the death of Captain Makee in 1879.
	The former Plantation was now used primarily for ranching.

Legends

Due to the timing of Inez Ashdown's work on this subject, no attempt has been made to discuss this aspect of the pre-historic life within the project site.

Land Use

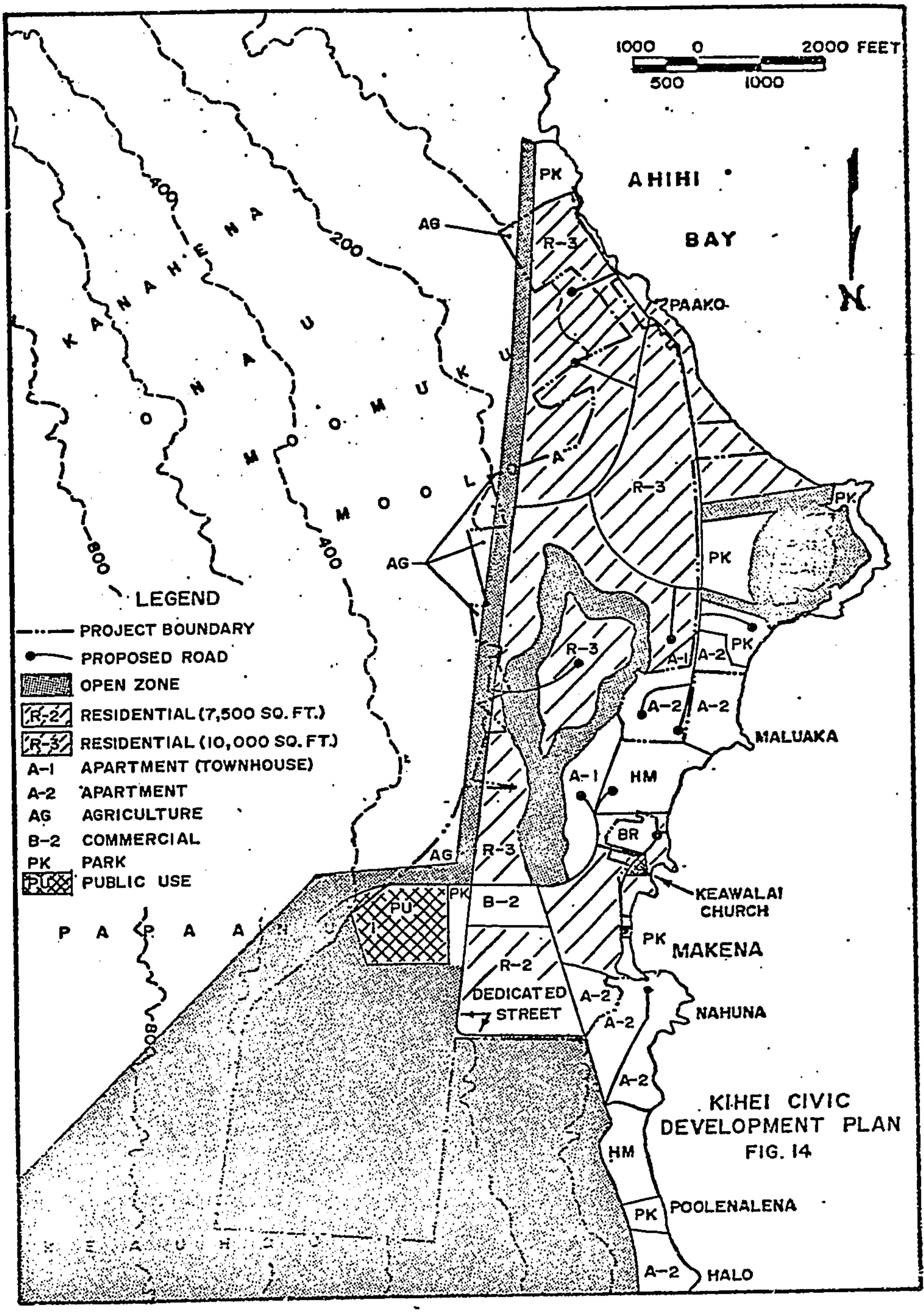
Land Ownership

As of January, 1974, Seibu Real Estate Co., Ltd. (SRECL) purchased or acquired rights to purchase the following parcels of land from Ulupalakua Ranch and other land owners in the Makena area:

Tax Map (Zone, Section, Plat & Parcel)	Approximate Acreage
2-1-05-86	11.4
87	7.4
81	16.3
26 (portions of)	452.0
2-1-06-27	8.759
36	7.531
37	5.794
58	4.523
59	6.450
2-1-07-60	1.149
56	1.024
2-1-08-01 (portions of)	507.162
	1029.492

County and State Land Use Designations

Figure 14 depicts the Maui County General Plan (Kihei Civic Development Plan) designations for the project site. Utilizing existing designations, the project site could be developed for the following land uses and densities:



KIHEI CIVIC DEVELOPMENT PLAN
FIG. 14

Land Use	Acres	Density (Total No. of Units)
Residential		
R-2	114.2	664
R-3	348.7	1,520
Apartment (Condominium)		
A-1	28.1	611
A-2	27.2	1,335
Hotel	28.7	2,032
Commercial		
B-2	15.4	---
B-R	5.1	---
Agriculture	13.4	---
Open Zone	399.8	---
Public Use	19.1	---
Park	14.3	---
Dedicated Streets	15.3	---
Total	1,029.4	6,162

The State Land Use Commission (SLUC) has designated the project site for "agricultural" uses. Under the SLUC agricultural designation, the following uses are permitted:

> Growing of crops, including but not limited to flowers, foliage, fruits, forage and timber;
>
> Game and fish propagation;
>
> Raising of livestock, including but not limited to poultry, bees, fish or other domestic animals;
>
> Farm dwellings, farm buildings, or activities or uses related to farming and animal husbandry;
>
> Public institutions and buildings which are necessary for agricultural practices;
>
> Public and private "open area" types of recreational uses including day camps, picnic grounds, parks, and riding stables, but not including dragstrips, airports, drive-in theaters, golf courses, golf driving ranges, county clubs, and overnight camps;
>
> Public, private, and quasi-public utility lines, transformer stations, etc., and appurtenant small buildings such as booster pumping stations, but not including offices or yards for equipment, material, vehicle storage, repair or maintenance, treatment plants and major storage tanks not ancillary to agricultural practices, or corporation yards or other like structures.

Retention, restoration, rehabilitation, or improvement of buildings or sites of historic or scenic interest;

Roadside stands for the sale of agricultural products grown on the premises; and

Buildings and uses, including but not limited to mills, storage, and processing facilities, maintenance facilities that are normally considered a direct accessory to the above-permitted uses.

In this regard, SRECL has petitioned the State Land Use Commission to redesignate the area for urban uses.

Present Uses of the Study Area

Residential/Commercial

Approximately 25 to 30 single-family dwelling units are within and makai of the project site. Most of the units are inhabited throughout the year while the remainder serve as vacation homes for absentee owners.

Shoreline Recreation

Within and makai of the project site, the shoreline and inshore waters are utilized for swimming (including body surfing) and sunbathing; pole, spear, and throw net fishing; pleasure boating; snorkeling; as well as picnicking and camping. This estimate is based on observations of human behavior from June 14 to July 7, 1974, and does not reflect intermittent seasonal trends which may occur.

Swimming

Swimming (including body surfing) and sun-bathing activity was observed along Makena, Naupaka, "Little" and "Big" Beaches; however, these activities were being performed primarily at Little and Big Beaches. The preference for these beaches was believed to result from their size, seclusion, and relatively good body surfing conditions throughout June and July, 1974. Maximum number observed swimming/sun-bathing during the study period, at any one time, were approximately as follows:

Beach	Maximum No. of Users (at any one time)
Makena	3- 5
Naupaka	10
"Little"	40-50
"Big"	70-80

Observations within the study area also indicate that activities participated in conjunction with swimming/sun-bathing were camping, picnicking, and snorkeling.

Pole, Spear and Throw Net Fishing

Pole, spear and throw net fishing primarily occurs along the shoreline and inshore waters from Makena Cove to the west end of "Big" Beach.

Pole fishing was more specifically observed during the study period to be participated in along the rocky shoreline just north of "Little" Beach and the inner northern shoreline of Makena Cove. Up to 20 fishermen were observed along the rocky shoreline north of "Little" Beach while some 6 to 7 fishermen were observed along Makena Cove. Local fishermen indicated that the rocky shoreline north of "Little" Beach is also frequently utilized at night for obtaining species such as mempachi. This activity was not observed to be performed in conjunction with other activities during the study period.

Spear fishing activities was only observed to occur in the inshore waters fronting Naupaka Beach. Only two persons were observed participating in this activity in conjunction with the camping along Naupaka Beach.

Throw net fishing by local residents at the area was observed along the inner southern shoreline of Makena Cove. Three young adults (14-16 years old) performed this activity in conjunction with pole fishing from nearby shoreline areas.

Pleasure Boating

Pleasure boating in the inshore waters was seen along the west side of Puu Olai where two boats were trolling from Puu Olai to Molokini. One sailing vessel also moored off the shore of "Big" Beach and combined boating with camping along the backshore of "Big" Beach. A home-made launching ramp is present at the site of the old Makena Landing; however, no small craft were observed launching from this area or any other site along the shoreline makai of the project site.

Snorkeling

Snorkeling activity was observed along Makena, Naupaka, "Little" and "Big" Beaches. Only several people were observed to participate in this activity throughout the study period. Primary participation in this activity was in conjunction with swimming and sun-bathing along "Little" and "Big" Beaches.

Picnicking and Camping

Both of these activities were observed along the backshore of "Big" and Naupaka Beaches. Picnicking (without camping) occurred along "Little" Beach in conjunction with swimming and sun-bathing. The greatest amount of this activity was seen along "Big" Beach in conjunction with swimming, sun-bathing, and snorkeling. It is believed that the greater desirability of this beach for swimming encourages camping here more than at other adjacent beaches, i.e. Naupaka Beach.

Ranching

At stated earlier, lands mauka of the project site, which are makai of Kula Highway between Keauhou and Kanahena, are a portion of some 3,000 acres owned by Ulupalakua Ranch. These lands support a few hundred head of beef cattle intermittently throughout the year as their use is dependent upon the condition of grasses and other plants for grazing. The Ranch considers these lands as "third rate" pasture land which cannot be feas-bly developed into highly productive pasture or other agricultural users.

In this regard, Ulupalakua Ranch has considered these lands for growing papaya, citrus and sorghum during the past few years. However, papaya was found to need fresher water than could be obtained from brackish wells. Citrus fruits such as limes, lemons and grapefruit would have only a "minor" growth potential due to soil type, fruit files, etc. The forage potential for sorghum, which could be a great supplement to pasturing in the area, could not be successfully grown on these lands because of, again, existing soil types, sporadic rainfall and no other readily available source of freshwater.

The Wailea Resort

The northern portion of the study area (adjacent to the project site), includes some 1,500 acres of land owned by Wailea Land Corporation. The Corporation has recently had its proposed amendment to the Maui County General Plan approved for hotel, duplex, single-family residential, apartments (condominiums), recreational, commercial area, and public uses on these properties. At the time of this report, the first phase of construction is already in progress. By the end of 1977, this phase will include the development of the following:

Land Use	Number of Units
Hotel	1,196
Apartment (Condominium)	480
Commercial	--- (100,000 sq. ft.)
Tennis Courts	14
Golf Courses (18-hole)	2

The ultimate, Wailea development, which is expected to be completed by 1990, is projected to include, at least, the following land uses, densities, and number of units (including first phase construction):

Land Use/Density		Number of Units
Residential		
R-1		233
R-2		224
R-3		216
D-2		397
	Subtotal	1,070
Apartment (Condominium)		
A-1		2,627
A-2		2,098
	Subtotal	4,725
Hotel		
H-1, H-2, and H-3		6,600
Commercial		---
School		---
Golf courses (4)		---
Tennis courts		---
	Total	12,395

Proposed Adjacent Land Uses

Proposed State Park

The Ahihi Bay-Puu Olai area (within, makai and mauka of the project site), has been recognized by park planners as a potential public recreational area for some 15 years (Territorial Park System, 1959; National Park Service, 1969; State Department of Planning Economic Development, 1969 and 1972; Maui County, 1973; Department of Land and Natural Resources, 1973). In light of these various proposals, the most recent action by any governmental body was a $350,000 appropriation, by the 1974 State Legislature, for the incremental acquisition of land and development of a master plan for a State Park.

Since no formal master plan has been prepared for this area by the State Department of Land and Natural Resources (DLNR), proposed uses of boundaries cannot be specified for the proposed State Park. However, on the basis of past recreational resource studies, it can only be concluded that the State of Hawaii has in the past, considered using some of the lands within the project site for public recreation. Within the past five years, DLNR has been appropriated monies for land acquisition and planning which could have been used for the proposed recreational area at Makena; however, Department priorities have shifted such funds for the development of other sites. Because of the delay in implementation of earlier proposals for land acquisition, DLNR is now faced with increasing land prices and recent purchases of land in the area by developers and land speculators.

Residential/Condominium/Speculation

A Honolulu Advertiser (7/14/74) review of State Land Use rezoning proposals throughout the State indicates that three separate investor groups have purchased a total of approximately 680 acres of land adjacent to the project site for residential and condominium development, as well as speculation. Each of these proposals is briefly described as follows:

Lawrence N. C. Ing of Honolulu proposes to utilize 1.25 acres at Makena (TMK 2-1-8:56) for the development of apartments. No schedule for development is known.

Arnold T. Abe, an attorney representing a hui of Japanese investors, indicates that a Japanese hui is considering the development of 670 acres adjacent to the northeast corner of the project site for single-family residential, townhouse, condominium and golf course development (TMK 2-1-8:56). At the present time, the hui is investigating the possibility of obtaining more adjacent lands for the same purposes.

A group of local investors have purchased eight acres of land (TMK 2-1-06:26) along Ahihi Bay. These lands are more specifically located on the Cape Kinau side of the proposed development program's R-2 residential area which also fronts Ahihi Bay. At the time of this report, no plans have been made for these properties. It is believed, however, that this hui is awaiting the construction of the proposed development program with hopes, at such time, to develop these lands or sell.

Socio-Economic Characteristics

Maui-Destined Visitors

Introduction

This section contains the general information depicting the number of visitors to Maui, their place of origin, their socio-economic characteristics, and possible trends.

Methodology

The basic data has been drawn from publications of the Hawaii Visitors Bureau. However, to depict the major points being considered, the data has been aggregated to some degree to eliminate small and/or insignificant quantities as specific entries. In general, the Hawaii Visitors Bureau data has been considered as sample data and has been converted to percentages within individual characteristics (age, sex, etc.) discussed. This was necessitated by failure of annual data on individual characteristics to match total visitors on annual basis, and because of the number of no responses appearing in each visitor characteristic.

In general, cross-section analysis has been applied to the years 1962 - 1967 - 1972. Although 1973 State wide visitor data has been released by the Visitors Bureau, 1972 was chosen as the final date to match the most recent Visitors Bureau publication pertaining specifically to visitors to Maui.

Where it is possible, data pertaining to military R&R travel has been eliminated as this travel is considered unique and therefore should be deleted from trend analysis (table 9).

TABLE 9

VOLUME OF R&R VISITORS ELIMINATED FROM CALCULATIONS

YEARS	WESTBOUND (Military)	EASTBOUND (Dependent)
1966	6,970	4,931
1967	70,150	50,174
1968	101,129	96,740
1969	116,327	129,776
1970	110,815	121,866
1971	46,029	44,162
1972	9,775	7,139
1973	801	484

Source: Donehower, 1974

Market

Maui is a "sub-market" of the visitor market of the State of Hawaii. Practically all of the current visitors to the State arrive by air transportation (Hawaii Visitors Bureau, 1974a). The only two airports in the State equipped to handle regularly scheduled service of the "jumbo" jets are Honolulu International Airport, Oahu, and General Lyman Field on the island of Hawaii. These two airports serve as the destination of regularly scheduled flights from the Mainland. Honolulu International Airport is the air "port of entry" for customs and immigrations, and, therefore, the terminus of all out-of-country originating flights arriving in the State. Accordingly, except for a small number of visitors who arrive directly on Maui by non-scheduled charter flights, Maui draws its visitors who have arrived on another island and been surveyed in the overall State visitors market (Honolulu Star Bulltetin, 1974a)[1]. Maui, in addition to being a destination for visitors from outside the State of Hawaii, is also a destination for a number of intra-state visitors.

Accordingly, the socio-economic characteristics of visitors to Maui will be analysed in three categories:

1. Westbound visitors to and beyond the State of Hawaii
2. Intra-state visitors
3. Eastbound visitors

---

[1] Such non-scheduled flights have occurred since at least 1961 when four airlines brought 3,000 visitors on economy tours direct from the Mainland (Honolulu Star Bulletin, 1962).

Considering the total of these visitors, since Statehood, the number of visitors to the State has increased each year. The annual State growth rate of visitors for the period 1958 - 1973 inclusive was 18.6 percent. During the period 1963 - 1973 inclusive, the annual growth rate of visitors to Maui was 20.5 percent (during the same period, the annual growth rate of the State was 17.9 percent) (Hawaii Visitors Bureau, 1974a; Allen, 1967).

Characteristics of Westbound Visitors

General

Westbound visitors to the State of Hawaii have, since Statehood, been the majority of the visitors (Hawaii Visitors Bureau, 1974a). The Hawaii Visitors Bureau statistics divided Westbound arriving passengers into those to Hawaii and those beyond Hawaii. As this division is considered to have little meaning for the Maui market, the two are combined into one statistic in developing the data that follows.

Number of Visitors Intending to Visit Maui

The number of Westbound arriving visitors who indicate they intend to visit Maui and the percent of total State arrivals are shown on table 10. This is, however, an unverified figure which must be assumed as correct.

TABLE 10

NUMBER OF WESTBOUND VISTORS INTENDING TO VISIT MAUI AND PERCENT OF TOTAL WESTBOUND VISITORS

YEAR	Number Intending to Visit Maui	Percent of Total Westbound Visitors
1962	61,320	21.9
1963	98,320	29.6
1964	130,795	32.5
1965	167,665	29.6
1966	183,395	26.7
1967	263,050	29.5
1968	327,155	32.2
1969	344,685	29.2
1970	397,260	28.8
1971	554,869	38.8
1972	710,100	39.8
1973	766,791	37.1

Source: Hawaii Visitors Bureau, Annual 1963-1974a inclusive

Sex

The male-female portion of visitors to the State, over time, runs approximately even (Hawaii Visitors Bureau, Annual). While the State market is calculated as 99 males arriving for each 100 females, the visitors to Maui in 1972 were divided as 80 males for each 100 females (Hawaii Visitors Bureau, 1973b).

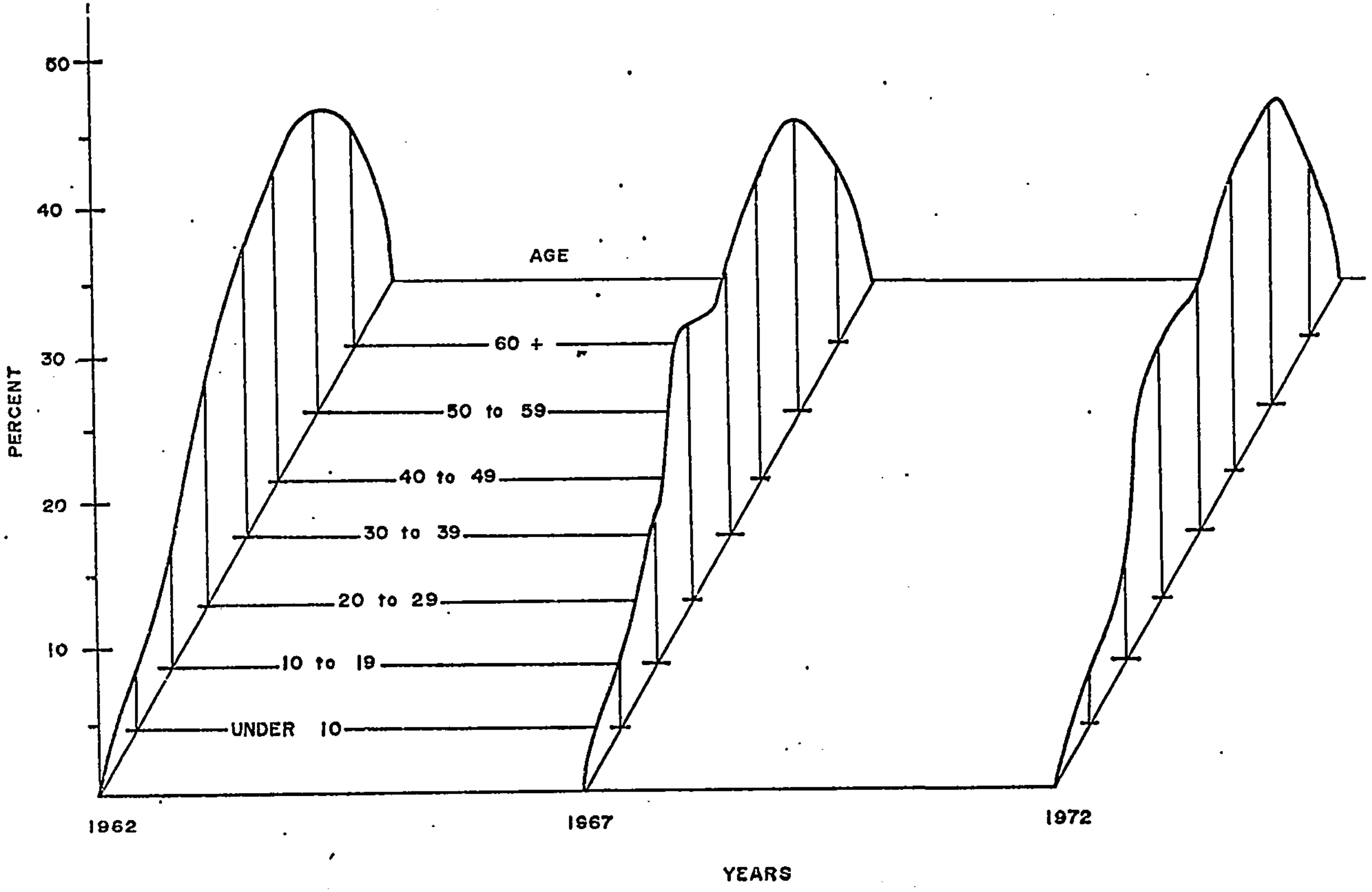
Age

Based on a cross section of the age distribution of westbound tourists, there is an indication that the Hawaii market is becoming a younger market. The major increase is a 3 percent increase in the 20-29 age group between the years 1962 and 1972 (Hawaii Visitors Bureau, 1963, 1968, 1973a). There are also traces of a bi-nodal curve being generated, over time, with peaks in the 20-29 and 50-59 age groups (figure 15). In the cross-section of Maui in 1972, these peaks appear for the same age groups but the 20-29 peak is of lesser magnitude than the State peak while the 50-59 peak is greater (figure 16).

Occupations

Cross-section analysis of the occupations of visitors to the State shows no radical change over time and approximately equals the distribution for 1972 (Hawaii Visitors Bureau, 1963, 1968, 1973a). The distribution of occupations of intended visitors to Maui does not deviate radically from the State distribution (table 11).

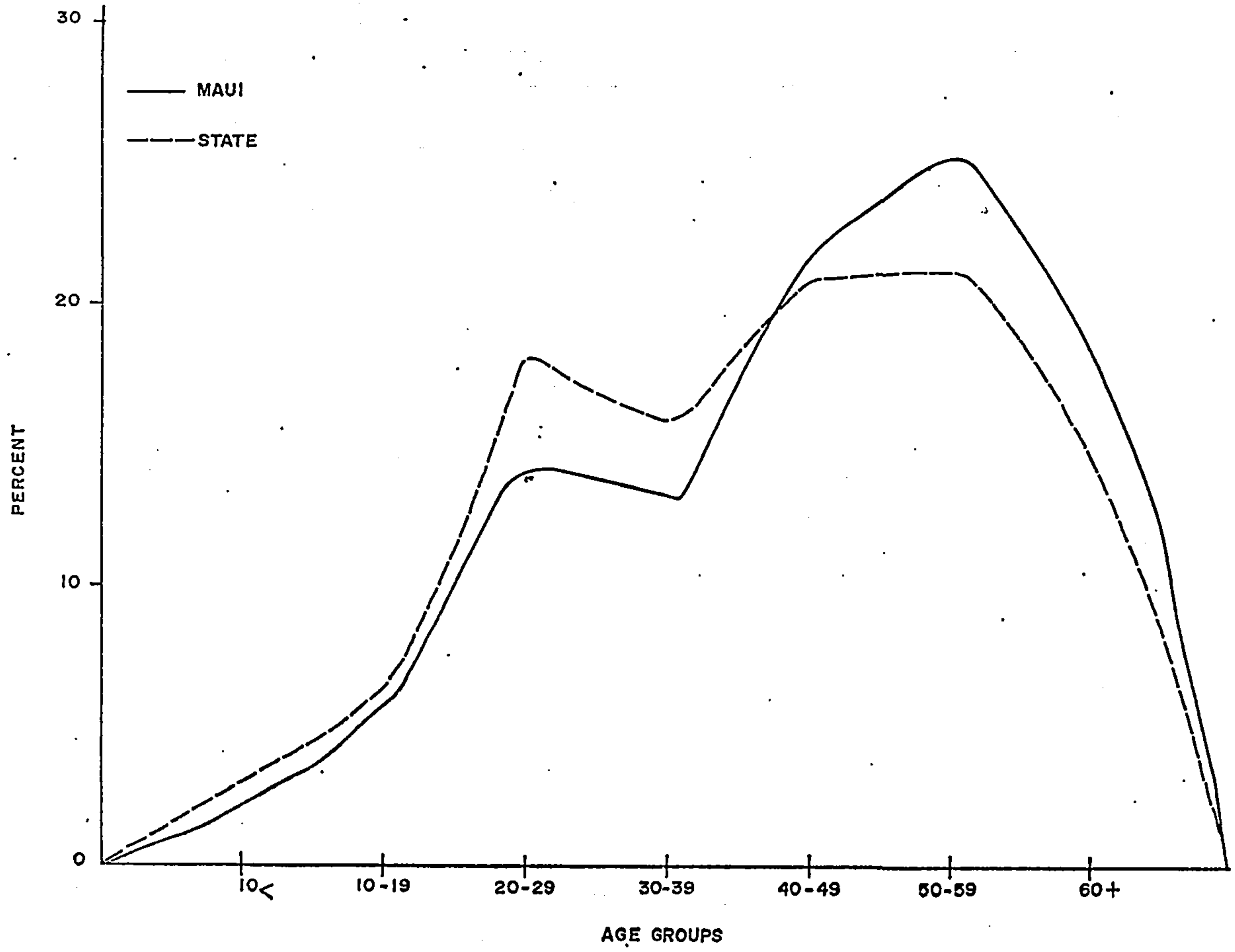
PERCENTAGE DISTRIBUTION OF AGE OF WESTBOUND VISITORS



SOURCE: HAWAII VISITORS BUREAU, 1963, 1968, 1973a

FIG. 15

COMPARISON OF PERCENT AGE GROUP DISTRIBUTION
BETWEEN VISITORS TO THE STATE AND INTENDED VISITORS TO MAUI — 1972



SOURCE : HAWAII VISITORS BUREAU, 1973b

FIG. 16

TABLE 11

PERCENT DISTRIBUTION OF OCCUPATION OF PARTY HEADS OF VISITORS TO THE STATE INTENDED VISITORS TO MAUI - 1972

Occupation	Total Maui	Percentage Distribution	Total State	Percentage Distribution
Visitors to				
Totals	259,785	100.0	598,375	100.0
Professional and Technical	83,935	33.6	188,950	33.1
Business, managerial, official	69,690	27.9	147,905	25.9
Clerical, office, sales	28,200	11.3	67,940	11.9
Military service	1,205	0.5	6,245	1.1
Other employed	18,305	7.3	45,110	7.9
Military dependent	1,165	0.5	6,855	1.2
Retired	33,460	13.4	66,015	11.6
Student	6,070	2.4	20,900	3.7
Other non-employed	7,700	3.1	21,610	3.8
No answer	10,055	----	26,845	----

Source: Hawaii Visitors Bureau, 1973b

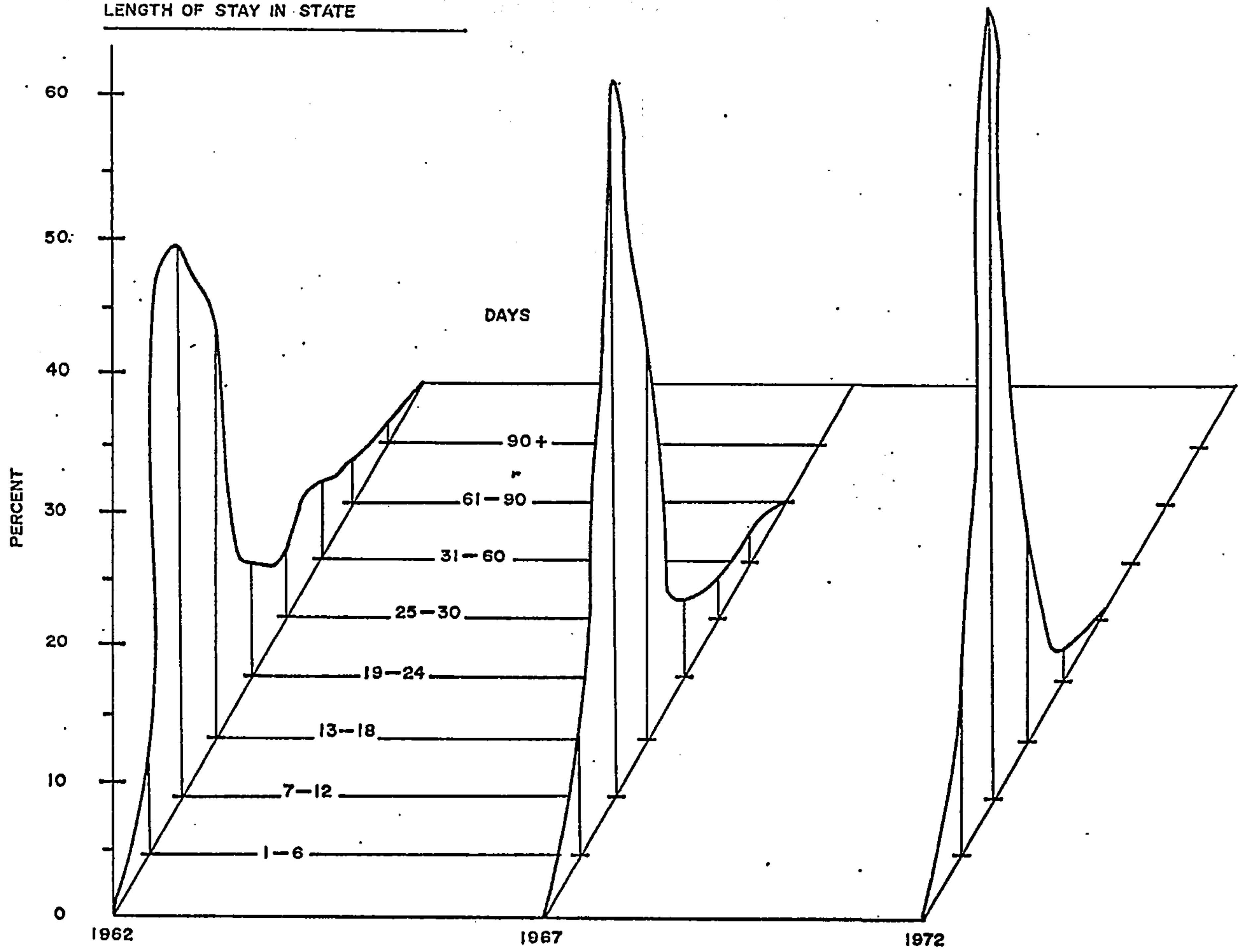
Length of Stay in Hawaii

Since the percent of visitors to Maui going beyond Hawaii has not, in the period 1962-1973, inclusive, exceed a 4.0 percent of the total visitors to Maui, visitors beyond Hawaii will be excluded when considering the length of stay in the State of visitors visiting Maui (Hawaii Visitors Bureau, Annual).

The length of stay of visitors to the State shows great changes in the 1962-1973 period (figure 17). The number of visitors staying over 60 days, has almost vanished during this period. Similarly, the percent of visitors staying the State between 19 and 59 days has shown a marked decrease. On the other hand, those staying 1 to 6 days has risen about 4 percent, while those staying 7 to 12 days has risen about 17 percent. However, even with these internal changes, the majority of the visitors to the State fall within the 7-18 day period throughout the span of years analysed (Hawaii Visitors Bureau, 1963, 1968, 1973a).

In 1972, just about 90 percent of the visitors to Maui were drawn from the visitors to the State in the 7-18 day period. Further, the visitors to Maui from the 19-24 and 25-30 day groups did slightly exceed the State distribution for these groups. There is also an indication that the proportion of the Westbound visitors' time spent in Maui is increasing. The average length of stay in Maui was reported as 2.97 days in 1970, 3.08 days in 1971 and 3.16 days

PERCENT DISTRIBUTION OF INTENDED LENGTH OF STAY IN STATE



SOURCE: HAWAII VISITORS BUREAU, 1968, 1973a, 1973b

FIG. 17

in 1972 (Hawaii Visitors Bureau, 1971, 1972, 1973b). It can be said the current visitor is staying three days and two nights in Maui.

Tours Versus Individual Travel

Over the period 1967 to 1972, the number of persons arriving in the State in tour groups has increased about 10 percent, while those travelling as individuals have decreased about the same number of percentage points (Hawaii Visitors Bureau, 1968, 1973a). The number of visitors to Maui travelling in tour groups in 1972 is about 8 percent above the State average (Hawaii Visitors Bureau, 1973b) (figure 18).

Intended Type of Accommodation

In considering intended type oc accommodations, the intransit count is omitted from the recalculated total. Intransits are considered to remain in the State one day (Hawaii Visitors Bureau, 1973a). As they remain in the State only one day, they are not considered candidates for the Maui visitor market. Over time, the four types of accommodations considered (for the State)--Hotel or Hotel-Apartment, Rented Home or Apartment, Friend or Relative, or Other, have shown little change between 1967 and 1972 (table 12). The intended use of Rented Homes or Apartments has stayed about constant. Intended use of Hotels has risen 4 percent, but this appears logical considering the increased use of tours. Accommodations with Friends or Relatives, and Other Accommodations have decreased.

TABLE 12

PERCENTAGE OF VISITORS INTENDING TO USE VARIOUS TYPES OF ACCOMMODATIONS FOR THE STATE AND COUNTY OF MAUI, 1972

ACCOMMODATIONS	PERCENT OF VISITORS AND YEAR		
	State		Maui
	1967	1972	1972
Hotel or Apartment Hotel	85.3%	89.2%	92.9%
Rented Home or Apartment	.7%	.8%	1.1%
Friend or Relative	10.8%	8.5%	4.9%
Other	3.2%	1.5%	1.1%

Source: Hawaii Visitors Bureau, 1968, 1973a, 1973b

For Maui, in 1972, the percentage of visitors using Hotel accommodations is above the State level. This appears logical as the percent of visitors visiting Maui on tours is larger than the overall State percent. The lower percent associated with staying with Friends or Relatives appears logical considering the small population of Maui. However, what does not appear logical is the closeness of the Maui and State percents for Rented Home or Apartment Accommodations. It appears that the effect of the large numbers of condominiums on Maui that are suspected to be in the rental market is somehow lost in these statistics. No firm statements can be made on this subject. However, it appears, considering constructed units, present construction and planned construction, condominiums on Maui will have a very definite effect in the future on the type of accommodations visitors to Maui intend to use.

Number of Trips of Party Heads

Based on 1962, 1967 and 1972 cross-sections, the number of repeat visits to the State by the party heads is increasing. In 1962, the ratio was 2.12 first visits for every repeat visit; it dropped to 1.98 to 1 in 1967 and to 1.44 to 1 in 1972. The largest internal change in repeat visits between 1962 and 1972 was an approximately 3.4 percent increase in visitors making four or more trips to the State (Hawaii Visitors Bureua, 1963, 1968, 1973a). For Maui, in 1972, the ratio of first visits to repeat visits was 2.23 to 1, higher than the State ratio. The number of repeat visits to Maui in all classes (2d, 3d, and 4th or more visits) is below the

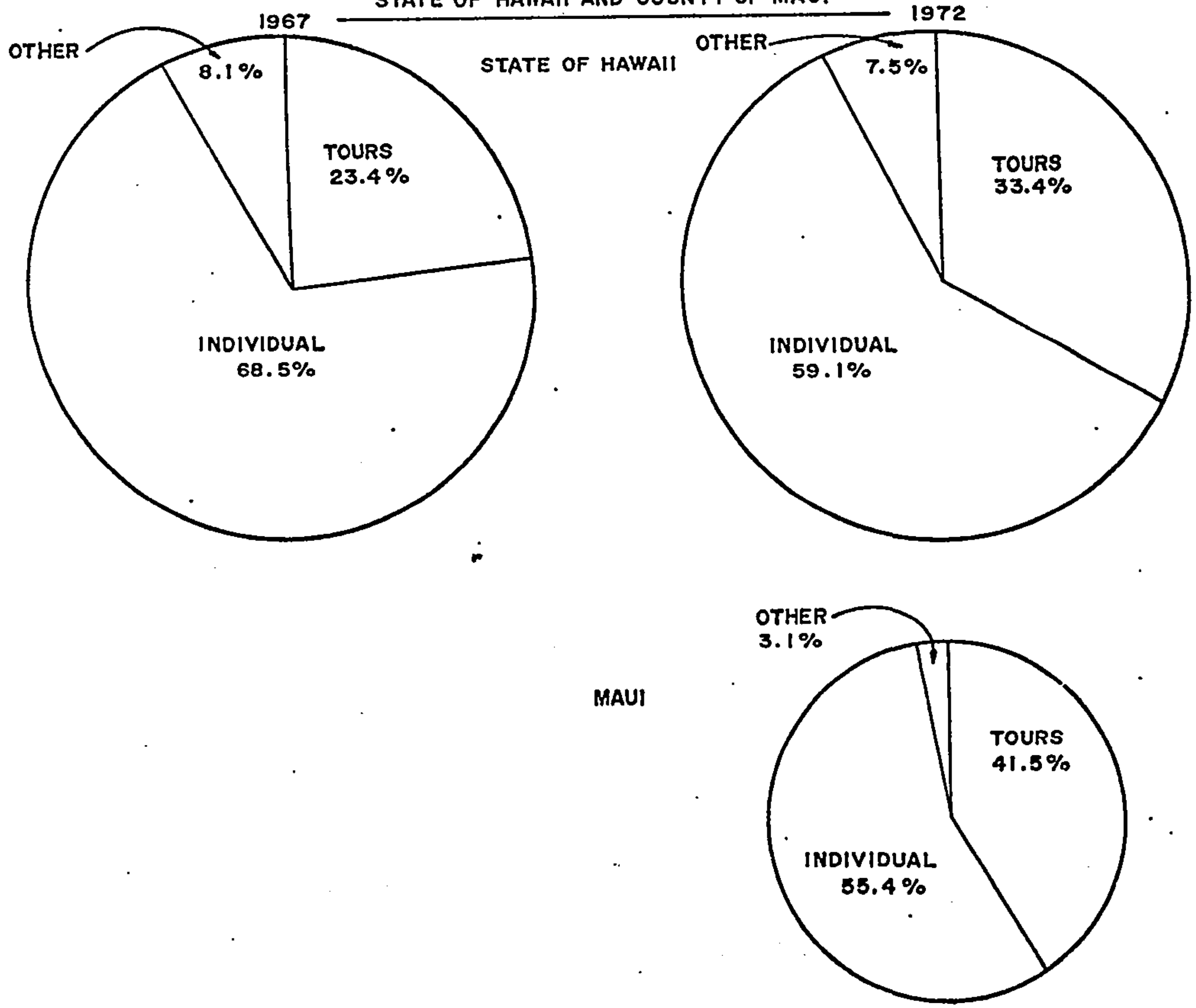
TABLE 13

PERCENTAGE OF PARTIES BY SIZE VISITING THE STATE AND COUNTY OF MAUI

Party Size	State	Maui
1 person	47.5%	35.5%
2 persons	45.5%	57.2%
3 persons	3.1%	3.3%
4 persons	2.5%	2.6%
5 or more persons	1.4%	1.4%

Source: Hawaii Visitors Bureau, 1973b

TOURS VERSUS INDIVIDUAL AND OTHER TRAVEL
STATE OF HAWAII AND COUNTY OF MAUI



SOURCE: HAWAII VISITORS BUREAU, 1968, 1973a, 1973b

FIG. 18

Purpose of Trip

Visitors coming to Hawaii are considered to come for one of five reasons: Pleasure and Business; Business, Government and Military; Visit Relatives; and Attend School or Other Reasons. Over time, the purpose of visits to the State has been predominantly for pleasure. 1962-1972 inclusive, the number of visitors arriving on pleasure visits increased approximately 6 percent in the total State percent of arriving visitors. In 1972, visitors arriving for pleasure accounted for over 70 percent of the arriving visitors. The percentage gain was at the expense of visitors arriving for business, government or military purposes which decreased about 7 percent over the time period. The percentage of visitors arriving for the other purposes generally remained constant over the time period considered.

The pattern of visitors to Maui differs from the State pattern. Approximately 80 percent of the visitors to Maui are purely for pleasure purposes. Those arriving for business and pleasure and attending school or other reasons remains about the State percent for these categories. The business, government and military category runs far below the State percent with 1.8 percent for Maui to 8.1 percent for the State in 1972. This appears logical in view of the small number of business, government (Federal and State) agencies in Maui. Also, the percent visiting Maui to visit relatives is below the State percent. Again, this appears logical due to the small population on Maui.

TABLE 14

DEMAND FOR HOTEL ROOM ON MAUI UNEXPLAINED BY WESTBOUND TOURIST VISITS

	YEARS										
	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Hotel Room on Maui 1	821	1190	1456	1635	1910	2285	2643	2940	3942	3976	5109
Times Average Annual Occupany Rates 2	62.7	65.9	63.9	63.5	71.1	71.6	67.1	66.7	66.9	70.6	76.5
Equals Room Fully Occupied on Annual Basis	515	784	930	1032	1358	1636	1773	1961	2637	2807	3908
Times Room Density of 1.8 Percent per Room Equals Census of Hotel Occupants 3	927	1411	1674	1858	2444	2945	3191	3530	4747	5053	7034
Visitors Intending to Visit Maui 4	98320	130795	167665	183395	263050	327155	344185	397260	554869	710100	766791
Times Percent Intending to Stay in Hotels 4	83.1	83.4	90.1	87.1	84.9	84.6	83.2	84.0	84.9	89.0	89.3
Equal Hotel Demand by Westbound Vistors	81704	109083	152575	159737	223329	276773	286778	333698	471084	631989	684744
Times Average Number of Nights in Maui (2) 5	163408	218166	305150	319474	446658	553546	573556	667396	942168	1263978	1369488
Divided by 365 Equals Daily Census of Westbound Visitors in Hotels	448	598	836	876	1224	1517	1572	1829	2582	3463	3752
Census of Hotel Occupants	927	1411	1674	1858	2444	2945	3191	3530	4747	5053	7034
Minus Census of Westbound Visitors in Hotels	448	598	836	876	1224	1517	1572	1829	2582	3463	3752
Equals Number of Unexplained Hotel Occupants	479	813	838	982	1220	1428	1619	1701	2165	1590	3282
Percent of Hotel Occupancy Not Accounted for by Westbound Visitors	51.2	57.6	50.9	52.9	49.9	48.5	50.7	48.2	45.6	31.5	46.7

Sources: 1 Hawaii Visitors Bureau, 1974; 2 Bank of Hawaii, 1974; 3 Hawaii, 1972; 4 Hawaii Visitors Bureau, Annual, 1963-1973; 5 Hawaii Visitors Bureau, 1973.

Intra-State Visitors to Maui

An analysis of room occupancy on Muai discloses a large occupancy not accounted for by Westbound visitors. This has been calculated by using the hotel rooms available in February each year as reported by the Hawaii Visitors Bureau (Hawaii Visitors Bureau, 1974a). The number of people occupying hotel rooms was estimated. Subtracted from this was the demand for hotel rooms occasioned by Westbound visitors to Maui. The residual represents other demands for hotel rooms on Maui. The expanded formula and calculations are shown on table 14. These calculations show that there is an occupancy of 40-50 percent of the hotel rooms on Maui not attributable to Westbound visitors to Hawaii.[2] The most logical explanation is that these rooms are occupied by intra-State visitors to Maui plus some Eastbound visitors. At present, no detailed State-wide statistics are maintained on the movement of either of these groups. However, as will be discussed later, it is believed little demand is generated by the Eastbound visitors. Therefore, it is

---

[2] It is considered there are two imperfections in the calculations which are believed to compensate for each other. New hotel rooms are phased into the calculation in a block at the start of the subsequent year. Therefore, a particular year's inventory of hotel rooms is understated and all calculations based on existing hotel rooms will be understated to some extent. Accordingly, the denominator used to obtain the percent of occupancy by Westbound tourists should be larger and the percent of occupancy unexplained by Westbound visitors larger.

On the other hand, the percent of visitors occupying hotels is based on the State demand. Earlier, it has been shown the hotel demand in Maui is higher than for the State. This will increase the numerator used to obtain the percent of occupancy by Westbound tourists.

considered that intra-State visitors account for a considerable percent of the room occupancy on Maui.

Eastbound Visitors

These are visitors arriving from Asia or Oceania. They arrive predominantly by air transportation (Hawaii Visitors Bureau, 1973a). They are not required to complete the State of Hawaii agricultural declaration form. Therefore, their characteristics are not gathered by the State, as they are for Westbound visitors. However, Honolulu International Airport is an air "port of entry" for customs and immigrations, so some statistics on these visitors are prepared.

The annual growth rate for Eastbound visitors, for the period 1958-1973 inclusive, was 12.0 percent. A growth rate that was less than that of the Westbound visitors over the same period. When R&R travel has been deleted, Eastbound arrivals for 1968 were 197,598. By 1973, the annual number of Eastbound visitors had almost tripled with 562,290 arriving that year with R&R travel removed. This represents an annual growth rate of 19.0 percent, while in the same period, Westbound arrivals increased at an annual growth rate of 12.4 percent (Donehower, 1974; Hawaii Visitors Bureau, 1974a).

In 1973, of the 562,300 arrivals, at least 300,000 were estimated as being from Japan (Hawaii Visitors Bureau, 1974a). Of these, it is estimated about 12.6 percent (37,800) visited Maui. The average length of stay on Maui was 1.7 days. Approximately one-half stayed on Maui only during the daylight hours of one day. The other half remained 1 to 3 nights (Hawaii Visitors Bureau, 1974a). The number of Eastbound Japanese visitors visiting Maui is calculated as 5.8 percent of all out of State visitors visiting Maui.

The socio-economic characteristics of these Eastbound Japanese visitors and their effect on State and local economies is relatively unknown at this time. A special study of these socio-economic characteristics is attached as Appendix D.

In summation of Appendix D, the Eastbound Japanese visitor is generally a younger and possibly less affluent visitor than the Westbound visitor and he comes for pleasure. He arrives in a tour package, remains generally with his group while here, spends the bulk of his time and money on Oahu, participates heavily in organized activities, stays for a shorter time than the average Westbound visitor, and currently, if he visits an Outer Island, he probably visits Kauai. There are indications that although the past several years have shown large annual increases to Hawaii, this travel may be leveling off and that future annual increases will not be as great as in the past.

Activities

Maui is historically and scenically different from Oahu. Also, Maui serves two visitor markets, visitors from out of state and intra-state visitors. Further, the span of activities on Maui is not as diverse as on Oahu. Lastly, activity organization on Maui differs from activity organization on Oahu.

The activities of visitors from out-of-state and intra-state overlap in some areas and diverge in others. Scenic and historical tours are participated in by both groups. The intra-state tourist uses his own or rental transportation; the more affluent out-of-state tourist does the same; but many tourists travelling with tour groups use tour bus transportation. Organized tours are generally restricted to sights in the Kahalui-Wailuku area, Haleakala, and the Kaanapali-Lahaina area. Those with rented or private transportation cover a wider area. Most of the first time visitors visit Haleakala and Lahaina. Many on tours visit Lahaina on the first day on Maui as a "fill" while hotel rooms are being remade between occupants.

Lahaina possesses a variety of souvenir shops, historic sites, food and beverage dispensers, and an aquatic base, Lahaina Harbor. Other than Lahaina, the hotels, which are generally not in towns, have internalized tourist attractions and activities. Shops, restaurants, bars, swimming pools, beaches and out-of-door games are incorporated in the various hotels. In the case of Kaanapali, the complex is augmented by a shopping center which includes shops providing subsistence and souvenir needs, as well as sight-seeing attractions. This internalization of activities at isolated hotel sites, as well as Lahaina's limited facilities, reduces the out-of-state visitor's contact with Maui over the contact he experiences in Honolulu. It is considered the intra-state visitor, because of increased mobility, has greater contact with Maui than the out-of-state visitor.

There are two activity areas where visitor participation in Maui probably exceeds similar activities on Oahu. The first is golf; many fine courses are adjacent to the visitors' destination and are thus more used by both out-of-state and intra-state visitors. The second is Lahaina's aquatic base which is readily available and provides fishing, skin and scuba diving, sailing, surfing and aquatic sight-seeing. Although out-of-state visitors generally do not avail themselves of the more active sports, a larger portion are considered to fish, sail and aquatic sight-see than participate in these activities on Oahu. However, a number of intra-state visitors will participate in these as well as skin and scuba diving and surfing.

Maui's public beaches are not as developed as Oahu's; the majority of the beach activity of the out-of-state visitor is mostly concentrated in the private areas of the hotels. The intra-state visitor is likely to roam to other beaches for wading, swimming, surfing, and other related water sports.

Lastly, there is considered to be a lack of diversified evening activities available to all visitors.

Conclusions on Socio-Economic Characteristics of Maui-destined Visitors

Maui is both a sub-market of the State's visitor market, and a market in its own right. As a sub-market of the State's visitor market, it draws visitors from both the Westbound and Eastbound segments of the State's market; however, visitors from the Westbound market currently, and in the foreseeable future, predominate. The number of Eastbound visitors to Maui will increase. First, just because of the increase in their numbers, but probably at a slower rate. Second, it is conceivable Maui hotel operators will find them a means of increasing the percentage of total hotel occupancy which is currently below Oahu. Finally, it is conceivable that this source of visitors will be used to level-off hotel occupancy during slack periods.

Although Maui is a sub-market of the State's Westbound market, it is not a duplicate market. It appears to match the State market only in the similarity of the distribution of occupations of party heads to both areas. It deviates from the State market in that

1. More females than males visit Maui
2. There is a greater demand for hotel rooms on Maui than in the State market
3. There are more return visits to Maui than in the State market
4. More people travel to Maui in two persons parties than in the State market
5. More people travel to Maui in a tour status than in the State market
6. More people come to Maui purely for pleasure than in the State market
7. Activities, generally, are more limited on Maui than on Oahu.

The socio-economic characteristics of the intra-state market are obscure. However, this market appears to absorb a large share of Maui's tourist facilities. Further research in this area is recommended.

It generally appears from analysis of time series, that the Maui market for out-of-state visitors reacts to changes in the State out-of-state visitor market. However, the appearance of changes in the Maui market are lagged at least several years behind the changes in the State market.

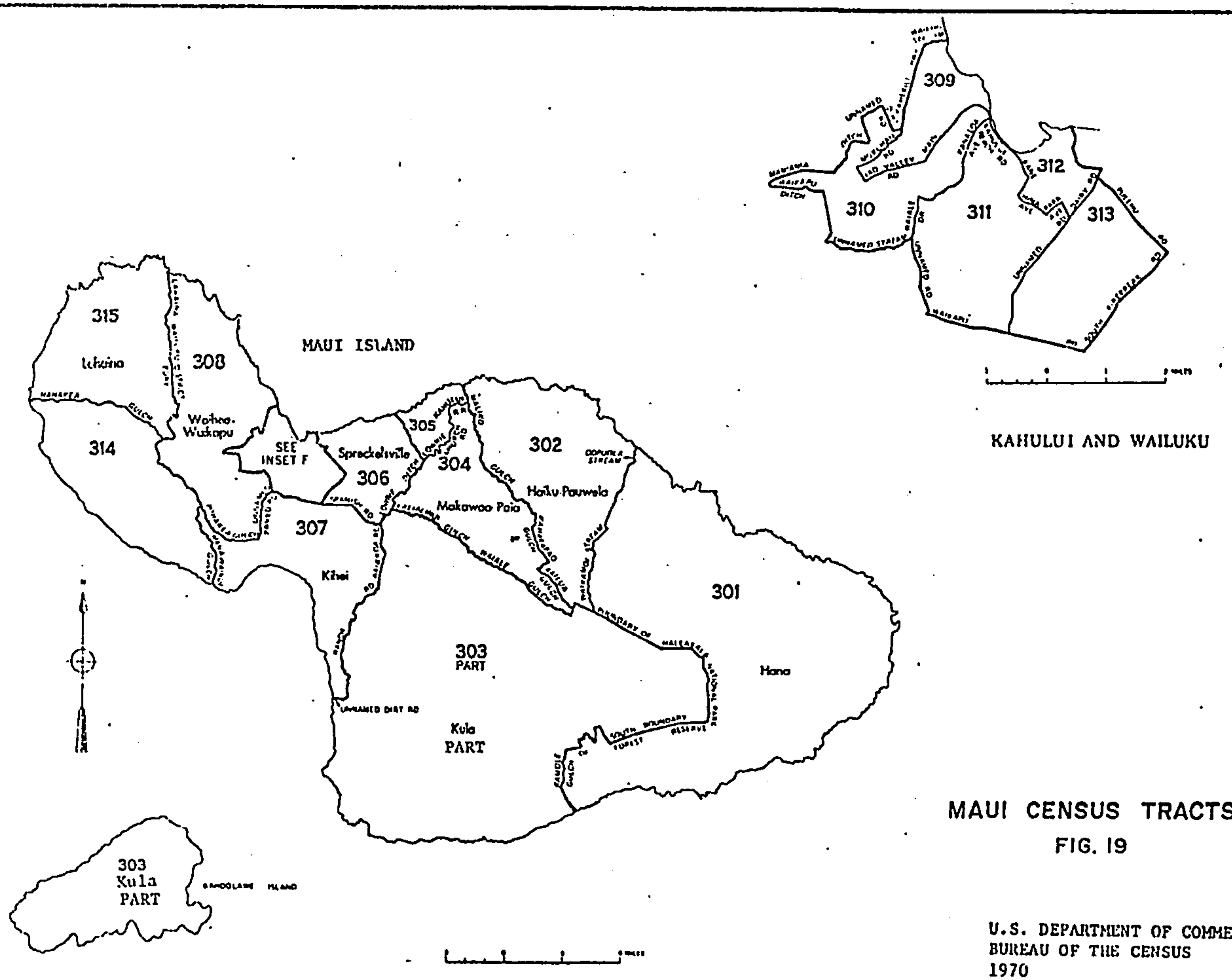
Kihei-Kamaole Residents

Residents that will be affected by the proposed development reside in two census tracts. They are Kihei, Tract 307 and Kula, Tract 303. The proposed development is in the Kula Tract (figure 19). Along the coast, the dividing line for the two tracts is the dirt road which goes inland (Mauka) from Makena. Therefore, the majority of the present population is in the Kihei census tract and this will be the only tract discussed (Hawaii, 1973). In this tract, the population is largely concentrated along the shoreline from the intersection of routes 31 and 35 to the area of the Wailea Golf course--a distance of about seven miles.

Census and Growth

The population of Kihei was 1097 in 1960, or 3.0 percent of the population of the island of Maui (Bureau of Census, 1961; Hawaii, 1973a). In 1970, the population had increased to 1,636 or 4.2 percent of the population of the island (Hawaii, 1973a). Between 1960 and 1970, this is a positive increase, for the Kihei area, of 51.6 percent.

Analysis of population changes in the Kihei Tract, based on voter registration and school attendance, shows the increase commenced around the year 1968 (ONACA, 1974; Hawaii, 1974a). During the



MAUI CENSUS TRACTS

FIG. 19

U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
1970

year 1968 to 1970, it is estimated the annual growth rate was between 10 and 13 percent. Between the years 1970 and 1973, it is estimated the growth rate increased to about 16 percent. On the basis of the latter growth rate, the population of the Kihei Tract, in 1973, is estimated as about 2,360 (Allen, 1967).

Age and Sex

In 1970, the median age of the Kihei population was 27.5 years; there were 861 males to 775 females, 483 households and the average persons per household was 3.34.

Income and Sources of Income

In 1969, the median family income for Kihei was $8,291 for 391 families. This was below the median family income for the County of Maui which was $9,643 and below the median income for the island of Lanai which was $8,826. It approximated the median income of the island of Molokai which was $8,286 (Hawaii, 1972b).

In 1970, there were 504 paid workers and 8 unpaid family workers in the Kihei Tract (Hawaii, 1972b). This figure has undoubtedly risen since that time with the population increase in the Kihei area. The employment of the 512 workers by Industry and Occupation is shown in table 15.

TABLE 15

INDUSTRY AND OCCUPATION OF WORKERS, KIHEI TRACT - 1970

Industry	Workers	Percent
Total Workers	512	100.0
Construction	23	4.5
Manufacturing	107	20.9
Transportation	5	1.0
Communications & Utilities	22	4.3
Wholesale Trade	10	2.0
Retail Trade	20	3.9
Finance, Insurance & Real Estate	35	6.8
Business & Repair Services	10	2.0
Personal Services	107	20.9
Health Services	18	3.5
Educational Services	29	5.7
Other Professional Services	4	.8
Public Administration	31	6.1
Other Industries	91	17.8
Occupation		
Total Workers	512	100.0
Professional & Technical	77	15.0
Managerial & Administrative	41	8.0
Sales Workers	9	1.8
Clerical Workers	51	10.0
Craftsmen & Foremen	111	21.7
Operatives	17	3.3
Laborers, exclusive of farm	31	6.1
Farm Workers	47	9.2
Service Workers	124	24.2
Private Household Workers	4	.8

Source: Hawaii, 1972b

Employment and Wages Earned Within and Outside the Kihei-Kamaole-Wailea Area

Employment opportunities in the Kihei-Kamaole-Wailea area have increased since 1970, but still are very limited. In 1974, there existed in this area:

Two "mama-papa" stores
Three gasoline stations
One post office
Two golf courses
Two car rental agencies
Six restaurants
Four cocktail lounges
One jewelry store
Two gift shops
One liquor store
Two apparel shops
Six or seven real estate agencies
One elementary school
Fourteen hotels, hotel apartments and condominiums (Hawaii Visitors Bureau, 1974c; Visitors Publication, 1974).

An estimate of employment requirements for the Kihei Tract can be made using the average employment for similar establishments in Maui County and multiplying these on an establishment basis based on the above list of establishments in Kihei (table 16) (Bureau of the Census, 1972b). If the labor force in the Kihei Tract grows at the same rate as the population (16 percent annually), the current

TABLE 16

ESTIMATED EMPLOYMENT KIHEI TRACT
1974

SIC	ESTABLISHMENT TYPE	Number 1/ in Maui	Employment 1/	Average Employment	Number in Kihie	Estimated Employment
599	General State	21	78	4	2	8
75	Gasoline Stations	28	198	7	3	21
---	Post Office				1	4 2/
79	Golf Courses	13	90	7	2	14
751	Car Rental Agencies	16	109	6	2	12
597	Jewelry Store	14	79	6	1	6
599	Gift Shop	21	78	4	3	12
599	Liquor Store	21	78	4	1	4
56	Apparel Shops	24	122	5	2	10
65	Real Estate Agencies	58	704	12	7	84
821	Elementary School	13	69	5	1	5
---	Hotels, Apartment Hotels and Condominiums	242	2645	11	14	154
58	Restaurants and Cocktail Lounges	67	1009	15	4	60
58	Restaurants	67	1009	15	2	30
	Total					424

1/ Bureau of the Census, 1972

2/ Kanemoto, 1974

labor force is estimated as about 800. A current recurring demand for workers in the Kihei area is estimated at about 435 workers. This excludes the demand for construction workers which is considered, over time, to vary from place to place. Accordingly, it is estimated that approximately 50 percent of the labor force available in the Kihei area currently is employed out of the area. It appears from the calculations in table 16 that the more skilled (professional-technical, craftsmen-foremen) do not have employment opportunities in the Kihei Tract. Accordingly, it is concluded they commute to employment locations in other areas on the Island of Maui.

Unemployment

During the years 1969-1972 inclusive, Maui County and the Island of Maui have had a larger percent of their labor force unemployed than for the State overall, or for any of the other counties (table 17) (Hawaii, Annual). The 1970 census reported unemployment in the Kihei Tract as exceeding the percentage for the County of Maui and thus exceeding the percentage for the State of Hawaii (Hawaii, 1972b).

Conclusions

Income to the Kihei Tract is low, while unemployment in the tract is high. Even with the expansion that has occurred in the area since the 1970 census, excepting construction, employment opportunities currently available will absorb only about 50 percent of the available labor force. It appears that the more skilled and thus higher paid (professional-technical, craftsmen-foremen) are employed in location on Maui other than in the Kihei Tract.

TABLE 17

PERCENT OF LABOR FORCE UNEMPLOYED

LOCATION	PERCENT			
	1969	1970	1971	1972
Oahu	2.6	3.5	5.0	5.8
Hawaii	3.1	3.2	5.5	6.0
Kauai	3.3	4.0	4.9	6.3
Maui (Island of Maui)	3.8 (3.5)	5.3 (5.0)	6.5 (6.1)	7.5 (6.9)
State	2.7	3.7	5.1	6.0

Source: Hawaii, Annual

CHAPTER V

ENVIRONMENTAL IMPACT AND RELATED RECOMMENDATIONS

INTRODUCTION

The proposed development program would, or could potentially, cause effects upon topography, soils, utilities, sound pressure levels, water and air chemistry, terrestrial and marine ecology, history/archaeology, as well as land uses within the project site and adjoining study area. Effects upon the greater tributary area would be in terms of land use trends and economic considerations. Thus, only those environmental aspects believed to be subject to some impact are discussed in the following paragraphs. Data providing the rationale for non-impact evaluation on other aspects of the project site, study area and tributary area can be obtained upon request.

Due to the preliminary assessment of environmental impact prior to the preparation of preliminary design plans and specifications, Chapter V also includes feasible recommendations to the developer and government agencies, for 1) minimizing environmental impact; and 2) assessing future potential impacts which cannot be assessed until additional baseline information is obtained, or until preliminary design drawings are available.

PHYSICAL CHARACTERISTICS

Alteration of Land Forms

In order to implement the development program requirements, extensive grading of the area would be required. Such grading, for the purpose of this discussion, would include all clearing, excavation, and filling expected to be undertaken in conjunction with construction of the roadway system; utilities; golf courses; and site development for the residential, commercial and hotel areas. Such grading would be required for each phase of the development and for individual sub-projects as they are constructed.

The impact of the grading operations would be the removal of almost all existing vegetation and topsoil in areas to be developed since all lands within the project site would be recontoured to meet the final design slopes and elevations. A short-range secondary impact (during construction) resulting from grading operations would be the creation of noise and dust from construction equipment (see section on sound levels within the study area). Such conditions would exist almost continuously throughout the 4 to 5 year construction period.

Without the benefit of an existing grading plan, it is estimated that cuts and trenches could exceed 20 feet; however, these would be backfilled to alleviate safety and aesthetic problems.

Recommendations

1. As discussed under the Chapter V drainage section, a grading and sedimentation control plan should be prepared to provide for water and wind erosion measures.
2. As recommended in the section regarding sound levels within the study area, the secondary impact resulting from increased noise during construction could be reduced by the use of safety equipment for construction workers, especially heavy equipment operators.

Drainage

Introduction

For the preliminary investigation of this development, the total drainage basin was analyzed by individual drainage basin as in figures 5 and 20. Table 18 shows the rate of rainfall runoff that can be expected from the drainage basins for a 50-year, 24-hour storm.

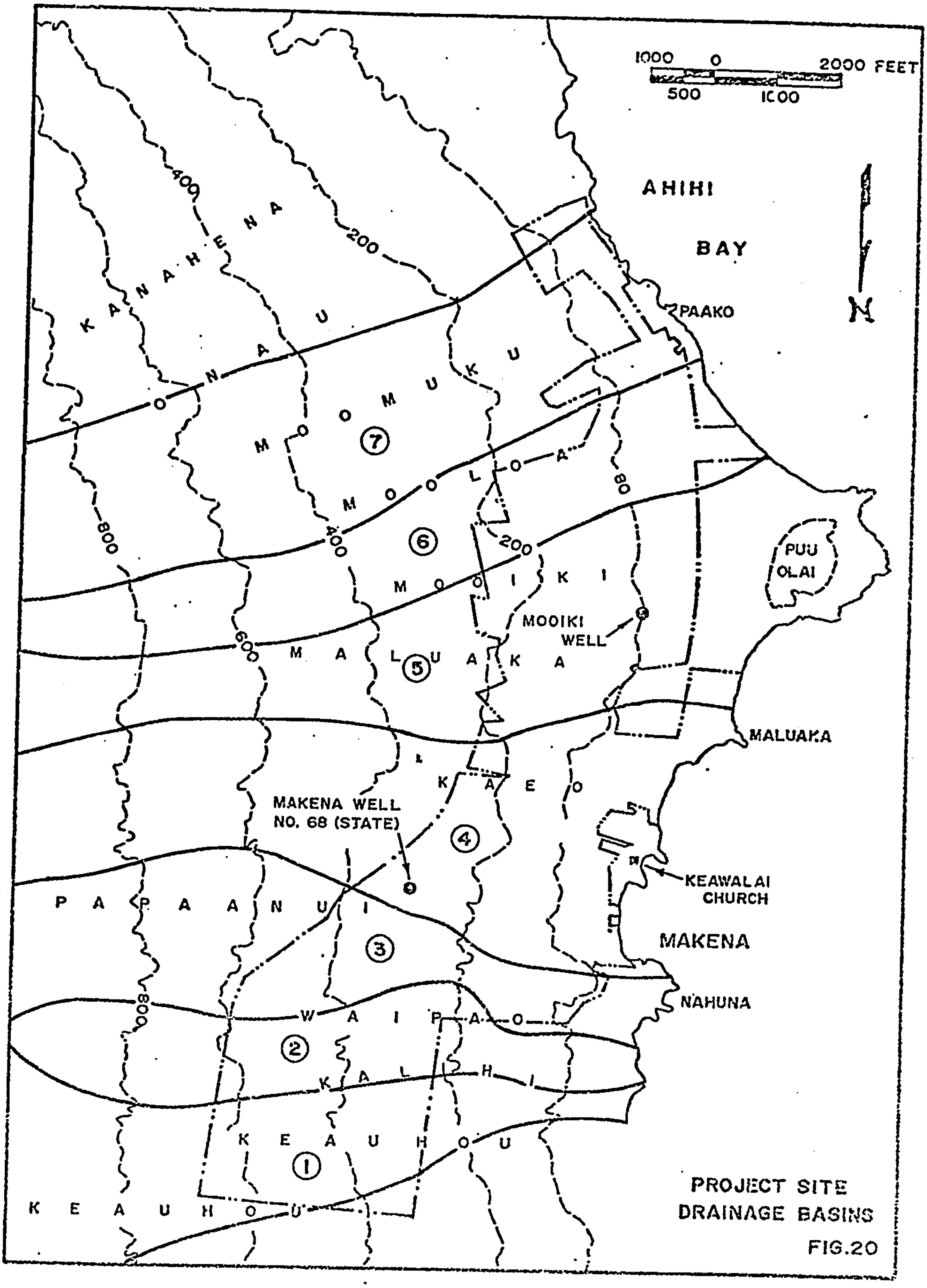
The Soil Conservation Service method of estimating rainfall runoff rates and volumes was utilized since the drainage areas were less than 2,000 acres in size. The area has only one natural drainage channel, with the remaining runoff flowing generally in "sheet flows" to the ocean. The 50-year, 24-hour rainfall runoff is about 8 inches for the total drainage basin. For the Uma soils which generally occur above the 2,500-foot elevation, it was assumed that negligible runoff under natural conditions would occur due to its excessive permeability (20 inches/hour).

For the runoff volume, a 10-year, 24-hour rainfall of 6.5 inches was used with the Soil Conservation Service method of estimating rainfall runoff volumes. The basic assumptions made for the SCS methods were:

a. The area from sea level to 1,000-foot elevation consists of woodland with a thin stand, poor cover and no mulch;

b. The area from 1,000-foot elevation to 2,500-foot elevation consists of pasture or range in poor condition;

c. An Antecedent Moisture Condition 1 indicates that the lowest runoff potential is prevalent.



PROJECT SITE
DRAINAGE BASINS
FIG.20

TABLE. 18

STORM RUNOFF QUANTITIES FOR THE TOTAL DRAINAGE BASIN

		Basin Area						
		1	2	3	4	5	6	7
	ACRES	971	256	830	874	855	363	1083
BEFORE DEVELOPMENT	Runoff Rate (cfs)*	525	78	418	392	342	101	547
	Runoff Volume (mg)*	45.8	7.6	39.2	36.2	29.5	10.8	44.0
AFTER DEVELOPMENT	Runoff Rate (cfs)	672	233	695	991	579	511	679
	Runoff Volume (mg)	50.1	12.2	47.1	52.2	37.8	21.0	49.6

*cfs = cubic feet per second
mg = million gallons

Using the boundaries of the proposed project (figure 20) an estimate of the rainfall runoff quantities for each individual drainage area, after development, was computed and is shown in table 19.

The project site drainage basins were considered as individual basins with the same boundaries existing after development as before. Since these basins were relatively small in size and the land usage within them varied, the Rational Method was used for the runoff rates. The SCS method for computing runoff volumes was used in light of the following assumptions:

a. The project site drainage basin areas were considered separate drainage basins with the same boundaries existing after development as before;

b. The golf course was considered hydrologically similar to a meadow;

c. All other development was considered to be hydrologically similar to a farmstead;

d. No roadways were considered;

e. An Antecedent Moisture Condition II, indicating an average runoff potential, existed (due to golf course irrigation); and

f. During development, grading and slope changes would be minimal.

Assumptions "a" - "d" are made in light of the fact that runoff curve numbers have yet to be developed for these land usages while assumptions "e" and "f" are made since no detailed development plans are available for this study.

The resulting quantities are very rough estimates only and should not be used for design purposes; however, they can afford some idea as to the

TABLE 19

STORM RUNOFF QUANTITIES FOR THE PROJECT SITE

	Basin Area	1	2	3	4	5	6	7
BEFORE DEVELOPMENT	ACRES	97	107	150	309	199	154	83
	Runoff Rate (cfs)	53	33	76	139	80	43	42
	Runoff Volume (mg)	2.9	3.2	4.4	9.2	5.9	4.6	2.5
AFTER DEVELOPMENT	Runoff Rate (cfs)	200	188	353	738	317	453	174
	Runoff Volume (mg)	7.2	7.8	12.3	25.2	14.2	14.8	8.1

type of change in runoff which could be affected by the proposed development.

Storm Runoff

The development of the project site would affect runoff characteristics of the project site in terms of:

1. An increase in storm runoff quantities;
2. Alteration of the type of storm runoff flows; and
3. Alteration in final deposition of storm runoff waters

Each of these primary impacts are discussed separately in the following paragraphs while their related impacts are considered in a subsequent section concerning chemical characteristics. .

Increase in Storm Runoff Quantities

Tables 18 and 19 show that the proposed development program would cause a 80 percent increase in the 50-year storm runoff rate of the total drainage basin, and a 420 percent increase in the runoff rate of the project site. The increase in the 50-year storm runoff rates for both the total drainage basin and the project site would result from the development of apartment, commercial and residential areas in which roofs and pavements would be constructed. At the same time, the well-grassed areas of proposed golf courses and public parks would be expected to contribute less runoff than existing conditions prior to construction of the proposed development.

Alteration of the Type of Storm Runoff Flows

Implementation of the proposed development program would bring about the construction of generally impervious roadways and roof systems which would tend to direct and channelize runoff throughout the project site. Channelized runoffs are in contrast to existing "sheet flows" within the natural drainage basins.

Alteration in the Final Deposition of Storm Runoff

Under present conditions, excess runoff flows directly in sheet flow into the coastal waters, or settles in the low lying areas of the drainage basins where it either seeps into the groundwater or evaporates. With an increase in runoff quantity and an increase in the development of the permeable low lying areas of the project site, the amount of areas required for "natural" deposition of runoff is substantially reduced. As a result, other methods of dispersion, i.e. ocena outfalls, seepage ponds, drywells and pond holding areas, must be employed to handle the estimated 500 acre-feet of runoff produced by a 50-year storm.

Soil Loss

Introduction

Soil loss quantities computed for the project area are shown in table 20. The quantities were based on available Master Plan information concerning the proposed development program and were computed under the following assumptions:

TABLE 20

SOIL LOSS QUANTITIES FOR THE MAKENA PROJECT SITE

	Basin Area						
	1	2	3	4	5	6	7
	BEFORE DEVELOPMENT						
Soil Loss (tons/yr)	464	512	718	1486	955	742	399
	AFTER DEVELOPMENT						
Soil Loss (tons/yr)	180	205	246	519	391	193	100
	DURING CONSTRUCTION						
Soil Loss (tons/yr)	2738	3019	4234	8765	5633	4376	2351

a. Before development:

1. The site is considered to be woodland, poorly stocked and unmanaged;
2. The project site is characterized by Makena soil; and
3. Soil deposition areas occur at least every 800 feet.

b. During construction:

1. The equivalent of 0.10 of each basin area within the site would be left bare for one year;
2. No ground cover would be used on the bare soil;
3. No grading standards would be utilized; and
4. No slope changes were considered.

c. After development:

1. Ground cover would be sod grass or fully established grass seedlings for golf courses; and
2. For all other development, 1/2 the area would be covered in sod and 1/2 pavement or concrete, i.e. no soil loss).

Since no detailed development plans were available and soil loss computation techniques have not yet been developed for all land usages, the quantities established are to be considered a rough estimaet of actual soil movement and should be used as a general indication of the potential amount of soil loss.

Impacts Resulting From Soil Loss

Table 20 indicates the potential amounts of soil loss which could result as the proposed project would progress through the development process. Soil loss problems involve (1) the amount of soil which could be lost due to storm runoff; and (2) the final deposition of the soil. As is shown, soil loss, in light of the assumptions given, would be greatest during the construction period when large ground areas would be devoid of protective cover for periods of time. However, after development, soil loss is projected to decrease due to the ground cover offered by the grass, garden, buildings and pavement which the development would bring.

The final deposition of the soil is a major concern during the construction period. If seepage areas or ponds are used for the deposition of runoff waters, and no erosion controls are used, the amount of sediment accumulated could be substantial. If such sediment were to drain into coastal waters makai of the project site, secondary impacts would be imposed on the marine biological community. This subject is more specifically addressed in the Chapter V section regarding Biological Characteristics.

Recommendations for Reducing the Effects Upon Existing Drainage

1. In light of the three types of impacts which would affect the existing drainage characteristics of the project site, special consideration must be given during the design stage to insure that:
    1. No flooding would occur during a 50-year storm; and that
    2. Direct runoff into coastal waters would be minimized.
2. A grading and sedimentation control plan should be prepared and should include, at least, the following water and wind erosion control measures:

1. Maximum grading area limits;
2. Erosion control and runoff water disposal devices such as terraces, berms, ditches, culverts, subsurface drains, sedimentation basins and erosion control planting, mulching, sprigging and sodding; and
3. Wind erosion and dust control measures in conformance with the air pollution control standards and regulations of the Department of Health.

Utilities

Access and Traffic

As indicated in Chapter III, thru-traffic within the project site would be re-routed through a 120-foot wide mauka road which would be situated roughly around the perimeter of the proposed Phase I golf course. Such re-routing would "necessitate" present Makena residents, living adjacent to the shoreline, to ultimately drive their vehicles mauka and through the proposed development in order to drive south of Makena. Such conditions are in contrast to the present, direct access afforded by the continuous Kihei Road.

Utilizing 1971 traffic estimates (State Department of Transportation, 1971) for the Kihei-Ulupalakua Road and traffic projections made for the present study (see section regarding "Sound Levels Within the Study Area"), it is estimated that the proposed development program would, during morning peak hours, generate 2,462 VPH by 1980 and 4,924 VPH by 1990. Project 1980 traffic is an increase of existing conditions by a factor of 10 while 1990 traffic projections show an increase of existing (1974) traffic volumes by a factor of 20. In conjunction with additional traffic generated by the Wailea Resort and other nearby developments in Kihei, the proposed development program would generate approximately 3,633 VPH during morning peak hours in 1980 and increase to 5,135 VPH by 1990.

Correlation of 1990 morning peak hour traffic projections, prepared for the preceding noise impact analyses, with State Department of Transportation (DOT) 1993 morning peak hour estimates for Kihei Road and the proposed Kihei-Ulupalakua Road, shows that DOT expects substantially fewer vehicles than those suggested by the present study. Even though each set of estimates was determined by utilizing different methods of projection, it is, nevertheless, believed that existing DOT estimates do not adequately reflect the amount of future traffic generated by the Wailea Resort. As a result, they were not utilized in the present study except for comparison. However, due to the timing of such projections, it is understandable that DOT projections do not consider:

1. Recent estimates of phasing and densities proposed by Wailea Land Development Company; and
2. The entire development program proposed by Seibu Real Estate Company, Ltd.

Thus, existing projections by DOT for its proposed Kihei-Ulupalakua Road could result in the development of a highway which could, potentially, be totally inadequate to meet traffic flows immediately after its construction.

Water

The development of a water system for the project would impact on the total water available on Maui for public use. Water must be transported from the West Maui source to the project site to meet the peak demand of the estimated 4.23 million gallons per day. Again, without this water transfer, the project cannot proceed unless the alternative treatment of the local basal lens source is undertaken. Specifically, the project would cost about $13 million which, as stated earlier, would be expended for water source development and transmission line installation off the project site. In this regard, $2,965,000 of the total off site development would initially be borne by SRECL; however, 85 percent of the initial SRECL contribution would eventually be recovered through County revenues obtained from the project site. Such costs would include a catchment or collection system while the transmission system would require both a pipeline and pumping stations.

Within the project site, the development of transmission lines, storage tanks, and pumping stations would be installed along roadways. Preliminary estimates indicate that approximately 54,000 linear feet of transmission line, ranging from 8 to 20 inches in diameter; two pump stations; and storage reservoirs for 4.23 million gallons would be required for the project. As stated earlier, construction of the water supply system on the project site would be by SRECL, and, upon completion would be dedicated to the Maui County Board of Water Supply for operation and maintenance. Revenue for such operations and maintenance are obtained from water supply charges to users.

Wastewater

As stated earlier (Chapter III), wastewater from the proposed project would be pumped to a treatment plant located (figure 3) near the mauka boundary of the project site. From the treatment plant, an ultimate average of 2.0 million gpd of treated effluent would be utilized for irrigation water on the golf courses or be dishcarged into emergency injection wells which would only be used during any breakdown or maintenance of the irrigation system.

The reuse of treated effluent on the two golf courses and/or discharge of treated effluent into injection wells could cause an increase in the ground water discharge by 1) the leaching of treated effluent used for irrigation; and 2) the, less likely, seepage of effluent from deep injection wells. The primary impact of a potential increase in the ground water discharge could also result in secondary and tertiary impacts which could, potentially, dilute seawater with a potential increased combination of additional freshwater and nutrient ions. The following impact of such dilution is discussed more fully in a following Chapter V section regarding marine ecology.

Another impact of the discharge of treated effluent into the basal lens (through injection wells) is the probable influence on the quality of such waters (Tenorio and Young, 1970). Such changes may make the use of waters from the basal lens more or less desirable as a water resource, i.e. reduction in salinity or increases in nutrient values.

Power and Communication Systems

Electric Power

The projected power requirements suggested by the proposed development program would be substantial and would greatly impact Maui Electric Company's development program as additional generating capacity would have to be made available to support the project.

On site power transmission would be installed underground in conjunction with the streets and sidewalks. One exception would be above ground street light standards which would be required with an underground system.

Television

The demand for cable television is expected to be high for this project. Impact of additional lines would be minimized by providing underground ducts in conjunction with the telephone and electrical service.

Aesthetics

It is subjectively believed that the proposed development program would be enhanced by the installation of all power and communication lines underground.

Recommendations

1. The State Department of Transportation, Highways Division, should update its projections for the proposed Kihei-Ulupalakua Road in order that the proposed roadway can be designed to adequately service the Kihei-Makena area.
2. In conjunction with the sewage plant treatment design, it is recommended that a ground water study be conducted to determine the effect of deep well injection discharges on the ground water table. The objectives of this study would be:
   a) Determine the geologic formation of the subsurface strata affected by the proposed wastewater injection by determining the porosity and

permeability of each defined strata; the potential existence of faults, fractures, cavities and lava tubes; and identification of permeable layers.

b) Determine base line hydrologic and water quality characteristics of the affected ground water table.

c) Establish specific capacities or recharge rates for the proposed injection wells.

d) Determine probable rates and directions of movement of the injection fluids.

3. In conjuncton SRECL's commitment to install all utilities underground, SRECL should work closely with all private and public utilities to insure that any structures associated with utilities, i.e. power substration, which might be constructed within the project site, be designed to minimize the intrusion often associated with such facilities.

Sound Levels Within the Study Area

Introduction

Analysis of the total noise impact of the proposed project includes essentially three geographic area: the project site, neighboring residences, and those properties along roadways which would serve the project site. Each of these areas are considered under two basic time frames--the construction phase and the conditions after project completion.

The Construction Phase

Noise from construction would have the greatest impact on the now quiet, unoccupied areas back from the beach. Bulldozers doing clearing and grading typically cause 85 dBA at a 50-foot distance. This noise level decays about 6 dBA with each doubling of the distance if there is direct path transmission. Thus, at a distance of 1,600 feet, the noise level from a bulldozer would be about 55 dBA and would be slightly audible above the background noise level if it was 55 dBA, L_{50}. Those residents living close to the beach with high, natural background noise levels would have less intrusive noise from construction. New residents occupying housing away from the beach during the construction of other units would experience a higher level of intrusive noise. However, if the housing units are air-conditioned, the interior noise levels would generally be acceptable for ordinary indoor activities when the construction noise is present.

Residents living along roadways to the project would experience increased noise exposures during the construction phase due to the transporting of materials and personnel. Diesel powered trucks typically cause 80 to 90 dBA at 50-foot distances depending on the type of truck, how it is operated, and how it has been maintained. If the proposed mauka road (Kihei-Ulupalakua Road) is in existence at the time of construction, the residents living along Kihei Road could be spared the noise of trucking involved with construction.

After Project Completion

The primary noise sources resulting from the ultimate proposed development would be from motor vehicles. In the following section, a traffic analysis is given to estimate motor vehicular movement in the project and on feeder roads. For example, it assumes that 1,720 autos leave the complex for the new mauka road while 742 autos exit on the makai road at morning peak hour. The traffic volume within the project was based on the distribution of housing units and the assumption that approximately 70 percent of the movement involved the new mauka road and 30 percent the makai road. Assuming that an average speed of 30 mph would exist within the project during peak hour, the dBA, L_{50} noise levels at a distance of 100 feet from the roadways are shown in Figure 6 in the triangles. The noise prediction technique of the Highway Research Board, 1971 was used. The impact of motor vehicular noise can be estimated by comparing the numbers of triangles with the background noise contours. For example, at the exit road to the new mauka road, 50 percent of the time, vehicular noise would exceed 61 dBA. This is well in excess of the natural background noise level of 35 dBA. The peak hour traffic noise would decay about 4 dBA in open areas when the distance is doubled; thus, at 200 feet from the road, it would be 57 dBA; at 400 feet--53 dBA;

at 800 feet--49 dBA; at 1,600 feet--45 dBA, etc. In those areas where the road runs close to the beach, the impact of traffic noise would probably be less because of the higher natural background noise and the lower traffic volume.

In the following section regarding "Traffic Analysis for Noise Predictions," predicted traffic volumes and development activity within the study area by Wailea Land Corporation and Seibu Real Estate Company, Ltd., are correlated in order to 1) predict the future traffic noise impact of the study area, and 2) to assess the future amount of traffic noise generated by the proposed development program itself.

It can be seen that in both 1980 and 1990, the predicted increase in noise level, due to the proposed development program, would be 4 dBA or less along the presently populated regions of Kihei Road. The greatest impact would occur at the entrance to the Seibu property at the makai road in 1980 where very little traffic would exist if there was no development. The increase in traffic noise level along feeder roads in 1990 should always be less than 3 dBA. Such small increases in noise levels are considered to be barely perceptible, and, therefore, the development itself should cause negligible impact with respect to traffic noise along the roads servicing the project after the Kihei-Makena area develops.

The preceding analyses of traffic noise are based on the assumption that noise from automobiles would dominate over truck and bus noise. For the traffic volumes assumed, this is consistent with the techniques of the Highway Research Board, 1971. However, if old, large, noisy diesel powered busses are purchased from the mainland for use by tour agencies, the annoyance to residents along the roadways inside and outside of the project could be much greater.

Traffic Analysis for Noise Predictions

Introduction

The most recent known state traffic study for the Kihei-Makena area was made by the State Highway Division in 1971, and did not reflect the many rapidly developing projects that now exist. Therefore, in order to more realistically estimate the impact of traffic noise caused by the Seibu development, a short independent study has been made.

A rigorous study of the area requires a general traffic and transportation study for the rapidly developing Island of Maui. This is not included here, but it is believed that the approach taken is acceptable to assess traffic noise impact because:

a. At the most, traffic noise level is approximately proportional to 20 times the logarithm (base 10) of the traffic volume in vehicles per hour. Doubling the traffic volume increases the noise level by only 6 decibels at the most. Thus, there is not a high sensitivity of traffic noise level to traffic volumes.

b. The noise impact is based on the relative difference between the traffice volumes with and without the Seibu development, not an absolute traffice volumes.

c. The Kihei-Makena area is not situated such that the volume of through traffic is not great and most of the traffic is generated by the land uses within the area.

This traffic study does not account for existing single dwellings in the area because the associated traffic volumes and noise levels are masked by the traffic related to the large number of condominiums and the new developments.

General Assumptions on Traffic

The primary assumption is that the project site would be developed to the maximum densities indicated in figure 3. It is further assumed that there would be two vehicles associated with units of R-1, R-2, R-3, and duplex housing. For apartment units (A-1 and A-2), it is assumed there would be 1.25 vehicles associated with each unit. It is assumed that these units are utilized 100 percent of the time. At peak traffic hours, it is assumed that 30 percent of these resident vehicles would be in motion. Furthermore, to account for non-resident traffic related to development in the area, an additional 10 percent of the resident vehicle population is assumed to use the road systems in the area. This activity would be related to business or employment and use of accessory facilities, i.e. commercial areas, golf courses, and public beaches. Thus, for condominium apartments (A-1, A-2): 1.25 x 0.4 = 0.5 VPH/unit and for single dwellings and duplexes (R-1, R-2, R-3, D-2): 2.0 x 0.4 = 0.8 VPH/unit at peak hour.

Hotel units in destination resort projects are assumed to maintain 70 percent occupancy. Eighty percent of the tourists are assumed to rent automobiles while 20 percent use busses. It is assumed that 34 percent of the rented autos associated with destination hotel units would be in motion during peak hour, therefore: 0.70 x 0.80 = 0.19 VPH/unit.

Assuming 1.8 tourists per unit, and that 50 percent of the guests uses busses during peak hour, then the number using busses during peak hour is: 0.70 x 0.20 x 0.50 x 1.8 = 0.126 tourist/unit. Assuming an average of 40 tourists per bus, then: 0.126 ÷ 40 = 0.003 busses/unit at peak hour. For example, a 1,200 unit destination hotel would cause 3.6 busses to be active during a typical peak traffic hour.

It is assumed that at peak hour 70 percent of the vehicles would head east to use the new mauka road (Kihei-Ulupalakua Road) and 30 percent would head west to use Kihei Road. Thus, parameters to estimate traffic volume are given below:

	VPH/UNIT AT PEAK HOUR	
Type of Unit	Mauka Road	Makai Road
Single or Duplex R-1, R-2, R-3, D-2	0.70 x 0.8 = 0.56	0.30 x 0.08 = 0.24
Apartment A-1, A-2	0.70 x 0.5 = 0.35	0.30 x 0.05 = 0.15
Hotel	0.70 x 0.19 = 0.13	0.30 x 0.19 = 0.06

Area Development Predictions

In the Kihei area there are presently 1,362 condominium or hotel units exclusive of the Wailea project in operation or will be in operation by October, 1974. This conclusion is based on an October, 1972 count (Environment Capital Managers, 1974), the use of the 1974 "Hawaii Hotel Guide," and direct inquiry. There are, by count, 1,500 condominium units presently under constructoin in addition to the above. For this study, these 2,862 units will be treated as condominium units (A-1 or A-2 apartments) rather than as destination hotel units.

The Wailea project is to have 680 condominium units and 1,196 hotel units completed by 1976. The maximum density development assumed to be completed in 1990 is shown in table 21. Assuming a linear development rate at Wailea between 1976 and 1990, the number of units developed per year would be 82 single-family residential and duplex units; 311 apartment (condominium) units; and 374 hotel units.

It is assumed that the Seibu project would be fully developed by 1980 and would consist of the units shown in table 21.

This study does not include any developments other than those mentioned above. For example, it is known that a 670-acre tract at Makena has been purchased and plans to develop it into residential usage are in process (Honolulu Star-Bulletin, June 14, 1974).

TABLE 21

KIHEI-MAKENA AREA DEVELOPMENT PROJECTIONS

	SINGLE & DUPLEX UNITS (R-1, R-2, R-3, D-2)				APARTMENT UNITS (A-1, A-2)			
	Other	Wailea	Seibu	Total	Other	Wailea	Seibu	Total
1980	0	246	358	604	2,862	1,613	3,896	8,371
1990	0	1,070	358	1,428	2,862	4,725	3,896	11,483

DESTINATION HOTEL UNITS

	Other	Wailea	Seibu	Total
1980	0	2,318	1,200	3,518
1990	0	6,060	1,200	7,260

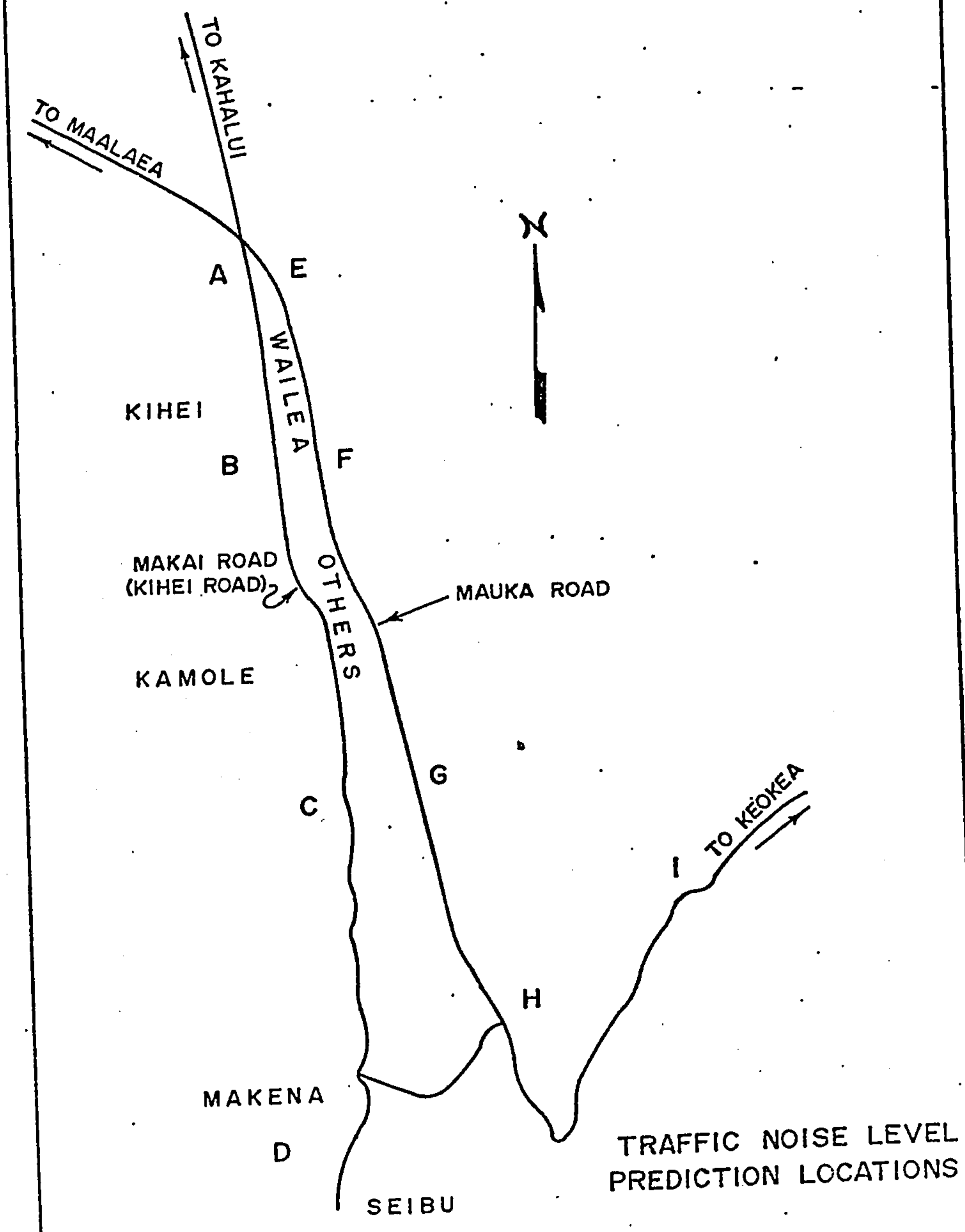
Assumptions concerning this development and others have not been considered; as a result, the predicted Kihei-Makena area development projects are conservative and the relative impact of the proposed Seibu project appear somewhat more severe than it would be if other developments occur.

Traffic Volumes and Noise Levels on Feeder Roads in Kihei-Makena Area

It is assumed that morning peak hour traffic, upon reaching the makai and mauka roads, splits such that 70 percent heads north and 30 percent heads south. Figure 21 shows nine locations where the traffic volume is estimated using the parameters given above. The peak hour traffic volumes in table 22 are for the locations shown in figure 15 and represent two-way traffic flow from the indicated population center: the Seibu and Wailea developments and others in Kihei and Kamaole. The noise levels shown in table 22 represent those occurring at a distance of 100 feet from the middle of the road. The L_{50} dBA column lists the difference in noise level caused by the Seibu development.

Recommendations

It County and State approval is given for amendments to the County General Plan and State Land Use boundaries, it is recommended that the planners and architects for the proposed project will consider the acoustic element in broad and detail design. Even though Maui County does not presently have any noise limits in zoning codes, such as those in Oahu's Comprehensive Zoning Code, good planning and design will not allow installations of



TRAFFIC NOISE LEVEL PREDICTION LOCATIONS

FIG.21

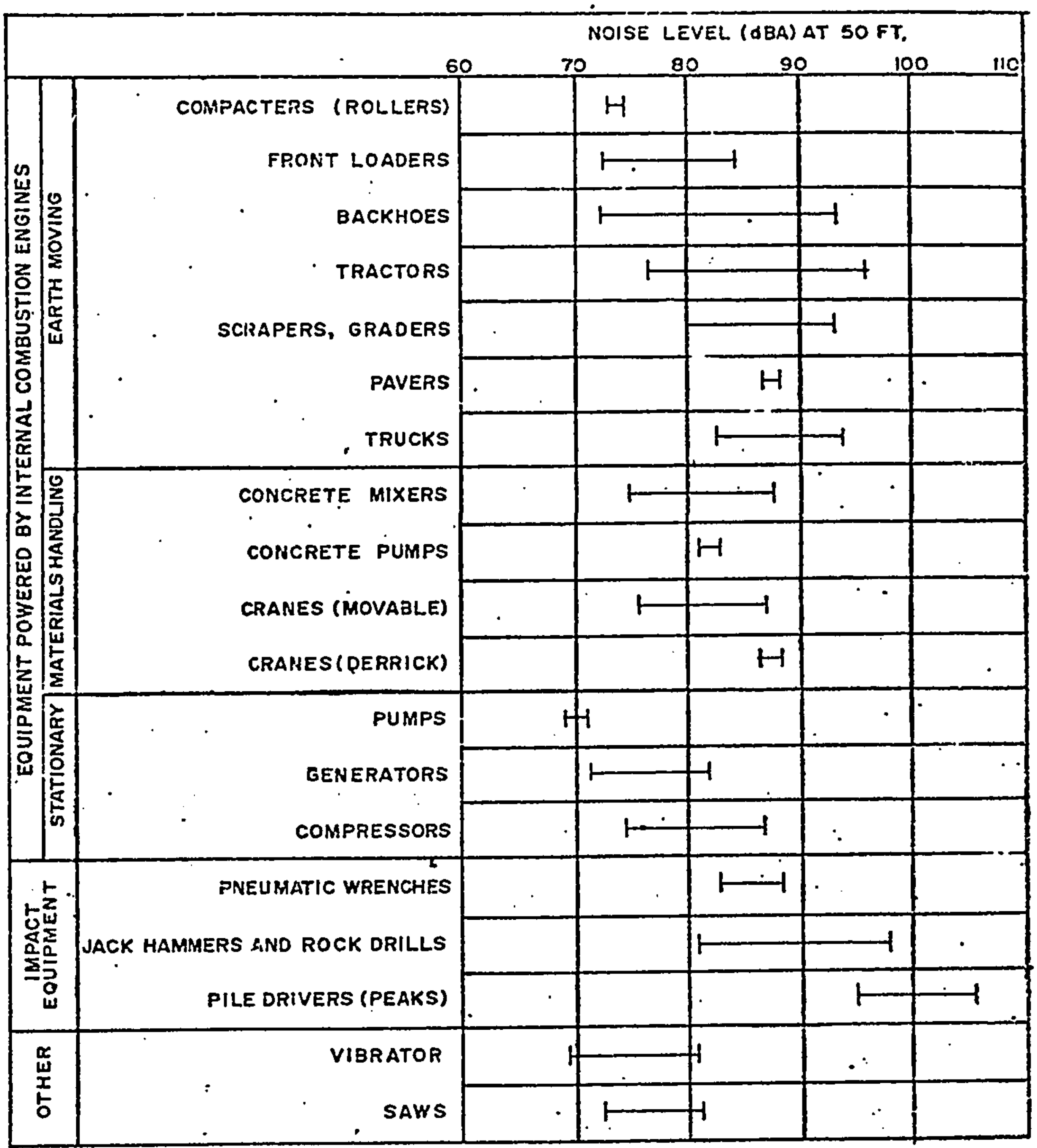
TABLE 22

PREDICTED TRAFFIC VOLUMES AND NOISE LEVELS AT MORNING PEAK HOUR

		1980					1990				
		W/O SEIBU		W SEIBU			W/O SEIBU		W SEIBU		
LOCATION		VPH	L_{50} dBA	VPH	L_{50} dBA	dBA	VPH	L_{50} dBA	VPH	L_{50} dBA	dBA
MAKAI	A	608	56	1,350	59	3	1,231	59	1,973	61	2
ROAD	B	737	57	1,479	60	3	1,360	59	2,102	62	3
(30mph)	C	569	55	1,311	59	4	1,459	60	2,201	62	2
	D	132	56	1,003	58	12	528	56	1,270	59	3
	E	1,404	64	2,608	66	2	2,830	67	4,034	69	2
MAUKA	F	1,705	65	2,909	67	2	3,131	68	4,335	69	1
ROAD	G	1,305	64	2,509	67	3	3,343	68	4,547	70	2
(50 mph)	H	602	60	2,322	66	6	1,214	64	2,934	67	3
	I	602	60	1,118	63	3	1,214	64	1,730	65	1

noisy mechanical equipment where people will be adversely exposed. By proper location and orientation of buildings; the use of natural (and man made) acoustical shielding; and the use of plantings which create noise in the wind; it is believed that an enjoyable acoustical environment can exist throughout the project site. In this context, the following are recommended for future site planning and design:

1. Existing HUD and EPA noise exposure guidelines should serve as criteria in project planning and design (Federal Housing and Urban Development, 1971, and Environmental Protection Agency, 1974).
2. Noise levels reflecting the natural background noise distribution in the project should be used as a guideline for choosing, locating, and installing fixed mechanical equipment. Figure 8 shows measured dBA vs. time plots from typical locations in the project area. The 50 dBA line in figure 8 represents approximately the noise limit in the Comprehensive Zoning Code for Oahu.
3. "Pre-preliminary" building plans and specifications should be reviewed by a trained noise specialist to insure the propoer use of walls, berms, buildings, cuts and fills for the mitigation of traffic noise and other open, direct sound transmissions.
4. Figure 22 is a chart showing typical ranges of noise levels from construction equipment. Construction equipment operators experiencing 90 dBA or greater should use personal hearing protection in order to minimize hearing damage risk.



NOTE: BASED ON LIMITED AVAILABLE DATA SAMPLES

CONSTRUCTION EQUIPMENT
NOISE RANGES

FIG.22

5. Maui County should adopt and enforce Motor Vehicle Noise Limits, which have been established in the State Department of Health Regulation, Chapter 44 A--"Vehicular Noise Control for Oahu," in order to control noise generated from:

   a. Excessively noisy trucks during the construction period; and

   b. Old, large, noisy, diesel-powered busses which may be utilized by tour agencies for transporting guests of the resort to and from the project site.

   If Maui County does not establish and enforce motor vehiclar noise limits, it is recommended that the hotel management place noise limits in its contract with tour agencies serving the resort complex. In this regard, a limit of 84 dBA at 50 feet would be consistent with regulations in force on Oahu.

Coastal Process

Secondary and Tertiary Impact Upon Shoreline

Since no construction or infringement on the beaches or nearshore zone is planned, the environmental impact of the proposed development at Makena on the coastal zone and its beach systems would probably be caused by the disruption of natural drainage patterns. During periods of moderate to heavy rainfall, such conditions could result in the potential introduction of large amounts of silts and clays (washed down from the development area) at the shoreline. The consequence of the introduction of these fine sediments on the environment are dependent to large measure on the efficiency of circulation during this study indicated it to be rather sluggish so that fine sediments introduced at the shoreline may remain in the area long enough to affect water clarity.

Recommendations

1. See Chapter V recommendations for drainage.

CHEMICAL CHARACTERISTICS

General

As discussed in other related sections of this report, the chemical characteristics of the study area and project site would be affected by 1) the probable influence on the water quality of the basal lens by use of emergency deep injection wells for effluent disposal, as well as the use of effluent for irrigation; 2) the potential dilution of inshore waters caused by a probable increase in ground water dishcarge capacity and/or altered water quality of runoff waters; and 3) changes in air quality resulting from increased vehicular traffic and related urbanization.

Water Quality of the Basal Lens

The use of an emergency injection well system on the project site would probably affect the quality of waters within the basal lens since treated sewage effluent would be discharged directly into the lens. Use of treated effluent for irrigation of the proposed golf courses would also probably change the water quality of the lens, as indicated by the work of Tenorio and Young (1970) on the effects of irrigation return water upon the ground water quality of Lahaina and Maui's Central Valley. During this research, irrigation return waters were noted to have widespread aerial and depth distribution under recharge areas.

A secondary impact resulting from possible changes in the quality of basal lens waters would be that such waters may become more or less desirable as a source for other uses, i.e. drinking water.

Seawater Dilution

As stated earlier, the degree of dilution would be proportional to the mixing rate of the sea, the quality of effluent in ion-form upon reaching of inshore waters through surface runoff or percolation, and the rate of ground water discharge. In this regard, the quality of effluent is somewhat predictable as Chapter 38 of the State Department of Health Regulation requires the following water quality standards (based on monthly averages) for outlets discharging into nearshore Class A waters and outlets discharging into an effluent reuse system for irrigation purposes.

Outlets Discharging Into Nearshore Class A Waters

"1. Biochemical Oxygen Demand, mg/l: Not greater than 5 and not to exceed 25 lb./day

2. Suspended Solids, mg/l: Not greater than 5 and not to exceed 25 lb./day

3. Total Phosphorus, mg/l: Not greater than 1 and not to exceed 5 lb./day

4. Total Nitrogen, mg/l as Total N: Not greater than 10 and not to exceed 50 lb./day

5. Fecal Coliform Bacteria, MPN/100 ml: Not greater than 2.2

6. pH: Not less than 6.5 nor greater than 8.5

7. Dissolved Oxygen, mg/l: Not less than 5

8. Temperature, C: Not less than 18 nor greater than 28

9. Radionuclides: Not to exceed concentrations specified by the U. S. Public Health Service, Publication No. 956, as revised in 1962, as acceptable for drinking water.

Provided that in the case where it has been affirmatively demonstrated to the Director that the effluent discharged in Class 2 waters is subsequently reused for irrigation purposes on a substantially complete basis, the Director may waive the requirements of this paragraph completely and may make the effluent requirements indicated under Section 7.B, applicable." (Chapter 38, Dept. of Health Regulations)

Outlets Discharging Offshore Into Class A Waters or an Effluent Reuse System

"1. Substantially complete removal of all floatable and settleable material;

2. Removal of not less than 85 percent of five-day biochemical oxygen demand or equivalent based on monthly averages;

3. Substantially complete removal of pathogenic micro-organisms on a continuous basis; and

4. In the case of an outlet which will result in the discharge into open ocean waters through an ocean outfall the Director may waive the requirements of subparagraph "2" of this paragraph and may modify the requirement relative to "on a continuous basis" of subparagraph "3" if he determines that such discharges will not adversely affect the open ocean environment and adjoining nearshore waters." (Chapter 38, Dept. of Health Regulations)"

Ambient Air Chemistry and Quality

A substantial increase in the amount of vehicular traffic, in comparison with existing conditions, would alter the ambient air quality and chemistry of, at least, the project site and study area. Such alternations would be in the form of long-term increases in the amount of toxic compounds, such as sulfer dioxide, nitrogen dioxide, carbon monoxide and various types of lead particulate.

Noticeable increases in the amount of organic particulate, i.e. fugitive dust, would also be generated by construction equipment and operations and would prevail during the entire six-year construction period.

Recommendations

1. In conjunction with water quality studies necessary to evaluate the marine biological impact of dilution of the inshore waters, (Chapter V--marine ecology and utility recommendations) studies of the inshore waters should be made to determine existing levels of BOD, suspended solids, total

phosphorus, total nitrogen, fecal Coliform bacteria, pH, dissolved oxygen, temperature and radionuclides under various seasonal, tidal and climatic conditions over the period of one year. Such analyses would provide 1) a basis for evaluating whether or not the existing Class A standards are practicable under existing conditions for the discharge of surface runoff and 2) baseline data necessary to estimate the biological and chemical impact of the sewage treatment plant for any required EIS.

2. In order to minimize the amount of fugitive dust during construction, the following precautions (State Dept. of Health, 1972) should be employed:
   a) Water or chemicals should be applied on roads, exposed land areas, i.e. cleared land, material stockpiles, and other surfaces which can give rise to airborne dusts;
   b) Open-bodied trucks, transporting materials to and from the project site, should be covered when in motion; and
   c) Earth and other solid waste material which has been transported onto paved streets should be removed promptly.

BIOLOGICAL CHARACTERISTICS

Terrestrial Ecology

Extensive grading operations would remove a great majority of the existing vegetation which would be almost completely replaced by the planting cultivated plants. As a result, almost all bird species would be substantially reduced during the 4-year construction program; however, upon completion of construction activity, a complete restructuring of the bird population would begin to occur over time. For example, birds within the project site which desire a good amount of cover, i.e. Chukar Partridge, or favor the existing dense Kiawe forest, i.e. large and small Doves, Grey Francolin and Cardinals, would permanently be reduced while the number of other species desiring open grassy area habitats, i.e. Mockingbirds and Golden Plovers, would increase. Thus, the type of existing species within the site would not be altered; however, the densities of each species would either be substantially increased or decreased.

As stated in the Chapter V section regarding land use, a secondary impact of increased recreational activity would result in further desecration of the lands makai of the project site by littering and disturbance to vegetation by the cutting of new trails to recreational destinations. Such desecration would probably also include the eventual destruction of brackish ponds along the Ahihi Bay shoreline which serve as bird habitat for the rare Hawaiian stilt and migratory shorebirds for miles along the coast in either direction.

An additional secondary impact would be caused by the proximity of the project site to the Kalua o Lapa lava flow which, as stated earlier, marks the beginning of a distinctly differnt environment for plants and animals. The proposed development program would result in some long-term stress on the growth of native and indigenous species found in this area as seeds from the newly-introduced plant species within the project site would be transported to this area by wind. In this regard, the present mixed Kiawe-Haole Koa forest on the southern end of the project site somewhat serves as a natural buffer for this area as a definite balance has already been established by these two communities.

Recommendations

1. A 1/4-mile wide buffer of existing vegetation from the souther boundary of the project site should be established in order to minimize the potential introduction of additional exotic plant species within the Ahihi-Kinau Natural Area Reserve.

Marine Ecology

Introduction

A list of the possible sources of stress to marine life resulting from the proposed development program includes: 1) offshore dredging and filling; 2) shoreline modification; 3) nutrient and toxic chemical infiltration from fertilizers, pesticides and herbicides used for golf course maintenance; 4) increased ground water discharges resulting from irrigation of the golf courses and/or seepage of injection wells; 5) runoff and sediment erosion from cleared lands and the development of impermeable barriers; 6) dust derived from road and building construction activities; and 7) increased levels of spearfishing, shell collecting, and coral collecting. The probable significance and effect of each source of stress are described as follows:

Possible Sources of Stress

Offshore Dredging and Construction

According to present available information, offshore construction or dredging is not planned by the developers.

Shoreline Modification

The only modification of the existing shoreline as planned by the developers would be the construction of a small boat ramp near the inner corner at Makena Landing. Marine surveys in the area (station 2S) indicated that few subtidal organisms live within 60 m of the proposed ramp site. Intertidal marine organisms exist on rocky surfaces adjacent to the site, but should not be affected by construction or excavation activities. Thus, it is concluded that ramp construction would produce negligible impact on marine communities.

Long term usage of the ramp may result in occasional gasoline or oil spillage which could damage intertidal marine organisms. However, if the users of the ramp exercise caution during the launching and hoisting of boats, much of the impact could be prevented. It is of interest to note that many marine organisms were found near an existing ramp located approximately 200 m northwest of the proposed ramp site.

Use of Herbicides, Fertilizers, and Pesticides on the Golf Courses

The proposed development would, most likely, use chemical additives to maintain the golf course in good playing condition. Chemical compounds may eventually leach through the sod and soil, and percolate into the ocean via the ground water seepage or be carried away during periods of storm runoff. Fertilizers contain concentrated amounts of nutrients which could stimulate plant growth. Sufficient increases in nutrient levels in ocean water would stimulate the growth of phytoplankton and benthic algae. The accelerated growth could result in changes in community structure which could be either beneficial or undesirable. An example of extreme nutrient enrichment has occurred in Kaneohe Bay, Oahu, where reefs in the south bay were probably killed by organic loading from increased water column productivity while reefs in the middle bay were smothered by benthic algae which began growing much more quickly after introduction of nutrients (Maragos, 1973).

It seems likely, however, that the amount of nutrients added to the golf course, via fertilizers, may in itself be insignificant to cause appreciable increases in ocean nutrient levels. Furthermore, most nearshore waters seem to be well mixed so that concentrated nutrients should be flushed and diluted quickly. However, nutrient analyses of inshore waters makai of the project site should be conducted before design of the sewage treatment plant, to determine if high nutrient levels occur naturally in the ground water system. Studies off the Kona coast of Hawaii indicated that extremely high nutrient levels occur in ground water (Raymond, 1973 and Doty, 1969) at Honokohau and Honaunau.

The use of herbicides or pesticides may also damage marine life if such additives are not broken down chemically by the time they reach the ocean. In this regard, the potential impact of fertilizers, herbicides, and possibly pesticides could be reduced by chemical compounds which degrade within a short time period.

Increased Ground Water Discharge Resulting from Irrigation of the Golf Courses and/or Seepage of Injection Wells

At the time of this report, no detailed sewage plan has been prepared. However, the present Master Plan proposes that treated effluent from a proposed sewage treatment plant would be utilized for irrigation on the two golf courses and/or be discharged into emergency injection wells. In either case, wastewater would have to meet the requirements established in the State Department of Health Standards, Chapter 38 for Class A waters.

Natural ground water seepage was evident to divers swimming offshore, especially off rocky coasts and promontories, i.e. Puu Olai and Makena Landing. Ground water seepage would probably increase through the continued irrigation of the golf courses and the less likely, seepage of effluent from injection wells. Potential seepage from injection wells could result from possible cracks, direct percolation, i.e. golf courses along shoreline, tubes or underground channels in the substrate which could provide a "path" for treated effluent waters to flow into shoreline waters.

The primary impact imposed upon the marine environment by either of these two potential stresses would be in the form of introducing additional nutrients and/or freshwater to the receiving waters. The degree of dilution, caused by effluent discharge, would be proportional to the mixing rate of the sea, the relative amounts of treated effluent and freshwater, and the rate of ground water discharge. The related secondary impact is the effect of increased nutrients or decreased salinity on marine organisms which cannot tolerate changes in water quality.

As stated earlier in this section, concentrated amounts of nutrients could stimulate the growth of phytoplankton and benthic algae which could further result in desirable or undesirable changes in community structure. However, it is impossible to reasonably predict what the effects of nutrient discharge would be without knowing the amount and type of treated effluent to be utilized for irrigation and the amount to be disposed into injection wells.

Organisms most likely to be subjected to seawater dilution resulting from freshwater seepage are nearshore subtidal and littoral algae and invertebrates. Scant information is available on the tolerance of nearshore marine organisms to depressed salinity conditions although studies off Honkakau Harbor, Kona, Hawaii (Raymond, 1973) and Honolua Bay, Maui (Environmental Consultants, Inc., 1974) indicate that most marine organisms can withstand moderate reductions in salinity. Intertidal marine organisms are adapted to salinity fluctuations which they encounter when exposed at low tide, and certain species of marine life thrive in areas where natural seepage occurs. At the most, salinity depression resulting from increased use of freshwater on the slopes may result in some species of marine organisms being replaced by others at the shoreline. Thus, it appears that seawater dilution, caused by an increased ground water discharge of freshwater, would not be significant enough to cause drastic modification to the existing marine communities.

Runoff and Sedimentation Resulting from Land Clearing Operation and the Development of Impermeable Barriers

Removal of natural vegetation cover by bulldozing, grading, etc. and the development of impermeable barriers, i.e. pavement could exposed soil to greater rates of erosion and runoff during construction. However, marine communities in the region are already somewhat adapted to conditions of high sediment concentrations and it is unlikely that short term sedimentation from land would significantly damage or affect marine life. Some reef life can apparently withstand frequent floods and sediment loading of moderate levels (Maragos, 1973, 1974). However, the probability of flood damage to marine life could be reduced by the implementation of recommendations given in the Chapter V section on drainage.

Generation of Dust During Construction

Considerable dust is present being generated by construction activity and road traffic at Wailea, a development north of the proposed development. Presumably dust would again be produced after commencement of the Makena project even if precuations are made during construciton. Wind may carry some of the dust offshore where it could settle on intertidal marine organisms and in the ocean. It is suspected that the dust impact would be minimal because of 1) "high" concentrations of dust would not be tolerated by the residents living in the Makena-Ahihi area; 2) intertidal organisms would be frequently "cleansed" of dust from wave splash and tidal fluctuations; 3) offshore marine communities are already somewhat adapted to naturally high levels of sediment in suspension and on the substratum; and 4) construction activity is presumed to be only temporary.

Sport Fishing, Shell Collecting, and Coral Collecting Activities

Planned proposals for an improved roadway and lodging facilities would greatly increase both resident and visitor traffic to the Makena-Ahihi region. As a result, diving activities would presumably accelerate proportionally. Many of the organisms identified during our surveys would be considered valuable souveniers by many marine enthusiasts. In this regard, the developers should attempt to discourage newcomers from collecting organisms such as corals and molluscs so that marine life can be preserved for future users of the area. This could be accomplished through dissemination of pamphlets and the posting of signs in appropriate places. Under no circumstances should the commercial harvesting of corals or shells be permitted or encouraged as such activities are illegal in the State of Hawaii.

Spearfishing activities are not expected to cause much impact on fish population because of the small size of most all fish observed during marine surveys. More information is required to assess the impact of probable increased levels of shore fishing on local fish stocks.

Recommendations

1. Prior to the preparation of preliminary plans for the construction of a sewage treatment plant and related injection well system, baseline studies of water chemistry should be conducted to determine
   a. The location of ground water discharge sites;
   b. The seasonal variation and average rates of freshwater discharge;
   c. The seasonal variation and average level of nutrients in the ground water; and
   d. The seasonal fluctuation of inshore currents.

   Such data would assist in minimizing the impact upon the marine ecology of the waters makai of the project site as civil and sanitary designers would be provided with a basis for determining more suitable sites for any surface runoff outlets, dispersion wells, and other developments, i.e. land berms and settling ponds.

2. Dust control measures should be employed during construction to minimize the amount fugitive dust which could affect intertidal marine organisms.

3. Seibu Real Estate Co., Ltd. should prepare and disseminate educational pamphlets to visitors using the waters makai of the project site and the adjacent Natural Area Reserve, for recreation purposes. The intent of the pamphlet would be to

   a. Discourage visitors from collecting organisms such as corals and mollusks for souveniers; and

   b. Provide visitors with a basis for appreciating and enjoying the coastal waters makai of the project site.

CULTURAL CHARACTERISTICS

Archaeology/History of the Project Site and Study Area

Implementation of the proposed development program would result in the destruction of numerous pre-historic and historical archaeological sites which are situated within the project site. The history associated with these sites and other sites in portions of the adjacent study area, i.e. Ulupalakua Ranch and other private lands mauka and makai of the project site, is a related potential loss which could also result from the proposed development unless future design plans and specifications reflect a concerted attempt by Seibu Real Estate Company, Ltd. to integrate what is known historically about the area with the intended resort/condominium/residential/recreational development.

Recommendations

In order to integrate existing physical, archaeological and historical data into future design plans and specifications, the following actions are recommended:

1. Prior to the preparation of preliminary plans and specifications, a preliminary design study should be undertaken to determine specific methods and costs which would be required to incorporate significant archaeological features, historical sites, and verbal history of the project site into the proposed development program. Such a study should be coordinated by site planners who should be supported by an architect, interior designer, a trained archaeologist and a historian.

Land Use

County and State Land Use Designations

As stated earlier, all lands within the project site have been zoned for agricultural use by the State Land Use Commission. As a result, implementation of the proposed project would require a boundary change or a request for spot urban zoning within the greater agricultural zone area. In this regard, SRECL has petitioned the State Land Use Commission, during its present five-year boundary review, to re-classify the lands within the project site for urban uses.

Should a boundary change request by Seibu Real Estate Co., Ltd. be approved by the State Land Use Commission, it is believed that, other proposed projects adjacent to the project site, which would require rezoning by the State Land Use Commission, would also gain approval by the Commission. The approval would be granted on the base of precedence and future land use trends in the area which would be generated by the existence of resort, commercial, and residential uses at Wailea and the adjacent project site.

Approval of rezoning proposals for the proposed development program and/or other proposed projects adjacent to the project site would also probably cause a secondary impact of greater speculation in the Makena-Ahihi Bay area, as well as other areas along the developed southern coast of Maui, for the development of additional residential resort and commercial land uses. On the basis of recent history and the precedence which would be set by the proposed development program, investors would most likely concentrate on shoreline residential properties which may soon be placed on the market by residents makai of the project site, as well as other marginal pasture lands which might be sold by the Ulupalakua or Kaupo Ranches.

Uses of the Study Area

General

In conjunction with the Wailea Resort development, uses of the study area would be altered substantially by the proposed development program in terms of the type and amount of land uses. The types of uses which would be introduced into the study area has been previously discussed in Chapter III and the Chapter IV section regarding land use. In this regard, residential usage would obviously increase within the project site; however, it is also expected that a number of families residing makai of the project site would move from their homes prior to the completion of construction.

Residential/Condominium/Hotel

On the basis of proposed densities and estimates by SRECL and Wailea Land Company, the study area would be characterized by, at least, the following number of units for residential, condominium and hotel use by 1990:

Type of Units	Wailea Resort	Seibu Resort	Total
Residential			
R-1	233	0	233
R-2	224	477	701
R-3	216	0	216
D-2	397	0	397
Apartment (Condominium and Townhouses)			
A-1	2,627	1,431	4,058
A-2	2,098	2,861	4,959
Hotel	6,600	1,200	7,800
	12,395	5,969	18,364

The preceding figures do not take into account the number of units which would probably result from other developers who have undefined or unknown development at the time of this report. As a result, estimates concerning the extent of residential condominium and hotel development in the study area by 1990 are conservative.

Population

On the basis of the preceding 1990 densities within the study area, their use, persons per room and vacancy rates, a rough estimate of the 1990 population can be determined for both the project site and study area. However, such factors have only been derived for the project site (Appendix E). Nevertheless, in order that a rough estimate of the study areas 1990 resident and visitor population could be made, the following occupancy rates were assumed for Wailea:

Type of Unit	No. of Persons/Unit
R-1, R-2, R-3	3.50
Duplex	2.25
A-1, A-2	2.00
Hotel	1.80 (at 70% occupancy)

These occupancy rates were used in light of the declining household size in Hawaii over the past 30 years which is expected to reduce to roughly these proportions in the mid-1980's (Weatherford, 1974). As shown in the preceding table, visitor population of Wailea assumed a 70 percent occupancy which is the average annual hotel occupancy rate on Maui from 1963 to 1973.

Even though the factors utilized in estimating the Wailea resident and visitor populations do not take into account as many factors as those used for the following Seibu estimates, the arithmetical factors are similar enough for a gross comparison and estimate of the study area's 1990 resident and visitor populations.

Type of Population	Wailea Resort	Seibu Resort	Total Study Area Population
Residential	12,698	7,741	20,439
Visitor	8,316	4,099	12,415
Combined Res. & Visitor	21,014	11,840	32,854

Thus, SRECL's proposed development would roughly generate a resident population of 7,741 persons and a continuous transient population of 4,099 visitors within the project site by 1990. When combined with the estimated 1990 population of the Wailea area, the study area may be characterized by some 22,000 residents and 15,600 visitors each day.

Recreation

Recreational uses within the study area would increase with the introduction of additional activities by the resort at Makena. The existing types of shoreline uses would primarily remain the same except for the participation in pleasure boating which would increase upon completion of the proposed boat ramp. The amount of recreational use, however, would be increased substantially by the ultimate resident and visitor populations of the project site.

The development of the hotel directly behind Keawalai Beach would probably somewhat discourage future residents of the project site from using Keawalai Beach and, as a result, would divert beach use to the other beaches, makai of the project site, which would be at a great physical distance from urbanized portions of the project site.

A secondary impact resulting from increase recreational activity in the study area would be the further physical desecration of the lands makai of the project site, i.e. Puu Olai, Naupaka Beach, Big and Little Beaches. Such desecration would primarily appear in the form of littering; and the disturbance to vegetation by the cutting of new trails to recreational destinations.

Public Services (Excluding Utilities)

The addition of some 7,750 residents within the project site would undoubtedly cause a need for greater police and fire protection and other emergency services; as well as a public education program. It is difficult to estimate the extent of resources required for emergency services except to the project that facilities for such services would have to supplement the availability of, or establish, such services within the Kihei-Makena area.

Education requirements are somewhat more predictable by using the State Department of Education "School Enrollment Factors." Such factors indicate the number of school pupils/unit which would result from various housing types. For the purposes of this study, it was assumed that 1) all single-family residences would be 3-bedroom homes which would range $90,000 or greater for purchase price; 2) 1-bedroom apartments would cost at least $65,000; 3) 2-bedroom apartments could be purchased at prices ranging from $70,000 or more; and 4) persons living in studio apartments would not be attending Maui public schools from K-12. On this basis, it was determined that the proposed development program would generate approximately the following number of students for a public education program:

	Type of Dwelling Unit			
Level of Education	1-Bed	2-Bed	SF	Total
K- 6	26	191	95	312
7- 8	13	51	24	88
9-12	13	102	48	163
Total	52	344	167	563

Should this amount of students overburden the soon-to-be-built K-6 facilities at Kihei and the existing intermediate and high school facilities in Wailuku, it is believed that the 30 acres set aside by SRECL would be adequate for the State Department of Education to develop additional public educational facilities for the area.

Recommendations

None.

Economy of the Kihei-Wailea-Makena Area

Methodology

This section is devoted to estimates of the economic effect of the Seibu project on the Kihei-Wailea-Makena area and on the County of Maui. It is believed that employment is the result of the level of population and the level of the daily census of visitors. A preceding section regarding population indicates that the resident and visitor population of Maui County would increase with the addition of more hotel rooms and dwelling units. From this basis, an estimate of increased employment was made by use of the "economic base" method. The necessary estimates were determined by using linear formulas developed by mutliple regression analysis. Variables and calculations are discussed in Appendix E.

Economic base analysis is founded on the premise that the growth of a region is caused by the increase of goods and services it produces locally but sells to the rest of the world. The "selling to the rest of the world" is a technical definition; for the purposes of this study, it refers to the purchaser as other than a permanent resident of Maui. The analysis distinguishes between industries which would sell a greater portion of their goods or services to the "rest of the world" and those which would sell the greater portion of goods to the resident population. Industries in Maui which would sell the greater portion of their goods and services to the "rest of the world" will be called "export" industries. Industries which would sell the greater portion to local residents will be called residential industries. The unit of measure may be either employment or income. However, as stated earlier, this study will use employment as the unit of measure.

Assumptions

It is assumed the project would contain hotel rooms, single and multiple dwelling units. When the project would be fully developed, it would contain on an average of about 11,840 persons. Of these, 4,099 would be visitors and 7,741 residents. It is assumed all visitor accommodations and dwelling units would be opened simultaneously in 1982. However, in reality, the 1200 hotel rooms would probably be opened first and the dwelling units for the resident population and visitor accommodation at a later date. It is also assumed the full employment and earning effect would lag one year behind the full opening of the project and thus will not be fully felt until 1983. It is further assumed that the effects of the project can be expressed in current time and conditions. It is realized that approximately 1500 condominium apartments would open in Kihei this year and that the Alexander and Baldwin project at Wailea will have opened at least several hotels before the opening of the Seibu project. When linear time series functions are used for estimation, they do not include data on such future projects. Therefore, estimations are based on conditions up to the present.

It is also assumed that the developer would provide housing for employees in the project and that resident support facilities would be developed in the project or other Kihei area. Under this assumption, the earnings of the employees would generally be spent in the Kihei area.

Projected Employment and Types of Employment

It is estimated the project would generate about 6,250 jobs. Of these, it is estimated about 4,915 would be in the export sector and 1,335 in the residential sector (Appendix A).

The first full year the completed project is considered in being, the export sector should earn $44,829,000 and the residential sector should earn $13,783,000, or a total of $58,612,000 in annual wages attributable to the project. However, there are two industrial categories--Contract Construction and Utilities--which appear in the export sector and are attributed to this project. It is believed that these categories would only appear for about two or three years. Once the construction and utilities on the Island of Maui would be developed to respond to the increased population, they would move to the support of other projects. Accordingly, a long range estimate is made for the export sector. In the long range estimate, the export sector employment would reduce to 3,587, 1983 earnings to $24,834,000; total employment to 4,922 and total earnings to $38,617,000.

The Effect of the Additional Employment on the Kihei-Wailea-Makena Area

Not all of the generated employment was ever conceived to reside in the Kihei-Wailea-Makena area. In this case, it is considered that the additional employment would encompass the total County of Maui. However, in actuality, it is believed that the effect would only be felt slightly, if at all, outside the Island of Maui. The gain to the Kihei-Wailea-Makena area is entirely dependent on the provision of dwelling facilities for additional workers and the commercial facilities in which they can purchase their subsistence needs. Neither of these conditions are currently met in the area.

Considering Lahaina as a developed visitor destination, some idea can be derived from the State labor statistics as to the type of employees who would reside in the project area (Hawaii, 1972b). In considering these data, manufacturing, which is primarily performed at the Pioneer Mill, is deleted on the Kihei comparison. Over 50 percent of the housing occupants are estimated to come from two categories; Retail Trade and Personal Services. This percentage reached 68 percent when Construction, Finance, Insurance and Real Estate, and Public Administration are added. Generally, persons who would be directly related to the destination would desire housing near the project. On the pay scale, all appear in the mid-income brackets--not capable of affording high-priced dwellings.

Personal Consumption Expenditures

Personal consumption expenditures (after taxes) based on employment in both sectors are shown on Table 10. Taxes are estimated at between 11 and 14 percent of total income (Hawaii, 1973). This leaves between $34,369,000 and $33,210,000 which could be spent for personal consumption. The percent estimates obtained from three sources are within 2 percentage points for food, etc.; medical care; and clothing, etc. Housing costs have a spread of 7 percent points; transportation, 5 points; and other, 7 points. Approximately 50 percent of the expenditures would be made in the food, etc., and housing areas. Including transportation, the value of expenditures is about 60 percent, or between $19,262,000 and $24,745,000. If clothing, etc., is added, the value of expenditures is about 70 percent, or $21,587,000 and $27,838,000. It is believed that these estimates provide some idea regarding the magnitude of expenditures that could occur in the Kihei-Wailea-Makena area, if support facilities, which responded to the market demand, would be created.

Comparison with Other Projections

A benefit-cost study was prepared and completed by Environment Capital Managers Inc. (ECMI) in May, 1974. This study consists of projections of certain economic elements which provide a comparison to the conclusions drawn here. The basic assumptions necessary to develop population and employment projections are common to both the ECMI study and the analysis prepared for this report. However, factors employed to represent these assumptions in mathematical analysis differ.

The population projections, after completion of development and marketing, result in a 9 percent lower population estimate in the ECMI study. The reason for this difference lies primarily in the factors used to express the visitor population per unit. The population projection, by virtue of the differing study objectives, affect the employment projections.

The ECMI benefit-cost study identifies only the increase of employment directly associated with the visitor destination at Makena and the

TABLE 23

PERSONAL CONSUMPTION EXPENDITURES

(BASED ON INCOME AFTER TAXES)

Item	Percent of Income			Expenditures in thousands of $'s	
	1/	1/	2/	Low based on $33,210,000	High based on $34,369,000
Food, Beverages & Tobacco	26%	27%	28%	8,635	9,623
Housing and Household Operations	22	24	29	7,306	9,967
Transportation	15	10	12	3,321	5,155
Clothing, Material and Services	7	8	9	2,325	3,093
Personal Care	3	2	2	664	1,031
Medical Care	5	7	5	1,660	2,406
Other	22	22	15	4,982	7,561

1/ Hawaii, 1973

2/ Shang, Albrecht and Ifukea, 1970

indirect employment derived. It does not attempt to measure employment opportunities that may result from any increase in the total resident population of Maui, nor profile the total labor force. This results in a 20 percent lower employment projection in the ECMI study.

The cost benefit attempts to be conservative so as not to overstate benefits whereas this study objective is to not understate the impact. This differing objective leads to a high-low projection result.

In summary, differing objectives of the economic analyses made for this environmental impact statement and the ECMI benefit-cost study necessitated differing approaches. Each of the analyses diverge slightly on common issues such as population assumptions; however, the resulting conclusions are similar. It is believed that the ECMI study attempts to be conservative in order that benefits are not overstated while the objective of the study by Neighbor Island Consultants is to not understate the impact. The differing objectives lead to high-low projections which, when combined, provide a forecast range.

Governmental Revenues and Costs

In May, 1974, Environmental Capital Managers, Inc. performed a benefit-cost analysis of SRECL's Makena project. Benefit-cost ratios were developed at three levels, with ratios at all levels showing a favorable benefit balance for the project. The calculations, as stated in the analysis, were purposely on the conservative side.

The calculations were based on an estimated 35-year "life" for the project. This time span includes both the construction and operational portions of the project's "life span". The analysis was based on governmental revenues and costs which would result to the County of Maui and the State of Hawaii. These revenues and costs were those primarily associated with the visitor (or export) portion of the Makena project. However, consideration was given to the residential portion of the project by the inclusion of estimated increases in revenues derived from the enhancement of real property and from the total increase in vehicle density.

The cost-benefit ratios developed by Environmental Capital Managers, Inc. were: 1) a State of Hawaii ratio of 5.55 to 1; 2) a County of Maui ratio which was calculated at 2.50 to 1; and 3) an overall, or combined State and County ratio of 3.08 to 1.

CHAPTER VI

OTHER ENVIRONMENTAL CONSIDERATIONS

ADVERSE ENVIRONMENTAL EFFECTS

Adverse environmental effects resulting from the proposed development program would include primary impacts 1 to 13, and their related impacts, listed in table 24. This table summarizes all the types of impacts resulting from the proposed project and traces the "chain-reaction" or "domino effect" of each primary impact. Question marks shown on the table indicate that a potential impact, i.e. quinary, is believed to exist but was not considered within the scope of the present study. Each of the impacts indicated on table 24 is discussed more fully within Chapter V.

RELATIONSHIP OF BENEFITS TO ADVERSE ENVIRONMENTAL EFFECTS

As discussed in Chapter V, the proposed development program would generate approximately 6,250 jobs and a total of approximately $58,612,000 in annual wages attributable to the project. In terms of governmental revenues and costs resulting from the proposed development program, benefit/cost analysis of the project indicates that the project would have a benefit/cost ratio of 2.5:1 to the County of Maui and 5.55:1 to the State of Hawaii.

As shown in table 24, the adverse environmental effects resulting from the project are, for the most part, all physical, biological or chemical effects which have no direct relationship. Thus, non of the "benefits" of this project would mitigate or avoid any of the adverse environmental effects.

TABLE 24

SUMMARY AND RELATIONSHIP OF PROJECTED IMPACTS

RESULTING FROM THE PROPOSED DEVELOPMENT PROGRAM 1976-1990

Primary	Secondary	Tertiary	Quadrinary	Quinary
1. Alteration of Land	Temporary creation of noise and dust and removal of existing vegetation	Potential health hazards to construction workers, effect on intertidal marine organisms; introduction of new floral species; and reduction in density of bird population during construction	Potential introduction of more exotic plants into Ahihi-Kinau Natural Area Reserve; restructuring of bird population within project site with density changes for each specie	Influence on ecosystem of the Reserve
2. Increase in storm runoff quantities; alteration of type of storm runoff flows; and alteration in final deposition of storm runoff waters.	Dilution and sedimentation of inshore waters	Potential influence on marine life	---	---
3. Inconvenience to resident motorists from road alignments	Potential irritation to local residents	---	---	---

TABLE 24 (Continued)

SUMMARY AND RELATIONSHIP OF PROJECTED IMPACTS

RESULTING FROM THE PROPOSED DEVELOPMENT PROGRAM 1976-1990

	Primary	Secondary	Tertiary	Quadrinary	Quinary
4.	Increase in vehicular traffic volume	Increase in noise levels and alteration of air quality	Irritation to existing residents of project site	?	?
5.	Reduction in the County potable water supply	County development of additional water supply	Additional development costs to SRECL and other developers	Increase in residential/condo sales cost	Influence on Hawaiian economy
6.	Leaching of treated effluent used for irrigation, and the potential seepage of treated effluent from deep injection wells	Increase in ground water discharge with potential flow to inshore waters	Dilution of inshore waters with increased combination nutrient ions.	Potential stimulation of the growth of phytoplankton and benthic algae	Potential changes in community structure of inshore marine biology
7.	Potential seepage of treated effluent from deep injection wells	Influence on water quality of basal lense	Influence on the usability of local basal lens as a water resource	?	?
8.	Development of additional power generation	Potential rate increases to commercial and household consumers; additional use of energy resources	Influence on Hawaiian economy	?	?

TABLE 24 (Continued)

SUMMARY AND RELATIONSHIP OF PROJECTED IMPACTS

RESULTING FROM THE PROPOSED DEVELOPMENT PROGRAM
1976-1990

	Primary	Secondary	Tertiary	Quadrinary	Quinary
9.	Shoreline modification	Potential influence on intertidal marine organism	---	---	---
10.	Destruction of numerous pre-historic and historical sites	Potential loss of the history associated with the Makena area	---	---	---
11.	Approval of State Land Use rezoning proposal	Adjacent projects would also gain approval	Greater speculation in the Makena-Ahihi Bay area, and other undeveloped areas along the southern coast of Maui	?	?
12.	Increase in residential population of the project site	Some existing residents would re-locate; greater demand for public services	Influence on County tax revenue base	---	---
13.	Increased shoreline recreational activity	Littering of shoreline and disturbance to vegetation and brackish ponds	Destruction of habitat for rare Hawaiian Stilt within study area	Reduction of habitat for rare Hawaiian Stilt on the Island of Maui	---
14.	Increase in Maui employment	Primary and secondary income to the regional economy	---	---	---

ALTERNATIVES

In light of the type of development ultimately proposed, land purchases and acquired land purchase which has rights by SRECL to purchase lands within the project site, it is believed that the only other alternative to the proposed development program would be for SRECL to sell its land and acquired purchasing rights, and forego implementation of the project. Such a sale would be either to private or public agencies.

The alternative of foregoing this project might slow down the rate of development in this area; however, it is doubtful considering that existing zoning would afford slightly higher densities than those proposed. As a result, a potential buyer of Seibu lands would probably be an investor who, at least, desired to develop the land under existing General Plan designations. Since these lands would most likely be developed by another investor/developer, the 1980 population would also probably be close to the proposed development program's projected 1980 population of some 17,000 residents and almost 1000 visitors/day.

Unless a similar development was subsequently made on the same lands, the Maui economy could potentially be without the development of almost 6,250 new employment opportunities, and approximately $58,612,000 in annual wages attributable to the project.

Assuming that a public agency, i.e. State Department of Land and Natural Resources, would purchase the Seibu lands for park purposes, it is believed that all impacts would be substantially minimized except for those created by increased recreational activity. However, it is extremely unlikely that the State would purchase such lands for park purposes since:

1) Acquisition funds of such an amount could probably not be obtained; and
2) Park development would be infeasible in terms of potential water, sewage and roadway development costs.

SHORT TERM/LONG TERM RELATIONSHIPS

Introduction

The following section attempts to speculate, without the availability of certain known facts, about future environmentally significant consequences to the study area and Maui County. Such an attempt is made by general environmental descriptions of the study area and the southern coast of Maui for the "short" and "long" term.

Short Term

Within the short term (the next 10 years), the Seibu Makena Resort would be developed, all residential properties sold, and a resident community of some persons established, as smaller residential/condo projects have been developed adjacent to the project site. At the same time, other similar resort/residential developments have recently been completed between the project site and Kaupo (along the southern coast of Maui). A four-land divided freeway exists from Wailea to Hana (east coast). Makai of the project site, a small State Park has been established which includes a portion of Naupaka Beach, Little Beach and portions of Big Beach.

Long Term

Within the long term (the next 20 years), the study area and the lands south to Kaupo are highly urbanized. The resident population is near 80,000 persons and the entire area from Kihei to Hana is developed; however, upland areas of the coast are being considered for additional housing as the former Ulupalakua and Kaupo Ranches have now devoted their total investments to land development.

IRREVERSIBLE COMMITMENTS

The commitment of resources resulting from implementation of the proposed development program would include:

1. The alteration of existing land forms and its related alteration to the terrestrial biological community;
2. Reduction in the County of Maui's potable water supply;
3. Potential usability of the basal lens at Makena as a water resource;
4. A potential change in the structure of the inshore marine ecosystem;
5. Energy resources required for providing electrical generating capacity to the Makena area; and
6. Potential loss of the history associated with the Makena area.

REQUIRED GOVERNMENTAL APPROVALS

A number of governmental approvals are required to fully implement the proposed development program. Each of the following necessary "approvals" is categorized by the type of governmental action required, the name of the agency responsible for officially approving/disapproving a particular request, and the status SRECL's attempt to have such actions approved.

Type of Action	Decision-making Agency	Status
1. Amendment to the Maui County General Plan	Maui County Planning Commission	Submitted by S in December, 1974
2. Approval to final building plans and specifications	Maui County, Planning Dept.	Not Yet Submi
	Maui County, Dept. of Public Works	Not Yet Submitt
	Maui County, Dept. of Water Supply (water supply only)	Not Yet Submi
	State of Hawaii, Dept. of Health (sanitary only)	Not Yet Submit
	Hawaii Register of Historic Places (historical sites/structures only)	Not Yet Submit

APPENDICES

APPENDIX A

APPENDIX.A-1

SUMMARY OF PLANTS OBSERVED

ENDEMIC SPECIES

Common Name	Scientific Name	Form	Relative Abundance
Ilima	Sada Fallas	forb, shrub	Common
Hialoa*	Waltheria amercana	forb, shrub	Common
Wiliwili	Erythrina sandwicensis	tree	Common
Prickly Poppy (pua-kala)	Argemone glauca	forb	Occasional

*Some botanists consider this plant introduced by the Hawaiians.

INDIGENOUS SPECIES

Common Name	Scientific Name	Form	Relative Abundance
Beach morning glory (pohuehue)	Ipomoea pes-caprae	vine	Abundant
Beach verbena (pohinahina)	Vitex ovata	forb	Common
Hau	Hibiscus tiliaceous	tree	Occasional
Scaevola (naupaka-kahakai)	Scaevola sp.	shrub	Occasional
Blue morning glory (koali-'awahia)	Ipomoea congesta	vine	Occasional
Tree heliotrope	Messerschmidia argentea	tree	Rare
Milo	Thespesia populnea	tree	Rare
Kou	Cordia subcordata	tree	Rare

APPENDIX A-1 (Continued)

SUMMARY OF PLANTS OBSERVED

EXOTIC SPECIES

Common Name	Scientific Name	Form	Relative Abundanc
Mesquite (kiawe)	*Prosopis pallida*	tree	Abundant
Koa-haole	*Leucaena leucocephala*	shrub/tree	Common
Klu	*Acacia farnesiana*	shrub	Common
Mango (manako)	*Mangifera indica*	tree	Common
Banana (mai'a)	*Musa* spp.	tree	Common
Papaya (papaia)	*Carica papapya*	tree	Common
Palms (niu, loulu)	*Palmae*	tree	Common
Plumeria (melia)	*Plumeria acuminata*	tree	Common
Oleander (oliwa)	*Nerium indicum*	shrub	Common
Bougainvillea (pukanawila)	*Bougainvillea spectabilis* *B. glabra*	shrub	Common
Poinsettia	*Euphorbia pulcherrima*	shrub	Occasional
Hairy abutilon (ma'o)	*Abutilon grandifolium*	shrub	Common
Octopus tree	*Brassaia actinophylla*	tree	Occasional
Crown flower (pua-kalaunu)	*Calotropis gigantea*	shrub	Occasional
Castor bean (pa'aila)	*Ricinus communis*	shrub	Common
African tulip tree	*Spathodea campanulata*	tree	Occasional
Hibiscus (aloalo)	*Hibiscus* spp.	shrub	Common (locally)
Monkeypod ('ohai)	*Samanea saman*	tree	Occasional
Golden crown-beard	*Verbesina encelioides*	forb	Occasional
Morning glory (Koali-'ai)	*Ipomea cairica*	vine	Common

APPENDIX A-1 (Continued)

SUMMARY OF PLANTS OBSERVED

EXOTIC SPECIES (continued)

Common Name	Scientific Name	Form	Relative Abundance
Saltbush	*Atriplex* sp.	forb	Occasional
Apple of Peru	*Nicandra physalodes*	forb	Abundant
Wild zinnia (pua-pihi)	*Zinnia pauciflora*	forb	Abundant
Beggar tick	*Bidens pilosa*	forb	Abundant
Spiny amaranth	*Amaranthus spinosus*	forb	Abundant
Hairy merremia (koali-kua-hulu)	*Merremia aegypti*	vine	Common
Yellow star thistle	*Centaurea melitensis*	forb	Occasional
Flora's paint brush	*Emilia sonchifolia*	forb	Occasional
Wild cucumber (ka'ukama)	*Cucumis dipsaceous*	vine	Occasional
Sow thistle (pua-lele)	*Sonchus oleraceous*	forb	Occasional
Feather fingergrass	*Chloris barbata*	grass	Abundant
Natal redtop	*Tricholaena rosea*	grass	Common
Bermuda grass (manienie)	*Cynodon dactylon*	grass	Occasional
Rush-grass ('aki'aki)	*Sporobolus virginious*	grass	Occasional
Giant fleabane	*Pluchea odorata*	shrub	Occasional
Wedelia	*Wedelia tribolata*	forb, vine	Occasional
Lion's ear	*Leonotis neptaefolia*	forb	Rare
Be-still (noho-malie)	*Thevetia peruviana*	shrub	Occasional
Citrus	*Citrus* spp.	tree	Occasional
Cocklebur (kikania)	*Xanthium strumarium*	shrub	Common (locally)

APPENDIX A-1 (Continued)

SUMMARY OF PLANTS OBSERVED

EXOTIC SPECIES (continued)

Common Name	Scientific Name	Form	Relative Abundanc
Tree tobacco	*Nicotiana glauca*	shrub/tree	Rare
Popolo	*Solanum nodiflorum*	forb	Occasional
Lamb's quarters ('aheahea)	*Chenopodium album*	forb	Occasional
Sanbur ('ume'alu)	*Cenchrus echinatus*	grass	Common
Wiregrass (manienie-ali'i)	*Eleusine indica*	grass	Occasional
Slender Mimosa	*Desmanthus virgatus*	shrub	Occasional
Guinea grass	*Panicum maximum*	grass	Occasional
Buffel grass	*Cenchrus ciliarus*	grass	Common
Sea Island cotton (ma'o)	*Gossypium barbadense*	shrub	Rare
Hairy horseweed ('ilioha)	*Conyza bonariensis*	forb	Occasional
Radiate fingergrass	*Chloris radiata*	grass	Common
Sour grass	*Trichachne insularis*	grass	Common
Cayenne vervain	*Stachytarpheta cayennensis*	forb	Occasional
Tomato ('ohia'a-lomi)	*Lycopersicon esculentum*	forb/vine	Common
Lantana (lakana)	*Lantana camara*	shrub	Common
Impatiens	*Impatiens* sp.	forb	Rare
Rattlebox	*Crotalaria mucronata*	forb	Occasional
Coffee senna (miki palaoa)	*Cassia occidentalis*	forb	Common
Balsam apple	*Momordica charantia*	forb	Occasional
Cactus (pa-nini)	*Opuntia megacantha*	tree	Abundant

APPENDIX A-1 (Continued)

SUMMARY OF PLANTS OBSERVED

EXOTIC SPECIES (continued)

Common Name	Scientific Name	Form	Relative Abundanc
False mallow	*Malvastrum coromandelianum*	forb	Occasional
Apple of sodom (popolo-kikania)	*Solanum sodomeum*	forb	Occasional
Passion flower (pohapoha)	*Passiflora foetida*	forb/vine	Occasional
Indigo ('inikoa)	*Indigo anil*	forb	Occasional

APPENDIX A-2

SUMMARY OF BIRDS OBSERVED

ENDEMIC SPECIES

Common Name	Scientific Name	Status	Relative Abundance
Hawaiian black-necked stilt (aeo)	Himantopus himantopus knudseni	Endangered	Rare

INDIGENOUS SPECIES

Common Name	Scientific Name	Status	Relative Abundance
Noddy tern (noio koha)	Anous stolidus pileatus	------	Occasional
Pacific golden plover (kolea)	Pluvialis dominica	Migratory	Occasional
Ruddy turnstone (akekeke)	Arenaria interpres	Migratory	Occasional

EXOTIC SPECIES

Common Name	Scientific Name	Relative Abundance
Ring-necked pheasant (kolohala)	Phasianus colchicus torguatus	Occasional
Indian gray francolin	Francolinus pondicerianus interpositus	Abundant
Spotted (Chinese) dove	Streptopelia chinensis	Common
Barred dove	Geopelia striata	Abundant
Mockingbird	Mimus polyglottos	Common
Common mynah	Acridotheres t. tristis	Common
Japanese white-eye	Zosterops j. japonica	Abundant
House finch (linnet)	Carpodacus mexicanus frontalis	Abundant

APPENDIX A-2 (Continued)

SUMMARY OF BIRDS OBSERVED

EXOTIC SPECIES (continued)

Common Name	Scientific Name	Relative Abundance
Ricebird (spotted munia)	*Lonchura punctulata*	Occasional
House sparrow	*Passer domesticus*	Common
Cardinal	*Cardinalis cardinalis*	Abundant

APPENDIX A-3

SUMMARY OF MAMMALS AND REPTILES OBSERVED

MAMMALS

Exotic Species

Common Name	Scientific Name	Relative Abundance
House mouse (iole li'ili'i)	*Mus musculus*	Abundant
Small Indian mongoose (iole-manakuke)	*Herpestes auropunctatus*	Common

REPTILES

Exotic Species

Common Name	Scientific Name	Relative Abundance
Fox gecko (mo'o-ala)	*Hemidactylus garnotti*	Common

APPENDIX B

APPENDIX B

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

NATURAL AREA RESERVES SYSTEM

REGULATION NO. 7

AUTHORITY. Under authority granted in Chapter 195, Hawaii Revised Statutes, the Board of Land and Natural Resources, hereinafter called the "Board," after recommendation and approval of the Natural Area Reserves System Commission, hereinafter called the "Commission," hereby adopts Regulation No. 7, RELATING TO THE PROTECTION, CONTROL AND USE OF AHIHI-KINAU NATURAL AREA RESERVE, ISLAND OF MAUI.

Section 1 PURPOSE AND INTENT. The Legislature has found that the State of Hawaii possesses unique natural resources such as geological features and distinctive marine and terrestrial plants and animals, many of which occur nowhere else in the world, that are highly vulnerable to loss by the growth of population and technology; that these unique natural assets should be protected and preserved for present and future generations of man to provide viable illustrations of an original natural heritage, to act as base lines against which changes made in environments of Hawaii can be measured, to serve as reservoirs of natural genetic materials, and to be used, as feasible, for research in natural sciences and outdoor teaching laboratories. In keeping with these findings, the Legislature has authorized the establishment of a statewide Natural Area Reserves System to preserve in perpetuity endangered species, important geological sites, and specific land and water areas which support native flora and fauna in their natural communities.

Section 2 DESIGNATION. This regulation shall govern the protection, control and use within the AHIHI-KINAU NATURAL AREA RESERVE, hereinafter called the "Reserve," which is established by Governor's Executive Order No. 02668. It constitutes a three-component system: 1) the lava flows forming Cape Kinau resulting from the last volcanic activity on Maui Island and their developing dry land vegetation; 2) an inshore marine ecosystem containing relatively unmodified floral and faunal communities with diverse speciation; 3) mixohaline ponds with unique environmental character and rare animals.

Section 3 LOCATION. The Reserve shall include submerged and emerged lands and inshore, ponded and subterranean waters of Cape Kinau and the southern part of Ahihi Bay, Island of Maui, as described and depicted in Exhibits A and B, attached hereto and made parts hereof.

Section 4 USE RESTRICTIONS AND CONTROL IN THE RESERVE.

(1) The cutting, killing, damaging, burning or removal of any terrestrial or aquatic plant or animal life or related acts are prohibited in the Reserve, including but not limited to angling, netting, spearing, trapping, or the gathering of coral, shellfish, or limu.

(2) The possession in the Reserve of implements for removing terrestrial or aquatic plants or animals, objects of antiquity, hunting or fishing gear including but not limited to firearms and archery equipment, angling devices, seines, nets, spears, traps, pry bars or noxious chemicals, is prohibited.

(3) The introduction, possession or release of any viable form of foreign plant or animal life in the Reserve is prohibited. "Foreign" shall mean originating outside the Reserve.

(4) The presence, introduction, possession or operation of any vehicle in the Reserve is prohibited.

(5) The introduction or possession of any vessel on the fast or dry lands in the Reserve is prohibited and no person shall operate a vessel on or in the waters except as provided in the State Boating Regulations, Department of Transportation, State of Hawaii.

(6) Swimming, wading or otherwise entering mixohaline lava ponds or brackish water ponds not definitely part of the open ocean in the Reserve or the placement of any materials in such waters, are prohibited.

(7) The appropriation, excavation, injuring or destroying of any historic or prehistoric ruin or monument or any object of antiquity in the Reserve are prohibited.

(8) The installation of any new structures, construction of new access routes, or the modification of existing road or trails are prohibited.

(9) Activities not consistent with preservation of natural values or scientific or education uses, such as the disturbance, excavation or removal of lava or other mineral material and grazing or other agricultural uses, are prohibited.

(10) Discarding of any foreign material, refuse, or litter of any description or depositing into waters within or bordering upon lands of the Reserve, any substance which pollutes or is liable to cause pollution of said waters is prohibited.

(11) The willful tearing down, defacing or disturbing of any public notice, sign, monument, or buoy posted or installed within or on the boundary of the Reserve is prohibited.

(12) Camping, building fires or nighttime use between one-half hour (½) after sunset and one-half (½) hour before sunrise in the Reserve are prohibited.

Section 5 EXCEPTED USES AND PERMITS.

(1) The Board or the Chairman of the Board after approval of the Commission may issue permits granting exceptions to the restrictions of this regulation for research or educational purposes. Each request for such special-use permit shall be submitted in writing and shall be considered on its own merits, particularly its effect on the Reserve. Said permits hall be non-transferable and subject to cancellation or termination by the Board or its duly authorized representative.

(2) Designated parking areas within the Reserve are excepted from specified restricted uses and from the prohibition of the introduction or possession of prohibited materials or articles as set forth in the above Sections 4.2, 4.3, 4.4, 4.5, and 4.12 of this Regulation. Exceptions apply to vehicle operation, possession of boats and catch devices intended for use outside the Reserve, possession of plant and animal materials originating outside the Reserve and being transported through it.

(3) The Reserve boundary landward from the Makena-Keoneoio Road is intended to include only recent lava flows and their vegetated kipukas. Because practical boundary lines cannot precisely follow the lava's edge, those portions of vegetated, non-kipuka lands extending into the Reserve along boundary course 3 through 23 are excluded from the restrictions of this Regulation.

Section 6 PENALTY. Any person who violates any of the provisions of this regulation shall be fined upon conviction thereof not more than One Hundred Dollars ($100.00) or imprisoned not more than thrity (30) days, or both for each offense.

Adopted the Board of Land and Natural Resources on this 8th day of June, 1973.

BOARD OF LAND AND NATURAL RESOURCES

By: /s/ Sunao Kido
Chairman and Member

And By: /s/ Newton Miyagi
Member

Approved this 2nd day of August, 1973.

/s/ John A. Burns
Governor of Hawaii

Approved as to Form:

/s/ Russell N. Fukumoto
Deputy Attorney General

Approved by the Natural Area Reserves System Commission this 10th day of July, 1973.

/s/ J. Linsley Gressitt
Commission Chairman

/s/ Arnold L. Lum
Member

CERTIFICATION

I HEREBY CERTIFY that the foregoing Regulation No. 7 was adopted on June 8, 1973, after a public hearing was held on March 12, 1973, in the State Building, Wailuku, Maui, notice of which was duly published in the Honolulu Star Bulletin and Advertiser Sunday edition on February 18, 1973 and the Maui News on February 27, 1973.

The foregoing is a full, true and correct copy of the original on file in the Office of the Chairman, Board of Land and Natural Resources, State of Hawaii.

Dated at Honolulu, Hawaii, this 26th day of July, 1973.

/s/ Sunao Kido
SUNAO KIDO
Chairman and Member
Board of Land and Natural Resources

STATE OF HAWAII
SURVEY DIVISION
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
HONOLULU

C.S.F. No. 16,807 January 22, 197

AHIHI-KINAU
NATURAL AREA RESERVE
PARTS 1 AND 2

Honuaula, Makawao, Maui, Hawaii

PART 1 - Being portions of the Government Land of Onau, Kanahena, Kualapa and Kalihi.

Beginning at a bent railroad spike imbedded in rock at high-water mark at seashore, at the northwest corner of this tract of land, the coordinates of said point of beginning referred to Government Survey Triangulation Station "PUU OLAI" being 5901.80 feet South and 3332.30 feet East, as shown on Government Survey Registered Maps 4132 and 4133, thence running by azimuths measured clockwise from True South:--

1.	280° 45' 20"	50.00 feet	along Government Land and across Keoneoio Government Road to the mauka side of said Government Rc
2.	Thence along the mauka side of Makena-Keoneoio Government Road fol-		lowing all of its sinuosities t a point on mauka side of said Go ernment Road, the direct azimuth and distance being: 321° 00' 2200.00 feet;
3.	213° 30'	1400.00 feet	along Government Land;
4.	247° 00'	4800.00 feet	along Government Land;
5.	337° 30'	1500.00 feet	along Government Land;
6.	55° 00'	2600.00 feet	along Government Land;
7.	107° 00'	500.00 feet	along Government Land;
8.	2° 00'	800.00 feet	along Government Land;
9.	287° 00'	1088.26 feet	along Government Land;
10.	10° 00'	486.50 feet	along Government Land;
11.	273° 00'	1800.00 feet	along Government Land;
12.	215° 00'	1200.00 feet	along Government Land;
13.	264° 00'	1200.00 feet	along Government Land;
14.	352° 00'	800.00 feet	along Government Land;
15.	46° 23'	992.87 feet	along Grant 1380 to Kapuahelane;
16.	15° 30'	1400.00 feet	along Government Land;
17.	52° 30'	700.00 feet	along Government Land;
18.	340° 00'	450.00 feet	along Government Land;
19.	36° 30'	743.39 feet	along Government Land, to toe of

Thence along the toe of hill for the next four (4) courses, the direct azimuths and distances between points on said toe of hill being:

20. 140° 00' 639.58 feet;
21. 95° 00' 500.00 feet;
22. 59° 00' 500.00 feet;
23. 29° 00' 600.00 feet, continuing over and across to the makai side of Makena-Keoneoio Government Road;

24. 114° 21' 20" 155.00 feet along the land conveyed to J.H. Raymond by the Territory of Hawaii by Exchange Deed dated January 25, 1915;
25. 355° 11' 20" 1161.00 feet along the land conveyed to J.H. Raymond by the Territory of Hawaii by Exchange Deed dated January 25, 1915;
26. 241° 12' 20" 300.00 feet along the land conveyed to J.H. Raymond by the Territory of Hawaii by Exhange Deed dated January 25, 1915, to highwater mark at seashore;

Thence along highwater mark at seashore for the next five (5) courses, the direct azimuths and distances between points on said highwater mark at seashore being:

27. 40° 00' 2500.00 feet;
28. 114° 30' 3200.00 feet;
29. 139° 00' 3270.08 feet;
30. 195° 30' 4526.06 feet;

31. 157° 19' 48" 1320.34 feet, to the point of beginning and containing a GROSS AREA of 1245.50 ACRES and a NET AREA of 1238.49 ACRES, after excepting and excluding Grants, Land Commission Awards and the Government Road, containing a total Area of 7.01 Acres.

<u>Exclusions:</u>

a.	Grant 2199, Apana 3 to Kapoi	2.06 Acres
b.	L.C.Aw. 2605, Apana 5 to Paela	0.67 Acres
c.	L.C.Aw. 5424, Apana 2 to Kanao	0.13 Acres
d.	L.C.Aw. 5388 to Hoomilianuke	0.25 Acres

C.S.F. No. 16,807 January 22, 197

e. Makena-Keoneoio Government Road 3.90 Acres

7.01 Acres

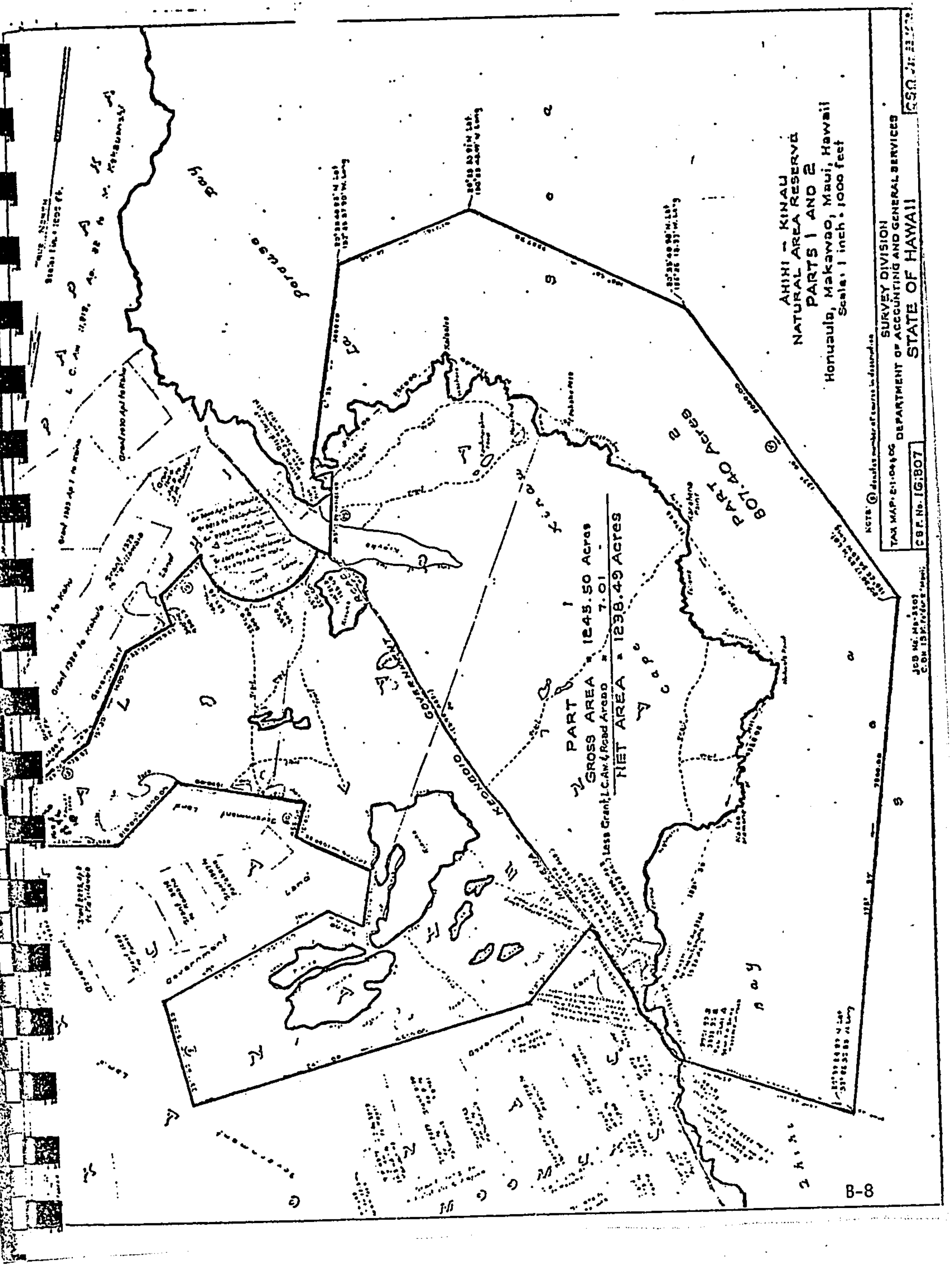
PART 2 - Submerged land fronting Moomuku, Onau, Kanahena, Kualapa and Kalihi.

Beginning at a bent railroad spike imbedded in rock at highwater at seashore, at the northeast corner of this submerged parcel of land the coordinates of said point of beginning referred to Government Sur very Triangulation Station "PUU OLAI" being 5901.80 feet South and 3332.30 feet, as shown on Government Survey Registered Maps 4132 and 4133, thence running by azimuths measured clockwise from True South:--

Along the lands of Onau, Kanohea and Kaulapa, along highwater mark at seashore for the first five (5) courses, the direct azimuths and distances between points at said highwater mark at seashore being:

1. 337° 19' 48" 1320.34 feet;
2. 15° 30' 4526.06 feet;
3. 319° 00' 3270.08 feet;
4. 294° 30' 3200.00 feet;
5. 220° 00' 2500.00 feet;
6. 0° 30' 3000.00 feet to a point, said point being 20° 35' 40.26" North Latitude and 156° 25' 27.90" West Longitude;
7. 60° 30' 1917.14 feet to a point, said point being 20° 35' 30.91" North Latitude and 156° 25' 45.47" West Lon tude;
8. 108° 00' 3287.30 feet to a point, said point being: 20° 35' 40.98" North Latitude and 156° 26' 18.37" West Longitude;
9. 137° 00' 5000.00 feet to a point, said point being: 20° 36' 17.23" North Latitude and 156° 26' 54.26" West Lon tude;
10. 178° 30' 7200.00 feet to a point, said point being: 20° 37' 28.57" North Latitud and 156° 26' 56.25" West Long tude;
11. 280° 45' 20" 2500.00 feet to the point of beginning and co taining an AREA OF 807.40 ACRES

COMPILED FROM GOVERNMENT SURVEY RECORDS: SURVEY DIVISION-DAGS-HAWAII



AHIHI – KINAU
NATURAL AREA RESERVE
PARTS 1 AND 2
Honuaula, Makawao, Maui, Hawaii
Scale: 1 inch = 1000 feet
SURVEY DIVISION
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
STATE OF HAWAII
NOTE: ⑥ denotes number of course in description
TAX MAP: 2-1-04 & 06
C.S.F. No. 16,807
PART 1
GROSS AREA = 1245.50 Acres
Less Grant, L.C.Aw. & Road Areas = 7.01
NET AREA = 1238.49 Acres
PART 2
807.40 Acres
Cape Kinau
Keoneoio
Government
La Perouse Bay
Ahihi Bay

APPENDIX C

APPENDIX C-1

Qualitative Physical and Geological Data Collected During Transect Surveys. Abundance Data (% cover) for Substratum Types Determined from Quadrat Method or Visual Estimates

	Transect Number																	
	1S	1D	2S	2D	3S	3D	4S	4D	5S	5D	6S	6D	7S	7D	8S	8D	9S	9D
Depth (m)	2	9	3	8	2	9	2	8	2	10	3	9	4	8	3	9	3	8
Visibility (horizontal, m)	11	14	3	6	6	12	14	17	15	15	10	15	7	9	6	10	10	15
% Carbonate in Sediments (visual estimate)	90	90	90	25	90	90	25	50	90	90	90	90	90	90	50	90	75	100
Sand Ripple width (cm)	4	7	6	4	12		20	9	6	5			6	6		55		
Basalt Rock			P						P						P		P	
Freshwater Seepage	P		P						P		P							
Substratum Types:																		
Loose Sand	1	14	50*	24	48	7	4	21	P	90*	P	95*	9	26	<1	46	<1*	<1*
Coarse Sand								P					<1					
Consolidated Reef Rock (exposed)		43	50*		44	27	49	43	90		95				89	14		
Algal Turf (over reef rock)				65									86	72		25		
Total Coralline Algae	18	<1					6		P				<1			1	P	P
Porolithon onkoides																	10*	
Porolithon gardineri																	10*	
Hydrolithon reinboldi																P		
Live Corals (total)	42	43	<1	11	9	66	41	36	35	32	32	<1	5	2	11	4	90	00

* % cover determined by visual estimate
<1 = less than 1%
P - present but not counted or measured

APPENDIX C-2

Substratum types directly beneath the 50 points of the transect line (Line-intercept Method) at each of eleven stations.

	1S	1D	2D	3S	3D	4S	4D
1	S	B	P.com	L.pur	So	So	So(SF)
2	So	B	So(SF)	So	P.com	P.lob	So(SF)
3	P.lob	So(SF)	So(SF)	So	P.lob	So	So(SF)
4	M.pat	S	P.com	So	R(SF)	So	So(SF)
5	So(S)	So(SF)	B(SF)	So	R	So	So(SF)
6	So	So(SF)	B(SF)	So	P.mdr	P.lob	So(SF)
7	So	S	P.com	So	So(SF)	P.lob	So(SF)
8	So	So(SF)	So(SF)	S	So	P.lob	So(SF)
9	So	So(R,SF)	So(SF)	So	P.lob	So	P.lob
10	So	So(SF)	So(SF)	So(SF)	So(SF)	P.lob	So(SF)
11	B	R	So(SF)	So	B(SF)	So(S)	So(SF)
12	B	P.mdr	B	S	R	So	So(SF)
13	So(S)	So(SF)	So(SF)	So	*R	P.lob	So(SF)
14	P.mdr	R	So(SF)	*So(SF)	R	So	M.pat
15	P.mdr	P.com	S	So	P.lob	So	P.com
16	So	So	So(SF)	So	R	So	So(SF)
17	* M.pat	P.lob	So(SF)	S	B	P.com	So(SF)
18	So	P.com	S	S	P.mdr	P.lob	S
19	So	P.lob	So(SF)	S	S	So	So(SF)
20	So	P.com	So(SF)	S	*P.com	So	B(SF)
21	B	R	*R	S	R	So	P.lob
22	So	So(SF)	So(SF)	S	P.lob	*P.lob	P.lob
23	P.lob	P.com	So(SF)	S	P.lob	P.lob	R
24	M.pat	P.com	So(SF)	S	So(SF)	P.com	*P.lob
25	P.lob	P.lob	So(SF)	So	So(SF)	So	P.com
26	L.pur	So(SF)	P.lob	So(S)	B	So	B
27	So	SC	So(SF)	S	R	So	P.lob
28	P.mdr	SC	So(SF)	So(SF)	R	So	P.com
29	So	So	So(SF)	So	P.lob	So	B
30	So(S)	So	So(SF)	*S	R	L.pur	B
31	L.pur	P.com	So(SF)	So	R(SF)	So	So(SF)
32	So(S)	P.lob	R(SF)	So	P.lob	So	So(SF)
33	So	So(SF)	So(SF)	So	P.lob	P.lob	B
34	Pa.tb	SF	So(SF)	So	P.lob	So	R
35	So	P.lob	So(SF)	So	R	So	R
36	P.lob	P.com	So(SF)	So	R(SF)	So	R
37	So	P.lob	So(SF)	So	P.lob	So	P.lob
38	So	SF	So(SF)	So	R(SF)	S	R
39	So	So(SF)	So(SF)	So	So(SF)	So	B
40	So	So(SF)	So(SF)	So(SF)	P.lob	So	P.lob
41	So	So(SF)	So(SF)	So	B	P.lob	P.com
42	P.lob	P.lob	So(SF)	So	P.lob	So	P.com
43	P.mdr	So(SF)	So(SF)	So	R(SF)	So	R
44	So(S)	*So(SF)	So(SF)	*So	R(SF)	So	R
45	M.vrc	P.com	So(SF)	So	P.lob	R	R(SF)
46	P.lob	R	So(SF)	So	R	P.lob	R
47	B(S)	R	So(SF)	S	P.lob	So	R(SF)
48	B(S)	P.lob	So(SF)	S	B	So	P.com
49	B(S)	*R	So(SF)	So	R	So	R(SF)
50	B(S)	So(SF)	So(SF)	S	P.lob	P.lob	R(SF)

* indicates position of quadrat samples

APPENDIX C-2 (CONTINUED)

TRANSECT NO.:	7S	7D	8S	8D
1	So(S)	So(SF)	So	So(S)
2	So(S)	So(SF)	So	So(S)
3	So(S)	So(SF)	So	So(S)
4	P.com	So(SF)	So	So(S)
5	So(S)	So(SF)	So	So(S)
6	So(S)	So(SF)	So	L.pur
7	So(S)	So(SF)	So	So(S)
8	So(S)	So(SF)	So	So(S)
9	S	B(SF)	So	So(S)
10	So(S)	So(SF)	So	So(S)
11	So(S)	So(SF)	So	So(S)
12	So(S)	So(SF)	So	So(S)
13	So(S)	P.mdr	P.com	R(S)
14	So(S)	So(SF)	So	So(S)
15	So(S)	So(SF)	So	So(S)
16	So(S)	So(SF)	B	So(S)
17	P.com	So(SF)	So	So(S)
18	So(S)	So(SF)	So	So(S)
19	So(S)	So(SF)	So	S
20	So(S)	So(SF)	So	So(S)
21	So(S)	So(SF)	So	P.mdr
22	So(S)	So(SF)	So	R(S)
23	S	So(SF)	So	So(S)
24	So	So(SF)	So	R(S)
25	So	S	B	So(S)
26	So(S)	S	So	So(S)
27	M.vrc	S	So	So(S)
28	So(S)	S	So	So(S)
29	So(S)	So(SF)	So	R
30	B(S)	So(SF)	So	So(S)
31	So(S)	So(SF)	So	So(S)
32	So(S)	So(SF)	So	R(S)
33	So(S)	So(SF)	So	So(S)
34	So(S)	So(SF)	So	So(S)
35	So(S)	So(SF)	So	So(S)
35	So(S)	So(SF)	So	So(S)
37	So(S)	So(SF)	So	So(S)
38	So(S)	So(SF)	So	So(S)
39	So(S)	So(SF)	B	So(S)
40	So(S)	So(SF)	So	So(S)
41	So(S)	So(SF)	So	So(S)
42	So(S)	So(SF)	So	So(S)
43	So(S)	So(SF)	So	So(S)
44	So(S)	So(SF)	P.com	So(S)
45	So(S)	So(SF)	So	So(S)
46	So(S)	So(SF)	So	So(S)
47	So(S)	So(SF)	So	S
43	So(S)	So(SF)	So	S
49	So(S)	So(SF)	So	P.com
50	So(S)	So(SF)	So	So(S)

CODES:

So – Consolidated carbonate reef; usually covered with an algal mat or turf.

So(S) or So(SF) – Consolidated carbonate reef covered by a thin layer of sand (less than 1 cm deep) or sand trapped in algal mat on solid substratum.

B – Boulder; usually a worn massive coral head unattached to consolidated reef.

R – Rubble; smaller fragments of corals or branches of non-livi coral unattached to consolidat reef.

S – Sand; sand deposit on solid substratum over 1 cm. deep; ma be noticably fine (SF) or coarse (SC).

P.com. – Porites compressa
P.lob – Porites lobata
P.mdr – Pocillopora meandrina
M.vrc – Montipora verrucosa
M.pat – Montipora patula
L.pur – Leptastrea purpurea
Pa.tb – Palythoa tuberculosa

APPENDIX C-3

Raw Data: Quadrat Method. All Transects Run Parallel to Shore

	Quadrat Number									
	1	2	3	4	5	6	7	8	9	10
					TRANSECT 1D					
S	5	27		16	11		55	3	25	
R	53	53	64	36	32	38	5	92	35	18
PL	11	4	15	15	14	42	4	3	28	6
PC	21	14	12	29	39	18	31		3	75
PM	9		3	2		1		1	4	
MV	1	1	6	2	3	1	5		5	
MP		<1			1			1		
TRIP		1	7	6	3	3			2	1
PV									1	
EM									P	
CA										1
					TRANSECT 1S					
CO						1				
HET								2	1	1
EXD	9	7	1	1		4	5	6	9	
TRIP	2	3	2		1	1	2	3	1	
PM	18	12	1	23	7	7	14	19	17	
PL	20	26	5	29	27	33	7	15	14	1
CA	62	59	86	32	25	59	55	42	49	96
MP		2	3	6	11		3			
PAL		1								
EM	P	3			3					
S			5	1		1	1			2
PB				<1	<1		1			
PV				2			12	5		
PMD				6	23		7	12	20	
LP					2			7		
MV					1	1				
					TRANSECT 2D					
PL	18	11	<1	2	1	15	<1		2	
PM	2	2			8	5			<1	
PC	28	2	<1	1		1				
S		4	50	60	4		4	40	45	30
AT	52	81	49	36	86	77	91	60	52	70
MV				<1	<1					
LP						1				
PLG						1				
PEY							1			
PMD							3			

APPENDIX C-3 (CONTINUED)

TRANSECT 3D

	Quadrat Number									
	1	2	3	4	5	6	7	8	9	10
MP				<1			1		2	
PM	3	3	3	5		2	3		2	2
PL	20	24	30	10	40	20	18	19	45	50
PC	34	20	41	27	45	3	22	62	40	30
PV							1			
S	1	4	3	15		27	5	12		3
MV	1	2	1	1		1		1	2	3
R	40	44	22	35	7	45	48	6	9	12
TRIP	1	1	1	2	3	2	1	1	3	3
PAL	1									
ECHIN							1			
PMD		3		6	8	2	2			
EM					1				1	
LINK					1					
LP						1				

TRANSECT 3S

	1	2	3	4	5	6	7	8	9	10
S	100	21	3	78	100	100	7	73		
PM		4					7			4
TRIP		7	2	4			3		3	1
LP		6								
PL			18				2		6	24
R		69	79	18			80	27	94	70
EXD			13						1	8
EM	P	P	P	P			P		P	P
EXC									1	
MP							4			2
HET										3

TRANSECT 4D

	1	2	3	4	5	6	7	8	9	10
PMD	1									
PL	2	2	16	36	25	1	24	17	3	18
S	19	75	9	3		85	4	6	5	2
PM	<1		2	<1	1				1	3
MV	<1		1	1				1	1	
MP		<1	1					<1		
PC			6	14	68	7	24	55	9	20
R	77	22	65	45	6	7	48	20	81	57
TRIP							2	1		2
EM								1	1	

APPENDIX C-3 (CONTINUED)

	Quadrat Number									
	1	2	3	4	5	6	7	8	9	10
TRANSECT 4S										
PL	27	24	36	35	6	18	42	25	15	9
PC	3		11	13	7	6	9		1	3
CO	1									
MV	2			2				1	3	
PM	5	8	3		7	3		10	9	
PMD	7								9	4
CA	2	7	7	10	6	13	10	2	1	
R	53	60	33	36	72	58	39	48	55	38
PV		1	3	2	1	2				
EM		P	P							
S			7	2				13	7	15
LP					<1					29
MVE								1		
MP										1
PB										<1
TRANSECT 7D										
S	5	7	8	19	15	97	13	27	40	33
AT	95	83	86	80	84	3	87	73	60	67
PM		6	5							
PL		3	1	<1	<1					
MP		<1								
TRANSECT 7S										
PL	1		2	1		3				
S	10	3	1	5	3	1	20	42	6	2
AT	89	95	84	92	93	88	80	58	91	93
PM		2	4		3	3				4
CA			1	<1					1	
PMD			8			4			2	
S (coarse)				1						
MV					1	1				
TRANSECT 8D										
PL	1		1		6	<1		<1	6	
S	75				30	45	91	60	80	75
MV		1		<1						
PM			3		<1				4	
CA			1							
R						54	9	39	9	25
MP									<1	
AT	85	26	79	60						

APPENDIX C-3 (CONTINUED)

	Quadrat Number									
	1	2	3	4	5	6	7	8	9	10
					TRANSECT 8S					
R	99	87	94	96	74	93	79	95	95	75
CO	<1			1	<1	<1		1		
PB	<1	<1	1	1				<1	1	
S		2				1				
PL		10			19	5	16			25
PM			5		6		5		3	
PSE				2				1		
MP								1		
MV								<1	1	
LB								<1		
MF								1		
PLG										3

Numbers: corals – % coverage in quadrat
echinoderms – numbers of individuals in quadrat
P: present in quadrat in unknown numbers
Substrate: S – sand
R – reef rock
CA – coralline algae
AT – algal turf
Echinoderms: TRIP – *Tripneustes*
EM – *Echinometra*
EXD – *Echinothrix diadema*
EXC – *Echinothrix calamaris*
HET – *Heterocentrotus*
DIAD – *Diadema*
ECHINO – unidentified echinoid (urchin)
LINK – *Linckia multifera*
Corals: CO – *Cyphastrea ocellina*
LP – *Leptastrea purpurea*
LB – *Leptastrea bottae*
PV – *Pavona varians*
PL – *Porites lobata*
PC – *Porites compressa*
PB – *Porites brighami*
PE – *Porites evermanni*
PM – *Pocillopora meandrina*
PMD – dead *Pocillopora meandrina*
PEY – *Pocillopora eydouxi*
PLG – *Pocillopora liqulata*
MV – *Montipora verrucosa*
MP – *Montipora patula*
MF – *Montipora flabellata*
PSE – *Psammocora explanatula*
PAL – *Palythoa tuberculosa*
MVE – *Montipora verrilli*

APPENDIX C-4

Raw Data from Fish Surveys along the Transects. Numbers Refer to the Number of Individuals of Each Species per Transect

Scientific Name	Local Name (if known)	Transect Number																	
		1S	1D	2S*	2D	3S	3D	4S	4D	5S*	5D*	6S*	6D*	7S	7D	8S	8D	9S*	9D*
ACANTHURIDAE (surgeon fishes)																			
Acanthurus sandvicensis	Manini	11		5		14				5		9		16	3	14		11	3
Acanthurus nigrofuscus	Maiko	133	36	87	16		35	140	46	80		16		5	1	72		83	16
Acanthurus achilles	Paku'iku'i	2	2							2						2		6	2
Acanthurus leucopareius	Maikoiko	10		8		7		4		6						1		5	
Acanthurus dussumieri	Palani											1		1	1			2	1
Acanthurus olivaceus	Na'en'e		1	3	5				7	12	5	7		1		35		16	11
Naso lituratus	Kala	3		9	2			4	1	50						8	1	11	
Naso unicornis	Kala	2		7						2	3		5		4	6		3	2
Naso hexacanthus	Kala	1	23		7		85	3		1	2	3	3		9	2			
Acanthurus mata	Pualu	1	1	1	24				2	5				9		4			
Ctenochaetus strigosus	Kole	13	114	1	9		103	2	97	18		9				13		19	15
Zebrasoma flavescens	Lau'i-pala		30				16		16	3	3		2			4		31	4
Acanthurus glaucopareius										2							1		
LABRIDAE (wrasses)																			
Thalassoma duperreyi	Hinalea lau-wili	94	65	103	53	112	28	104	51	70	30	60	41	93	93	109		63	40
Thalassoma ballieni	Hinalea luahine	2					4	2		4	1		3			1	4	5	
Thalassoma fuscum		2		3		3		2		4		1		4		3	1	2	
Thalassoma lutescens		4	1																
Labroides phthirophagus		1					2				4	2	2			3		4	2
Stethojulis axillaris	'Omaka	26	16	33	9	75	12	23	4	30	45	7	30	33	10	30		27	9
Stethojulis albovitatta	'Omaka				2	3	1				1		4			1	4	2	
Pseudocheilinus tetrataenia		1	2		2						2		2						
Pseudocheilinus octotaenia			12		9		19		19		17		11		3		1		3
Gomphosus varius	Hinalea i'iwi	1	1					4	1	1	2		3					3	
Halichoeres ornatissimus	La-o	5	1			2	5							17	1	1	1	1	
Coris flavovittata	Hilu					1													
Coris gaimardi	Hinalea lolo		2				1			7		2		6	4	3	1	7	
Novaculichthys bifer														1		5	3	1	
Anampses cuvieri	'Opule			1			3								2				
Bodianus bilinulatus	'A'awa						1				2		1	1			1		1
Iniistius pavoninus	Lae-nihi														1				
CIRRHITIDAE (hawk fishes)																			
Paracirrhites arcatus	Pili-ko'a	17	12		19		5	3	9	3	11	1	19	16	18	1	21	3	9
Paracirrhites forsteri	Pili-ko'a			2	3			1			7	2	3		1			1	

APPENDIX C-4

Scientific Name	Local Name (if known)	Transect Number																	
		1S	1D	2S•	2D	3S	3D	4S	4D	5S•	5D•	6S•	6D•	7S	7D	8S	8D	9S•	9D•
CIRRHITIDAE (cont.)																			
Paracirrhites cinctus	Pili-ko'a																	2	
Cirrhitops fasciatus	Pili-ko'a	9	1	5	10	15	4	5	6	9		2		5	1	7	9		5
Cirrhitus alternatus	Pili-ko'a																	1	
Cirrhitus pinnulatus						1				1							4		
POMACENTRIDAE (damsel fishes)																			
Plectroglyphidodon johstonianus		36	21	54	27	27	23	28	14	17	18	5	7	8	10	21	1	13	17
Chromis leucurus			53				268		46		23				1				
Chromis ovalis		325	26		31	19	2		6	19	15			16	31	22	11	41	29
Pomacentrus jenkinsi		108	27	61	8	23	23	54	3	40	13	30	21	8	4	26		51	63
Abudefduf imparipennis		28		43		80		1		31		20		38	19	24		11	
Abudefduf abdominalis	Maomao	27		16		9		3		7				4	2	8		16	
Abudefduf sindonis							9												
Abudefduf sordidus	Kupipi					1				2		1						5	
Dascyllus albisella	Alo'ilo'i				14		15		18		9		7		8				8
MULLIDAE (goat fishes)																			
Parupeneus pleuostigma	Malu	3	5	21			4		1	2		3			1	3		5	
Parupeneus multifasciatus	Moano	7	10	13	11	5	34	1	17	9	8	5	3			6		11	4
Parupeneus chryserydros	Moano kea	1	4	5			4						2		1	2		2	1
Parupeneus porphyreus	Kumu		1	3		4				3			2	5				3	2
Parupeneus bifasciatus	Munu														3	13		1	
Mulloidichthys samoensis	Weke-'a'a			16	4													9	100
Mulloidichthys auriflamma	Weke-'ula																	2	3
CHAETODONTIDAE (butterfly fishes)																			
Chaetodon fremblii	Kapuhili	3	2		3		1			3	1		2					3	5
Chaetodon lunula	Kikakapu			1				1		1						4		1	3
Chaetodon multicinctus	Kapuhili	1	37		6		29	1	28		11		9					16	11
Chaetodon ornatissimus	Kikakapu	3	2				1	3	1	2	2	1						4	4
Chaetodon trifasciatus	Kapuhili							2		2								4	
Chaetodon quadrimaculatus	Lauhau									6						2		7	9
Chaetodon reticulatus	Lauhau																	1	
Chaetodon unimaculatus	Kikakapu		1	2			2			1								5	3
Chaetodon miliaris	Lauwiliwili	2														1		3	
Chaetodon corallicola	Kapuhili						28		14		7		6						
Chaetodon auriga	Kapuhili			1							1								
Forcipiger flavissimus	Lau wiliwili-nukunuku-'oi'oi						4	1			1		3					1	8
POMACANTHIDAE (angel fishes)																			
Centropyge potteri			28		14		25		31		11		19					7	16

Scientific Name	Local Name (if known)	Transect Number																	
		1S	1D	2S•	2D	3S	3D	4S	4D	5S•	5D•	6S•	6D•	7S	7D	8S	8D	9S•	9D•
CANTHIGASTERIDAE (puffer fishes)																			
Canthigaster jactator		12	13	9	12		7	11	18	11	12	4	7	4	16	7	22	11	7
Canthigaster amboinensis	Pu'u-u-ola'i	5				1		1		2			1			2		3	
BLENNIIDAE (blennies)																			
Runula ewaensis		5				5				7	2	9	2	8		3		7	
Exallias brevis	Pao'o kauila	2	3		1		1		2		1		3			1		1	2
Cirripectus variolosus		4		7		16		8					3						5
Cirripectus obscurus						1										1			
OSTRACIONTIDAE (box fishes)																			
Ostracion lentiginosus	Moa	4		2				2		1	2	1	1			1		1	
MURAENIDAE (moray eels)																			
Gymnothorax meleagris	Puhi	3				1					1				2			1	
Gymnothorax urostus	Puhi					1							1	1	1	1			1
Echidna zebra	Puhi							1											
ZANCLIDAE (moorish idols)																			
Zanclus canescens	Kihikihi	2		1			2	1	3	1	1							3	7
AULOSTOMIDAE (stick fishes)																			
Aulostomus chinensis	Nunu	1			3				1	2	2	3	2			3		2	3
FISTULARIIDAE (stick fishes)																			
Fistularia petimba	Nunu peke							4			2								
BALISTIDAE (trigger fishes)																			
Sufflamen bursa	Humuhumu-umauma-lei	3					6		1	2							1	2	1
Rhinecanthus rectangulus	Humuhumu-nukunuku-a-pua a	1		3	1	1		1	2	3	2	1			3	3	7	3	5
Melichthys vidua	Humuhumu-uli	1	1							1							1	1	2
Melichthys buniva	Humuhumu-'ele'ele																	1	
Balistes fuscus	Humuhumu				1				1										
MONACANTHIDAE (file fishes)																			
Pervagor spilasoma	'o'ili uwiwi	1	5		4		2	2	5	7	6	2	3	3	6		4	4	1
SCARIDAE (parrot fishes)																			
Scarus sordidus	Uhu	3		11	2		7	28	9	23	3		5					7	7
Scarus rubroviolaceous	Uhu																	1	
Calotomus spinidens	Uhu														1				
CARACANTHIDAE (---)																			
Caracanthus maculatus		11	1		14			3	1	13	19	16	7	5	25		24		3

A...DIX C-4

Scientific Name	Local Name (if known)	1S	1D	2S*	2D	3S	3D	4S	4D	5S*	5D*	6S*	6D*	7S	7D	8S	8D	9S*	9D*
SCORPAENIDAE (scorpion fishes)																			
Scorpaena coniorta		16			4	20			3	7	7	3	3		12	15	19		7
Taenianotus triacanthus															1				
SPARIDAE (porgy)																			
Monotaxis grandoculis	Mu						1						1					3	2
CHANIDAE (milk fishes)																			
Chanos chanos	Awa																	2	2
HOLOCENTRIDAE (squirrel fishes)																			
Myripristis argyromus	Menpachi		2				3											1	6
Holocentrus xantherythrus	'Ala'ihi maoli		3		9		5		1										
APOGONIDAE (cardinal fishes)																			
Apogon menesemus	'Upapalu		2		4		6		8		3		1		1				2
MALACANTHIDAE (---)																			
Malacanthus hoedtii	Maka-'a														1		7		
ANTENNARIIDAE (angler fishes)																			
Antennatus bigibbus																	1		
BOTHIDAE (flat fishes)																			
Bothos mancus	Paku															1			
BROTULIDAE (---)																			
Brotula multibarbata				1															
CONGRIDAE (conger eels)																			
Conger marginatus				1															
SPHYRAENIDAE (barracudas)																			
Sphyraena barracuda								3											
TOTAL SPECIES/STATION		48	38	33	34	26	36	35	36	50	43	29	39	25	36	46	24	66	49
TOTAL FISHES/STATION		956	567	518	343	447	836	457	493	543	318	226	250	308	301	495	150	585	472

TOTAL SPECIES OBSERVED FROM ALL STATIONS = 101

* Numbers for stations 2S, 5, 6, and 9 were estimated from notes. No actual counts of fishes were recorded for these stations.

APPENDIX C-5

PARTIAL INVENTORY OF THE MARINE ALGAE AND MACRO-INVERTEBRATES IN THE STUDY AREA

ALGAE

CYANOPHYTA

Lyngbya sp.	1M, 1D(C), 2D(A), 3D(C), 4D, 7D, 8D

CHLOROPHYTA

Ulva fasciata	1I, 2I(C), 3I(A), 8I
Enteromorpha sp.	2I
Halimeda sp.	1S, 2D, 3D, 4M, 4D
Neomeris sp.	2M, 7D
Dictyosphaeria versluysi	1D, 4M

PHAEOPHYTA

Ectocarpus breviarticulatus	1I
Padina sp.	5I (tide pool)
Colpomenia sinuosa	1D, 2D
Sargassum ?echinocarpum	8I
Turbinaria sp.	4I, 5I

RHODOPHYTA

Liagora sp.	1M, 1D(C), 2D(C), 3D, 4D
?Asparagopsis sp.	8D(C)
Gelidium sp.	On hard substratum at all stations dominating a belt close to low tide level.
Hydrolithon reinboldi	2M
Jania sp.	2S(A)
Porolithon sandvicense	1D(A)
Grateloupia sp.	8I (mixed with Gelidium sp.)
Ahnfeltia concinna	On hard substratum at all stations forming a belt on wave-washed surfaces above tide level.
Amansia sp.	4S, 4M(C), 8D

PORIFERA (SPONGES)

Terpios zeteki	1M, 1D, 2D, 3D, 4D(C), 7S, 7D(C), 8D(C)
Cliona vastifica	1M, 1D(C), 2D, 4D, 7S(C), 7D(C), 8D
Dysidea herbacea	4S(C), 9S
Psammaplysilla purpurea	1M, 1D(C), 2D, 3D
yellow club	1D, 2D, 7D
black osculate	1D

CNIDARIA (COELENTERATES NOT INCLUDING CORALS)

Pennaria tiarella	1M, 2D, 7D
Palythoa tuberculosa	1D, 2I, 2S, 3S, 4S, 5I, 8S
Zoanthus ?pacificus	5I

APPENDIX C-5

PARTIAL INVENTORY OF THE MARINE ALGAE AND MACRO-INVERTEBRATES IN THE STUDY AREA

ARTHROPODA (CRUSTACEA)

DECAPODA

Stenopus hispidus	1M, 1D, 7S(C)
Panulirus sp.	4D
Calcinus latens	7S, 5I (tide pool)
Clibanarius zebra	1S, 1D, 3S, 4S(C), 7M
Grapsus grapsus	At all stations on hard substratum above high tide level.
Metopograpsus thukuhar	5I (tide pool)
Ocypode sp.	1I, 3I, 4I, 7I (beach dwelling species)

MOLLUSCA

GASTROPODA

Cellana sandwichensis	5I, 1I
Trochus histrio intextus	8S
Nerita picea	Common at all stations on hard substratum above tide level.
Littorina pintado	1I, 2I, 5I
Littorina picta	5I
Vermetidae (at least 2 spp)	At most or all stations, particularly 7S, 8S
Cerithium nesioticum	4M
Cypraea maculifera	1S
Cypraea tigris	9D
Cypraea sulcidentata	2D, 7S
Cypraea isabella	4M
Cypraea caputserpentis	1S, 3S(C)
Cypraea helvola	7S, 8D
Drupa morum	8S
Drupa speciosa	1S, 3S
Coralliophila sp.	1S
Mitra litterata	8S
Conus leopardis	7M
Conus quercinus	1M
Conus striatus	7D(C)
Conus lividus	4M, 7S
Conus pulicarius	1M, 7S, 7D
Conus miles	7S, 8M
Conus moreleti	8S
Conus ebraeus	8D
Conus abbreviatus	7D, 8S
Conus sponsalis	4S
Terebra lanceata	2S
Terebra gouldi	2D
Terebra inconstans	1S(A)
Terebra spp.	7S, 8D
Peristernia chlorostoma	4S, 8M
Siphonaria normalis	1I
Phyllidia ?trilineata	3M, 4D

APPENDIX C-5

PARTIAL INVENTORY OF MARINE ALGAE AND MACRO-INVERTEBRATES IN THE STUDY AREA

MOLLUSCA (CONT)

BIVALVIA

Acar plicata	2D(C), 3D, 4D
Barbatia sp.	4M
Arca sp.	4D
Pinctada margaritifera	4D
Isognomon perna	9S
Macoma obliquilineata	2M
Angulus nucella	2M
Arcinella thaanumi	4M

ECHINOMETRA

ASTEROIDEA

Culcita novaeguineae	7D(C)
Linckia multifora	1D(C), 2D, 3D(C), 4S, 4M, 4D, 5S(A), 5M, 6S
Linckia diplax	1M, 1D, 2D, 3M, 4M, 4D, 5D, 6S, 7D

OPHIUROIDEA

Ophiocoma spp.	1S, 1D, 2S, 3D, 4S, 7S, 7D, 8S, 8M, 9S
Ophiactis savignyi	2D

ECHINOIDEA

Echinothrix calamaris	1M, 1D, 2S, 2D, 3S, 3D, 4D, 5M, 7S, 7D, 9D
Echinothrix diadema	1S(A), 2S, 3S(A), 3M, 5M, 6S(C), 7M, 8S, 9S, 9D
Diadema paucispinum	3S
Pseudoboletia indiana	1D, 3D, 4D, 7M, 8D
Eucidaris metularia	1D, 2D, 3D, 4D
Tripneustes gratilla	1S, 1M, 1D(C), 2S(C), 3S(A), 3M(A), 3D(A), 4S, 4D(A), 5M(C), 6S, 7S, 7D, 8S, 8M
Echinometra mathaei	1S, 1M, 2S(A), 3S(C), 3D, 4S(A), 4D, 5I, 5S(C), 6S(C), 7S, 8S, 9S(C)
Heterocentrotus mammillatus	1S(C), 1D, 2S, 3S, 6S, 8S, 9M(A)
Colobocentrotus atratus	2I(C), 5I(C)

HOLOTHUROIDEA

Holothuria atra	2D, 7D
Actinopyga mauritiana	2S(C), 3S

Following each species is a listing of the stations at which divers recorded the presence of that species; I - intertidal, S - 1 to 3 meters, M - 3 to 7 meters, D - 7 to 10 meters;(C)- common, (A) - abundant relative to that species' distribution at other locations within the study area.

APPENDIX D

TABLE OF CONTENTS

LIST OF TABLES

JAPANESE TOURISM IN HAWAII

INTRODUCTION

In the last two years a great deal of interest has been taken in the pattern of expanding Japanese tourism. Such interest is justified when it is estimated that the number of East and West bound residents of Japan visiting Hawaii has more than doubled since 1970.

STUDY PURPOSE, TECHNIQUE AND ORGANIZATION

The purpose, then, of this paper is to present statistics, informal interview discussion and conclusions in terms of the Eastbound Japanese visitor to Hawaii.

The approach employed was as comprehensive as possible in view of the limited statistics available. Much of the information in text form was drawn from interviews with those in Honolulu particularly acquainted with the Eastbound Japanese visitor to Hawaii.[1]

This analysis discusses the history and organization of Japanese overseas tourism from the late 1960's, then the tour package process; characteristics of the Japanese Eastbound visitor; analysis of expenditures; comparison with Guam as a Japanese destination; and the conclusions formed from the analysis pertaining to the overall picture of the Eastbound Japanese visitor and their relation to Maui in particular.

---

[1] The cooperation of the representatives of the following organizations is appreciated: The Japan National Tourist Organization; The Duty Free Shoppers Ltd.; The Japan Travel Bureau; The Hawaii Visitors Bureau; and Aloha World Incorporated, travel agents.

THE JAPANESE EASTBOUND VISITOR TO HAWAII

The History and Organization of Japanese Overseas Travel

The number of Japanese nationals travelling to foreign countries registered its first large increase in 1969 when the number increased 43 percent over the 1968 figure. This annual increase has continued with an increase of 35 percent in 1970, 45 percent in 1971, and 45 percent again in 1972, then it jumped to 64 percent in 1973. This increase in travel to foreign countries is attributed to the increase of personal income and travel allowances (Japan, 1970, 1971, 1974; Mainichi Daily News, 1974).

The number of Japanese visitors, visiting the United States, was approximately 104,000 in 1969, 132,000 in 1970, 207,000 in 1971, 311,000 in 1972 and 650,000 in 1973 (Japan, 1970, 1971, 1974; Mainichi Daily News, 1974).

The first American visitor destination in the Pacific to feel the impact of the increase of Japanese visits to foreign countries was Guam. In 1967, Pan American Airlines inaugurated two to three flights a week between Guam and Japan. Since that time, the number of Japanese visitors to Guam has increased on an annual basis (Guam, 1972).

Hawaii generally did not feel the impact of the growing Japanese overseas travel until 1972. However, over the years there had been an increase in the number of Japanese nationals visiting Hawaii on the Westbound (return) portion of their out of country trips (table 1).

TABLE 1

COMPARISON OF ESTIMATES OF JAPANESE VISITORS TO HAWAII

	Year				
	1969	1970	1971	1972	1973
Estimate of Visitors to Hawaii with Residence in Japan[1]	90,000	131,500	180,000	230,000	330,000
Estimate of Eastbound Visitors with Residence in Japan[1]	N/A	N/A	93,000	106,000	231,700
Estimate of Eastbound Visitor with Residence in Japan Travelling to Hawaii Only[2]	60,000	94,000	160,000	N/A	N/A

Source: [1]Hawaii Visitors Bureau, 1974;
[2]Japan, 1974.

The indigenous Japanese visitor industry is highly organized. Any person who operates a "General Travel Agency", one dealing with out of country visits, must be licensed by the Ministry of Transportation, deposit business guarantees, and file a schedule of fees and contracts. Applicants for a license must satisfy certain conditions including conditions concerning financial ability, credit and staff. In the years 1966 and 67, 81 percent of the Japanese overseas travel was handled by these General Travel Agencies. The figure for 1968 was 67 percent; 1969, 61 percent; 1970, 77 percent, and for 1971, back up to 81 percent (Japan, 1970, 1971, 1974).

The Tour Process

Because ninety percent of the Japanese who visit Hawaii come with a tour group, we will give particular attention to the tour group process (Hawaii Visitors Bureau, 1974b).

The Japanese tourist has approximately twenty-six accredited travel bureaus available to him.

The tour agency solicits a number of prospective Hawaii bound people, between 40 and 200 individuals in a group. A contract is made with an air carrier to transport the group for a bulk rate. Presently the bulk rate appears to approximate one-half the economy round-trip air fare.[2]

Upon completion of air transportation arrangements, the tour agency contracts with a tour operator in Hawaii to execute the land arrangements. Land arrange-

---

[2] Northwest Airlines quote economy round-trip, $718.00. Tour industry quotes bulk rate estimated $400.00 in 1973.

ments include transportation to and from the airport, hotel reservations, one meal a day, and one or two basic tours.

Upon arrival at Honolulu International Airport, the local tour operator officially greets the group and escorts them on a tour of the city, and sometimes a tour of the Arizona Memorial.[3] Following the tour, group members are offered a variety of options to fill their days and nights in Hawaii. In addition to greeting the group, the tour operator confirms selected optional arrangements, oversees individual needs, and concludes the Hawaii trip by escorting the group to the airport for departure.

Tour bureaus generally focus their tour packages in Honolulu. They are motivated by the Japanese client's perferences. The Japanese people are constantly on the move. Many prefer to visit an area with a variety of day activities and large scale evening entertainment. Although they appreciate the solitude and beauty of the less populated islands, there is less incentive for an extended stay.

To provide Honolulu based tourists with an experience on islands other than Oahu, tour packages including a one day visit to the island or islands of their choice are offered. Tour experts disclose a definite trend in popularity of Kauai with the Japanese. Hawaii Visitors Bureau statistics substantiate this trend. Of the 47 percent of Japanese who embarked on a one day tour, 87 percent chose to visit Kauai; 36 percent visited Hawaii; and

---

[3] These tours are necessary because the flights from the Orient generally arrive early in the morning. The tour time permits the hotel operators to re-make the hotel rooms.

14 percent visited Maui (Hawaii Visitors Bureau, 1974b). Tour experts offer an explanation for this preference. They feel Kauai is accessible and provides a variety of sights to be seen in one day.

Expenditures

In examining expenses, it must be considered that a portion of the visitor expenditure is lost before arrival. This loss is incurred when the package is purchased in Japan. According to experts in tourism, the Japanese tourist generally comes on a tighter budget and spends less while in Hawaii than visitors from the United States Mainland. Such an opinion is supported by the Hawaii Visitors Bureau statistics (Hawaii Visitors Bureau, 1974). Another practice limiting the amount of Japanese expenditures in Hawaii is the use of Duty Free Ltd. shops by an estimated 90 percent of the Japanese visitors. The distribution of the items purchased, in the order of the percent of visitors making such purchases, is:

Item	Percent of Visitors Purchasing
Liquor	92.9
Cigarettes	84.0
Clothing	77.3
Native Products	74.8
Perfume	73.1
Macadamia Nuts	62.2
Others	45.0
Jewelry	43.7
Pineapple	24.8
Photographic Supplies	11.3

(Hawaii Visitors Bureau, 1974)

Table 2 is an itemized breakdown of tourist expenses compiled from tour pattern information. In addition to these expenses, the average Japanese tourist spends $200 for gifts to relatives, close friends and business

TABLE 2

ESTIMATE OF EXPENDITURES

Estimated factors and cost of tour package purchased in Japan.

$ 400.00 - round-trip bulk fare
80.00 - hotel room ($20 x 4 nights)
14.00 - bus to and from airport
20.00 - one meal/day ($4 x 5 days)
9.00 - Pearl Harbor tour
7.50 - city tour

$ 530.50 - estimated total package cost on a four night/five day basis

Estimated factors and cost of an individual's expenditures in Hawaii.[1]

$ 30.00 - two additional tours (includes lunch)
28.00 - individually purchased meals ($7 x 4 days)
14.00 - luau
40.00 - two evenings of entertainment
40.00 - merchandise purchased for consumption[2]

$ 156.00 - estimated total individual expenditures on a four night/five day basis

Estimated factors and cost of a one day tour to Kauai, possibly purchased in Japan with the package.

$ 18.00 - common fare to out-of-state round-trip ticket holder
12.00 - Waimea Canyon tour, lunch included
12.00 - Fern Grotto tour

$ 42.00 - estimated cost of one day neighbor island tour (Kauai)

Source: [1] Hawaii, 1973;
[2] Merchandise includes cosmetic items purchased on economy not shown on source estimate.

associates. Such expenditures result from a portion of Japanese tradition which is still present today (Pacific Business News, August 26, 1974). Thus, it is estimated that approximately 56 percent of the total trip expense is spent in Hawaii.

Characteristics of Eastbound Japanese Visitors to Hawaii

To achieve a complete overview of the Japanese tourist, consideration must be given to tourist characteristics. Table 3 tabulates those characteristics defined by the Hawaii Visitors Bureau on their passenger information forms. The table also indicates corresponding characteristics of all Westbound visitors to Hawaii, and, where the information is available, Japanese visitors to Guam. With regard to length of stay (table 3), it should be noted that an increasing number of Japanese companies are tending to recognize Saturdays as a "day off" and allowing greater amount of vacation time to employees (Sasaki, 1974). Such trends point to an increasing length of stay for Japanese visitors.

Activities other than tours participated in by Japanese visitors should be considered. Many of the more popular outdoor activities do not necessitate much financial outlay by the individual. Those activities which attract most interest and participation are walking for pleasure, sunbathing, swimming, pleasure driving or sightseeing, and golf. The estimated activities of the Japanese visitor are compared to other visitors in table 4. These recreational activities are even more attractive when public transportation is available to make participation in such activities more convenient and inexpensive (Sasaki, 1974).

TABLE 3

COMPARISON OF CHARACTERISTICS OF JAPANESE EASTBOUND VISITORS

Characteristic	Visitor		
	Eastbound Japanese	Westbound Visitor[2]	Japanese to Guam[3]
Sex			
Male	59.7%	48.7%	63.5%
Female	40.3	51.3	36.5
Occupation			
Professional	37.1	53.2[4]	29.7[5]
Clerical	44.8	9.5	52.7
Travel Arrangements			
Tour Groups	90.2	35.3	56.9
Individual Basis	9.9	55.8	43.1
Median Age	31.8 years	39 years	N/A
Median Party Size	1.8 persons	2 persons	N/A
Purpose			
Business	1.8	5.1	11.7
Pleasure	93.7	68.8	72.6
Length of Stay			
Days	5	9	5
Nights	4	8	4
Visits to Neighbor Islands			
Maui, total	12.6	31.1	--
Less than 24 hours	6.7	--	--
More than 24 hours	5.9	--	--
Kauai, total	58.4	23.9	--
Less than 24 hours	39.1	N/A	--
More than 24 hours	19.3	N/A	--

Source: [1] Hawaii Visitors Bureau, 1974b
[2] Hawaii Visitors Bureau, 1974c
[3] Guam, 1972b
[4] Combines Hawaii Visitors Bureau categories; Professional and Technical, and Business, Managerial and Official
[5] Not fully compatible with Hawaii Visitors Bureau definition

TABLE 4

PARTICIPATION IN MAJOR OUTDOOR RECREATION ACTIVITIES[1]

Activities	Percent of Visitors Participating	Estimated Japanese Visitors Participating
Swimming	78.0	less
Sunbathing	71.0	same
Pleasure driving, sightseeing	69.0	same
Walking for pleasure	65.0	more
Attending outdoor sports, cultural activities	53.0	same
Pleasure boating	20.0	less
Golf	13.0	more
Surfing	11.0	less
Fishing	9.0	less
Scuba, skin diving	7.0	less

Source: [1]Hawaii, 1973

Of particular interest is the number of Japanese visitors to the neighbor islands for one night or more. In the previous discussion of the tour process we found that approximately 66 percent of the Japanese visitors to Hawaii visited neighbor islands. Of these, 47 percent intended a less than 24 hour trip. Therefore, approximately 19 percent chose to stay one night or longer. Eighty-seven percent of the visitors perferred Kauai, 36 percent preferred Hawaii and 14 percent chose Maui; thus, we find a reduced traveler population destined for Maui (Hawaii Visitors Bureau, 1974b). With the potential increase in length of stay, it can be expected that greater time would be spent on the neighbor islands, especially if it is made more attractive through incentives such as public transportation.

Let us then examine the number of visitors to Maui overnight or longer. Sixty percent of the Japanese to Maui stayed one night and two days, 14 percent stayed two nights and three days, and 21 percent stayed three nights and four days (Hawaii Visitors Bureau, 1974b). In contrast, Westbound visitors to Maui averaged two nights and three days (Hawaii Visitors Bureau, 1973b).

Although Kauai presently enjoys considerable attention from Japanese tourists, tour operators indicate that many tourists have expressed a desire to stay overnight on Maui. Unfortunately hotels are reluctant to accommodate a visitor for perhaps two nights, then offer a guaranteed reservation for the fourth night while the visitor spends night number three on a neighbor island.

Highlights of Japanese visitor characteristics are:

- Japanese tourists are younger than Westbound tourists by about ten years;
- Almost half of this youthful concentration is employed on a clerical level. Only 12.5 percent of the Westbound people are similarly employed;
- More men than women visit Hawaii from Japan, while about an equal number of men and women travel from the other direction;
- About 90 percent of the Japanese travel in tour groups while approximately 40 percent of the Westbound visitors arrive in a similar travel status;
- Comparing the length of stay, we find that the Japanese spends about half as many days and nights on his Hawaii trip as does the Westbound visitors; however, present trends, i.e. "days off" and vacation time, point to an increasing length of stay;
- In considering preference to the neighbor island, the majority of the Japanese chose Kauai for a visit while the Westbound visitors seem to tend toward Maui. When the Japanese visitors go to Maui, they spend less than 24 hours there;
- While here, the Japanese participate in the generally inexpensive activities, and, as a result, appear to spend less money in the state than do other visitors.

COMPARISON TO GUAM

It is possible to trace the development of Guam's tourism from 1967 and make comparisons to Hawaii's visitor industry. In terms of Japanese visitors, Guam began to sustain a marked increase in the percentage of Japanese visitors in the years 1969 and 1970 (table 5). Guam continued to enjoy record numbers of visitors in 1972 (Guam, 1972). Hawaii has experienced a similar advance in the years 1972 and 1973. Economic experts in both situations attribute this sudden expansion in Japanese tour trade to recent increases in personal income in Japan plus more lenient government policies on travel abroad (Guam, 1972).

TABLE 5

GROWTH IN THE NUMBER OF JAPANESE RESIDENTS VISITING HAWAII AND GUAM

	Hawaii				Guam			
Years	Total Visitor Arrivals[1]	Percent of Japanese Residents[2]	Number of Japanese Resident Visitors	Annual Percent Increase	Total Visitor Arrivals[3]	Percent of Japanese Residents	Number of Japanese Resident Visitors	Annual Percent Increase
1967	1,124,818	N/A	---	---	4,500	20.5%	922	---
1968	1,314,571	N/A	---	---	15,000	35.0	5,250	469.4%
1969	1,527,012	5.9%	90,000	---	58,265	50.0	29,133	459.9
1970	1,798,591	7.3	131,500	46.1%	73,721	59.8	44,095	51.4
1971	1,818,944	9.9	180,000	36.9	119,174	70.5	84,018	90.5
1972	2,244,377	10.2	230,000	27.8	182,600	65.2	119,055	41.1
1973	2,630,952	12.5	330.000	43.5	N/A	N/A	---	---

Sources: [1] Hawaii Visitors Bureau, 1974c
[2] Hawaii Visitors Bureau, 1974
[3] Guam, 1973

Hotel investment patterns indicate substantial influence of tourism expansion in Guam. The number of hotel rooms available for occupancy jumped from 680 in 1969 to 1,091 in 1972, an approximate increase of 48 percent.

The characteristics of the visitor to Guam varies little from those of the visitor to Hawaii (table 3).

However, Guam, with its longer experience with Japanese visitors, may offer some conclusions not yet projected for the Hawaiian market (Guam, 1972):

1. That the tour packages will continue through the 1970's, but more affluent, independent travelers might be expected in the 1980's;
2. That support for Guam's expanded visitor industry has necessitated the importation of alien workers. These workers now compete with the indigenous population for jobs;
3. That Guam is not certain the Japanese visitors on organized tours bring much new money to the economy because of the sale of the tour package in a foreign area.

Overall, the visitor industry pattern between Hawaii and Guam appears very similar. However, note should be taken of Guam's experience with packaged tours and the labor problem in support of the visitor industry.

LOOKING AHEAD

Overseas travel was liberalized by the Japanese government in 1965 (Mainichi Daily News, 1974b). In the late 1960's, the Japanese visitors to Guam registered a large increase. In 1972, the Japanese visitors to Hawaii registered a similar large increase. It is anticipated the number of Japanese visitors to Hawaii will continue to grow. Based on Guam's experience, it does not appear that the characteristics and activities of these visits will change in the immediate future.

A 1973 sample of a particular travel agency indicated about 45 percent of the overseas travelers visited Hawaii. They paid in Japan between 140,000 to 180,000 yen for a six to seven day stay (Mainichi Daily News, 1974b). On an exchange rate of 295 yen to a dollar, the above prices are: $475; $610; and $340 (Honolulu Star Bulletin, 1974).

However, there are certain dampening effects that should be considered. First Japan is now in the grip of the most severe inflation in its postwar history - it is reported that family savings are being devoured and the family pleasures are out of reach (Mainichi Daily News, 1974b). Second, the requirements for foreign currency to purchase oil have doubled over 1973 as a result of the oil crisis (Mainichi Daily News, 1974c). The Japanese residents will not have the money to travel and the Japanese government will not have the foreign currency to permit travel.

The effect of Japanese internal problems on the characteristics of Japanese overseas travelers will appear first in the 1974 statistics when they are published. Until December, 1973, the Japanese overseas travelers could take out any amount of dollars with them. In December, 1973, Japan instituted currency curbs, and a limit of $3,000 and 100,000 yen ($339) for any one trip without approval was established. 1 April 1974, this allowance was further reduced to $1,500 and 30,000 yen ($102) for any one trip (Mainichi Daily News, 1974d; Honolulu Star Bulletin, 1974). Whatever the reason may be, Eastbound visitors to Hawaii, who have been primarily Japanese in the last several years, have shown an increase of only 10 percent in the first five months of 1974 over a similar period in 1973 (Sunday Star Bulletin and Advertiser, 1974). By way of comparison, the Eastbound arrival increase of 1973 over 1972 was 22 percent (Hawaii Visitors Bureau, 1974c). It is concluded that there will be a slowdown in the growth of the number of Eastbound Japanese visitors in the foreseeable future and further, they will have less money to spend per trip.

Interviewed tour representatives foresee a change in the Japanese tourist pattern. Approximately 90 percent (Hawaii Visitors Bureau, 1974b) of the Japanese travel in tour groups. If the government discourages travel abroad this trend will of necessity discontinue. The pattern will then change to an increase in independent travelers. As a result, the economic and occupational status will tend to be higher, and individual expenditures in Hawaii will escalate.

Travel by the Japanese visitors to the neighbor islands will continue. Though the Japanese visitor is not a factor of great consequence on Maui at this time, there appear to be actions favoring an increase. The Department of Planning and Economic Development has published a study recommending increased neighbor island growth (Hawaii, 1974). Secondly, a major promotional effort to attract visitors to Maui is reportedly being planned for 1975 (Honolulu Star Bulletin, 1974b). Such a promotion is considered to have some effect on the Japanese visitor when he chooses a neighbor island destination. Accordingly, it is concluded the number of Japanese visitors to Maui will increase.

It is not envisioned that Maui will become an air "port-of-entry". Accordingly, visitors arriving in the islands will debark on Oahu. It is then expected that they will spend the majority of their time and money in Honolulu. Further, initial clothing and subsistence supplies, as well as export items, will generally be purchased in Honolulu. Lastly, tour arrangements for neighbor island trips will be made in Honolulu. These conditions generally limit the visitor stay on Maui to one night and two days, purchase of only those meals not associated with his tours, and purchase of souvenir items. In general, it appears that the visitor to Maui will continue to spend a smaller portion of his Hawaii expenditures on Maui. However, the increasing number of independent Japanese travelers, combined with potential longer lengths of stay, will probably increase the total expenditures of Japanese visitors in Maui.

In summary, the total amount of Japanese visitor expenditures in Maui is expected to increase; however, no substantial revenue growth for Maui is expected to be generated by this input to the Island tourist industry.

APPENDIX E

APPENDIX E

POPULATION AND EMPLOYMENT CALCULATIONS

POPULATION

The population was calculated on the basis of units, their use, persons per room and vacancy rates as shown on table 1. It is assumed that about 1/3 of the dwelling type units would be utilized as visitor accommodations. A sample survey of the ownership of condominium units on the Kihei coast discloses that only about 11 percent are owner occupied with the address of the owner being a Kihei address, and who are thus considered to be Kihei residents. Of the remaining condominium units, 20 percent are owned by owners with an address on Maui; about 31 percent are owned by owners with a Hawaiian address other than the Island of Maui; and finally, the remaining 38 percent are owned by owners with addresses outside the state (Real Estate Data, 1973). Persons per room was based on Hawaii Visitor Bureau statistics for Maui (Hawaii, 1972). The annual occupancy rate was estimated at 70 percent based on table 14 of the text.

For the residential units, except studios, the persons per unit were calculated on the basis of the high number of the median range per room shown for the State in the 1970 Census. The number of rooms per unit was estimated by multiplying the bedrooms by a factor of two. A vacancy rate of 1.5 percent was assumed, except for detached dwellings.

The annual occupancy rate of studios was estimated at 1 as the minimum that would occupy the unit and the maximum permissible per room without the facility being classified sub-standard. A vacancy rate of 1.5 percent was assumed.

TABLE 1

ESTIMATE OF POPULATION, SEIBU PROJECT

VISITOR UNITS

Facilities	Number	Number	Vacancy Rate	Fully Occupied Units	General Per Room Occupancy Rate	Daily Census
Hotel Rooms	1200	1200	.3	840	1.8	1512
Multiple Dwelling Units						
Studios	429	142	.3	99	1.8	178
1 Bedroom	1932	637	.3	446	1.8	803
2 Bedroom	1931	637	.3	446	1.8	1606
Detached Dwellings	477	--				
Total						4099

RESIDENTIAL UNITS

Facilities	Number	Vacancy Rate	Fully Occupied Units	Number of Rooms	Occupancy Per Room	Daily Census
Hotel Rooms	--					
Multiple Dwelling Units						
Studios	287	1.5	283	283	1.00	283
1 Bedroom	1295	1.5	1276	2552	.75	1914
2 Bedroom	1294	1.5	1274	5096	.75	3822
Detached Dwellings	477		477	477	3.61	1722
Total						7741

EMPLOYMENT

The total increase of employment estimated to support the Seibu development at its completed level is developed by regressing County of Maui annual resident population and the Daily Visitor Census estimated on an annual average of employment in the County. The resulting equation is:

$$Yi = 9.31 + .16X_{1i} + 1.13X_{2i}$$

where Y equals Total Employment, X_1 equals resident population lagged one year and X_2 equals average annual daily visitor census lagged one year and i is equal to year of observation. Solution of this equation estimates the project generates about 6,250 jobs.

The division of labor between the export and residential sectors was developed as follows: the labor force estimates for the County of Maui were developed by industry by years for the years 1964-1972 inclusive (table 2). The County was chosen instead of a smaller area because statistics cover sufficient years for time series regressions. Secondly, State statistics can be augmented by Federal government statistics. The annual labor force estimates were divided into employment in the export sector and the residential sector by the method used by Sasaki in "Military Expenditures and the Employment Multiplier in Hawaii" (Review of Economics and Statistics, 1963). Certain employment, such as hotel, sugar and pineapple, were automatically placed in the export sector. For industries which were not obviously in the export sector, they were estimated by establishing by industry a ratio between County of Maui employment and the population of the County and a ratio between National employment and National population.

TABLE 2

ESTIMATED EMPLOYMENT

IN EXPORT AND RESIDENTIAL SECTORS

COUNTY OF MAUI

YEAR	EXPORT	RESIDENTIAL	TOTAL
1964	10,433	9,167	19,600
1965	10,750	9,780	20,530
1966	10,455	10,305	20,760
1967	10,571	10,489	21,060
1968	10,708	10,482	21,190
1969	11,124	9,015	20,139
1970	11,286	9,674	20,960
1971	11,392	10,315	21,707
1972	9,937	8,936	19,873

If the County ratio was greater than the National, the industry was considered an export industry. If the National ratio exceeded the Hawaiian ratio, the industry was classified as residential (The Review of Economics and Statistics, 1963). Export and residential employment in 1972 is shown in table 3. A linear relationship can be assumed between export, residential and total employment. The resultant equation was:

$$Y_i = .33 + .46_{1i} + 1.47X_{2i}$$

where Y_i equals employment on an annual basis in the County of Maui, X_{1i} equals annual residential employment in the County and X_{2i} equals annual export employment in the County and i equals year of observation. The solution of this equation estimates an increase of 4,915 employees in the export sector and 1,335 in the residential sector.

In estimating the export and residential sector income and employment in the County of Maui, it is assumed the employment mix will remain as it was in 1972. The additional employment generated can then be assigned in proportion to their percentage of the total County employment. It is assumed that employees in the sugar, pineapple and the food processing portion of these industries will not be affected by the multipliers. The number of employees in these industries are therefore deducted both as industry and from the County total employment.

Certain industrial categories which do not provide pertinent information have been aggregated. These categories include construction, durable goods manufacturing and agriculture.

TABLE 3

ALLOCATION OF LABOR FORCE BETWEEN EXPORT AND RESIDENTIAL SECTOR

Industry	U.S. Ratio	Maui Ratio	County Labor Force 1972
Contract Construction	.0165	.0334	1170
General Building Contractors	.0049	.0096	812
Heavy Construction Contractors	.0037	.0044	182
Special Trade Contractors	.0081	.0068	378
Manufacturing	.0961	.0497	2140
Durable Goods	.0555	.0056	240
Lumber & Wood Products	.0089	.0007	30
Stone, Glass & Clay	.0032	.0030	130
Non-Durable Goods	.0406	.0440	1900
Food Processing	.0089	.0403	1720
Textile & Apparel	.0117	.0007	30
Printing & Publishing	.0055	.0022	120
Transportation & Other Public Utilities	.0223	.0249	1050
Local Passenger Transit	.0014	.0179	852
Wholesale Trade	.0191	.0078	390
Retail Trade	.0551	.0571	3060
General Merchandise	.0116	.0062	443
Food Stores	.0086	.0102	566
Apparel & Accessory Stores	.0035	.0029	122
Eating & Dining Places	.0122	.0160	1009
Finance, Insurance & Real Estate	.0182	.0102	953
Real Estate	.0320	.0041	724
Hotels and Other Lodging Places	.0037	.0174	1880
Services & Miscellaneous (less Hotels)	.0574	.0393	1740
Personal Services	.0049	.0034	151
Miscellaneous Business Services	.0077	.0043	221
Medical & Other Health Services	.0153	.0077	366
Amusement & Recreational Services			
Government			2670
Federal			180
State & Local			2490
Agriculture			360
Other Agriculture			360

TABLE 3 (Continued)

ALLOCATION OF LABOR FORCE BETWEEN EXPORT AND RESIDENTIAL SECTOR

Industry	U.S. Ratio	Maui Ratio	County Labor Force 1972
Non-Agricultural Self-Employed			2110
Agricultural Self-Employed			560

Source: Bureau of Census, Annual; Hawaii, Annual

The basic data is from the "Labor Force Estimates for the County of Maui"; however, aggregated categories in these estimates have been expanded using Employment and Payrolls in Hawaii and County Business Patterns (Hawaii, 1973c; Hawaii, 1973b; Bureau of the Census, 1972b).

Average annual earnings were calculated by multiplying generated employment by the average earnings by industry or portion of industry as applicable (table 4). These were summed for the export and residential sectors and are $27,604,057 and $8,487,358 respectively. Over the years, the County of Maui has shown a 5.2 percent annual wage increase. To adjust for 1983, (opening year 1982 plus 1 year because of lag used in calculations), the total annual earning by sectors have been increased by a factor of 41.6 percent giving annual earnings of $39,087,000 for the export sector and $12,017,000 for the residential sector.

A review of the employment generated by the project appearing in the export sector gives the impression that in two types of employment--contract construction and utilities--might be of short duration. In this regard, a long term estimate is made which reduces estimates for the export sector to 3,587 generated employment and annual earnings of $21,653,000 for 1983 salaries. This gives a new total of generated employment of 4,922 jobs with a 1983 wage of $33,670,000.

TABLE 4

ESTIMATE OF EXPORT AND RESIDENTIAL

LABOR FORCE AND INCOME

	CURRENT MAUI CO. LABOR FORCE	EXPORT				
		Export Labor Force	% of Total Labor Force	Estimated Labor Force Increase to Export	1970 Average Annual Wage	Estimated Income (using 1970 base)
Contract Construction	1170	1170	17	837	9169	7,674,453
Manufacturing						
Durable Goods	240					
Non-Durable Goods						
Food Processing	575	575	9	442	4261	1,883,362
Textile and Apparel	30					
Printing and Publishing	120					
Other Non-Durables	30					
Transportation, Communications, and Utilities						
Local Passenger Transit	399	399	7	344	5671	1,950,824
Transortation and Public Utilities (n.a.f.)	651	651	10	491	9477	4,638,477
Wholesale Trade	390					
Retail Trade						
General Merchandise	438					
Food Stores	560	560	9	442	4314	1,906,788
Auto Dealers and Service Stations	419					
Eating and Drinking	998	998	15	737	2858	2,106,346
Apparel and Accessory	119					
Retail Stores (n.e.c.)	526					

TABLE 4 (Continued)

ESTIMATE OF EXPORT AND RESIDENTIAL LABOR FORCE AND INCOME

	CURRENT MAUI CO. LABOR FORCE	EXPORT				
		Export Labor Force	% of Total Labor Force	Estimated Labor Force Increase to Export	1970 Average Annual Wage	Estimated Income (using 1970 base)
Finance, Insurance and Real Estate	600					
Hotels and Other Lodging Places	1880	1880	29	1426	4599	6,553,575
Service and Miscellaneous (less Hotels and Other Lodging Place)						
Personal Services	195					
Miscellaneous Business Services	122					
Auto Services and Garages	110					
Auto Rentals and Leasing	134	134	2	98	4941	484,218
Amusement and Recreational Services	117	117	2	98	4135	406,014
Medical and Health Services	471					
Other	591					
Other Agriculture	920					
Government						
Federal	180					
State	1870					
Local	680					
Self-Employed Non-Agricultural	2110					
Total	16645	6484	100.0	4915		27,604,057

TABLE 4 (Continued)

ESTIMATE OF EXPORT AND RESIDENTIAL LABOR FORCE AND INCOME

	CURRENT MAUI CO. LABOR FORCE	RESIDENTIAL				
		Second-ary	% of Total Labor Force	Estimated Labor Force Increase to Residential	1970 Average Annual Wage	Estimated Income (using 1970 base)
Contract Construction	1170					
Manufacturing						
Durable Goods	240	240	2	27	7301	197,127
Non-Durable Goods						
Food Processing	575					
Textile and Apparel	30	30	.5	7	7301	51,167
Printing and Publishing	120	120	1	13	7301	94,913
Other Non-Durables	30	30	.5	7	7301	51,107
Transportation, Communications and Utilities						
Local Passenger Transit	399					
Transportation and Public Utilities (n.a.f.)	651					
Wholesale Trade	390	390	4	53	6144	325,632
Retail Trade						
General Merchandise	438	438	4	53	4787	253,711
Food Stores	560					
Auto Dealers and Service Stations	419	419	4	53	4914	260,442
Eating and Drinking	998					
Apparel and Accessory	119	119	1	13	3905	50,765
Retail Stores (n.e.c.)	526	526	5	67	4182	313,694

TABLE 4 (Continued)

ESTIMATE OF EXPORT AND RESIDENTIAL

LABOR FORCE AND INCOME

	CURRENT MAUI CO. LABOR FORCE	RESIDENTIAL				
		Second-ary	% of Total Labor Force	Estimated Labor Force Increase to Residential	1970 Average Annual Wage	Estimated Income (using 1970 base)
Finance, Insurance and Real Estate	600	600	6	80	6476	518,080
Hotels and Other Lodging Places	1880					
Service and Miscellaneous (less Hotels and Other Lodging Places)		195	2	27	3195	86,265
Personal Services	195					
Miscellaneous Business Services	122	122	1	13	3195	41,525
Auto Services and Garages	110	110	1	13	5015	65,195
Auto Rentals and Leasing	134					
Amusement and Recreational Services	117					
Medical and Health Services	471	471	5	67	5228	350,276
Other	591	591	6	80	4227	338,160
Other Agriculture	920	920	9	120	5336	640,320
Government						
Federal	180	180	2	27	8974	242,298
State	1870	1870	18	241	8589	2,069,949
Local	680	680	7	93	9121	848,253
Self-Employed Non-Agricultural	2110	2110	21	281	6009	1,688,529
Total	16645	10161	100.0	1335		8,487,358

APPENDIX F

APPENDIX F

BIBLIOGRAPHY

PHYSICAL CHARACTERISTICS

Blumenstock, D. I., and Saul Price. 1967. Climates of the United States, U. S. Department of Commerce. *Climatography of the United States* No. 60-51.

Comprehensive Zoning Code (CZC), Section 21-232. 1967. "City and County of Honolulu." Noise Regulation.

Corell, Allen L. (Local Observer for U. S. Weather Bureau). July 10, 1974. Keawakapu, Maui. Personal Communication.

Department of Commerce, Weather Bureau. 1962. *Rainfall Frequency Atlas of the Hawaiian Islands*.

Department of Labor Occupational Safety and Health Standards. May 29 1971. "Federal Register."

Division of Land and Natural Resources. July, 1968. *Flood of March 24, 1967, Kihei and Olowalu Areas*.

Division of Water and Land Development, Report R38. October, 1970. *Water for Kihei-Makena*.

Environmental Capital Managers. March, 1974. "In Depth Market Analysis for Condominiums, House Lots and Hotel at Makena, Maui."

Environmental Protection Agency, PB 206717. December 31, 1971. "Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances."

Environmental Protection Agency. April 2, 1974. "Noise Information Document."

Erdman, Pardee (Owner of Ulupalakua Ranch). June 19, 1974. Ulupalakua, Maui. Personal Communication.

Hawaii Urban Development, Circular 1390.2. August 4, 1971. "Noise Control and Abatement."

Hawaii Visitors Bureau. 1974. "Hawaii Hotel Guide."

Highway Research Board, Report 117. 1971. "Highway Noise--A Design Guide for Highway Engineers."

Honolulu Star Bulletin. June 14, 1974. "95 Plans for Resorts, Residences Revealed."

PHYSICAL CHARACTERISTICS (Continued)

Macdonald and Abbott, University of Hawaii Press. 1970. Volcanoes in the Sea.

Public Health Regulations, Chapter 44A. March, 1972. "Vehicular Noise Control for Oahu."

Soil Conservation Service. May, 1974. Guidelines for Use of the Universal Soil Loss Equation in Hawaii (Preliminary Information).

Soil Conservation Service. March, 1972. Handbook for Erosion and Sediment Control in Urbanizing Areas in Hawaii.

Soil Conservation Service, SCS-TP-149. January, 1968. A Method for Estimating Volume and Rate of Runoff in Small Watersheds.

Soil Conservation Service. December, 1973. Soil Survey of the Island of Hawaii.

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

Soil Conservation Service. 1971. U. S. Department of Agriculture. Tri-Isle Resource and Development Project.

State Highways Division. September, 1971. "Traffic Assignment Project TA 71-18, Kihei-Ulupalakua Road, Maui."

Stearns, Harold T. 1942. "Geologic and Topographic Map of Island of Maui."

Tenorio, P., and R. H. F. Young. August, 1970. Presented at the Fifth International Conference, International Association on Water Pollution Research. "The Effect of Irrigation Return Water Upon Ground Water Quality."

Towill, R. M. Corp. October, 1971. Drainage Master Plan for County of Maui.

Towill, R. M. Corp. October, 1971. Sewerage Master Plan for County of Maui.

Towill, R. M. Corp. December, 1971. Water Master Plan for County of Maui.

CHEMICAL CHARACTERISTICS

Bodhaine, Barry. 1974. Personal Communication.

Department of Health, State of Hawaii. January, 1968. "Public Health Regulations, Chapter 37A."

Department of Health, State of Hawaii. May, 1973. "Public Health Regulations, Chapter 38."

Tenorio, P. and Young, R. H. F. 1970. The Effect of Irrigation Return Water Upon Ground Water Quality. Water Resources Research Center, University of Hawaii.

BIOLOGICAL CHARACTERISTICS

Armstrong, R. W. 1973. (Editor) Atlas of Hawaii. University Press of Hawaii.

Berger, Andrew J. 1972. Hawaiian Birdlife. University Press of Hawaii.

Blumenstock, D. I., and Saul Price. 1967. Climates of the United States, Hawaii, U. S. Dept. of Commerce. Climatography of the United States No. 60-51.

Bowers, R. L. 1973. Marine Biological Reconnaissance of Wailea, Maui.

Brock, V. E. 1954. Handbook of Hawaiian Birds

Bryan, E. H., Jr. 1958. Check List and Summary of Hawaiian Birds. Books About Hawaii.

Campbell, J. F., B. R. Rosendahl, W. T. Coulbourn, and R. Moberly, Jr. 1971. Reconnaissance Sand Inventory: Office Leeward Molokai and Maui. UNIHI-SEAGRANT TR-71-02.

Campbell, J. H. 1972. Erosion and Accretion of Selected Hawaiian Beaches, 1962-1972. UNIHI-SEAGRANT TR-72-02.

Caum, Edward L. 1933. The Exotic Birds of Hawaii. Occ. Pap. Bernice P. Bishop Museum, 10:1-55.

Department of Land and Natural Resources. "Marine Preserve Survey--Island of Maui."

Department of Land and Natural Resources. "Natural Area Reserve Survey, La Perouse Bay--Cape Kinau-Ahihi Bay, Maui."

Department of Land and Natural Resources. "Regulation No. 7: Relating to the Protection, Control, and Use of the Ahihi-Kinau Natural Area Reserve, Island of Maui."

Doty, M. S. (ed) 1969. The Ecology of Honaunau Bay, Hawaii. University of Hawaii Bot, Science Paper 14:1-71.

Environmental Consultants, Inc. 1974. Honolua Bay Study: Marine Geological, Physical, and Biological Surveys. ECI Report 126.

Haselwood, E. L. and G. G. Motter. 1966. Handbook of Hawaiian Weeds. Hawaiian Sugar Planters Assoc.

Hitchcock, A. S. 1950. Manual of Grasses of the United States. Misc. Publications No. 200. U. S. Government Printing Office.

Hunsaker, Don II., and Paul Breese. 1967. Herpetofauna of the Hawaiian Islands. Pacific Science, 21:423-428.

Kramer, Raymond J. 1971. Hawaiian Land Mammals. Charles E. Tuttle Co.

Maragos, J. E. 1974. Coral Transplantation: A Method to Create, Preserve and Manage Coral Reefs. UNIHI-SEAGRANT AR-74-03.

Maragos, J. E. and K. E. Chave. 1973. "Stress and Interference of Man in the Bay." (In Atlas of Kaneohe Bay: A Reef Ecosystem Under Stress). Smith, Chave, and Kam (ed). UNIHI-SEAGRANT TR-72-01.

Medeiros, J. S., R. L. Walker, E. Kosaka and T. Telfer. 1970. Introduction of Exotic Game Birds. Job Completion Report, W-5-R-20, Hawaii Division of Fish and Game.

Moberly, R. and T. Chamberlain. 1966. Hawaiian Beach Systems. Hawaii Inst. Geophys. 64-2.

Munro, George C. 1944. Birds of Hawaii. Tongg Publishing Co.

Neal, Marie C. 1965. In Gardens of Hawaii. Bernice P. Bishop Museum. Bishop Museum Press.

Oliver, J. A., and C. E. Shaw. 1953. The Amphibians and Reptiles of the Hawaiian Islands. Zoologica, 38:65-95.

Ord, W. Michael. 1967. Hawaii's Birds. Hawaii Audubon Society.

Peterson, Roger T. 1961. A Field Guide to Western Birds. Houghton Mifflin Co.

Pope, Willis T. 1968. Manual of Wayside Plants of Hawaii. Charles E. Tuttle Co.

Raymond, L. P. 1973. An Environmental Survey of Honokohau Harbor--1972. Oceanic Institute.

Ripperton, J. C., and E. Y. Hosaka. 1942. Vegetation Zones of Hawaii. Hawaii Agric. Exp. Station Bulletin 89.

Schwartz, Charles W. and Elizabeth Reeder Schwartz. 1949. The Game Birds in Hawaii. Board of Commissioners of Agriculture and Forestry.

St. John, Harold. 1973. List and Summary of the Flowering Plants in the Hawaiian Islands. Pacific Tropical Botanical Garden Memoir No. 1.

Tomich, P. Quentin. 1969. Mammals in Hawaii. Bernice P. Bishop Museum Spec. Publ. 57.

Udvardy, Miklos D. F. 1961. The Occurrence of the Mockingbird on the Island of Maui. Elepaio, 21:72.

Whitney, L. D. et.al. 1939. Grasses of the Hawaiian Ranges. Bulletin No. 82. Hawaii Agricultural Experiment Station.

CULTURAL CHARACTERISTICS

Allen, R. G. D. 1967. Mathematical Analysis for Economists. St. Martin's Press, Inc.

Ashdown, Inez. 1964. Personal Communication.

Bank of Hawaii. 1974. Construction in Hawaii, 1974. Bank of Hawaii.

Bureau of the Census. 1972. Characteristics of the Population. Vol. 1 U.S. Department of Commerce.

Bureau of the Census, Annual. County Business Patterns. 1964-1972 inclusive. U.S. Department of Commerce.

Bureau of the Census. 1972b. County Business Patterns, 1972. U.S. Department of Commerce.

Clark, Stephen D. 1974. A Reconnaisance Survey of Makena Properties for Seibu Corp., Bishop Museum.

Donehower, E. 1974. Hawaiian Visitors Bureau, Personal Communication.

Environment Capital Managers, Inc. 1974. Benefit-Cost Analysis, Makena Development Project. Makena, Maui, ECMI.

Garrison, C. B. 1972. "The Impact of New Industry: An Application of the Economic Base Multiplier to Small Rural Areas." Land Economics 48: 329-337.

Hawaii. 1972. Tourism in Hawaii. State of Hawaii, Department of Planning and Economic Development.

Hawaii. 1972b. Selected Manpower Indicators, Maui County, 1970. Department of Labor and Industrial Relations.

Hawaii. 1973. The State of Hawaii Data Book, 1973. Department of Planning and Economic Development.

Hawaii. 1973b. Employment and Payrolls in Hawaii, 1972. Department of Labor and Industrial Relations.

Hawaii. 1973c. Labor Force Estimates, 1971-1972. Department of Labor and Industrial Relations.

Hawaii. 1974. Personal Contact, Information Center, Department of Education.

Hawaii. 1974b. Maui County, Facts and Figures - 1974. Department of Planning and Economic Development.

Hawaii, Annual. Labor Force Estimates. Years 1969-1972 inclusive, Department of Labor and Industrial Relations.

Hawaii Visitors Bureau. 1963. 1962 Annual Research Report. Hawaii Visitors Bureau.

Hawaii Visitors Bureau. 1965. 1964 Annual Research Report. Hawaii Visitors Bureau.

Hawaii Visitors Bureau. 1968. 1967 Annual Research Report. Hawaii Visitors Bureau.

Hawaii Visitors Bureau. 1971. A Study of Westbound Visitors to the Island of Maui: Supplement to the 1970 HVB Research Report. Hawaii Visitors Bureau.

Hawaii Visitors Bureau. 1972. A Study of Westbound Visitors to the Island of Maui: Supplement to the 1971 HVB Research Report. Hawaii Visitors Bureau.

Hawaii Visitors Bureau. 1973. 1972 Annual Research Report. Hawaii Visitors Bureau.

Hawaii Visitors Bureau. 1973b. A Study of Westbound Visitors to the Island of Maui: Supplement to the 1972 HVB Research Report. Hawaii Visitors Bureau.

Hawaii Visitors Bureau. 1974. 1973 Annual Research Report. Hawaii Visitors Bureau.

Hawaii Visitors Bureau. 1974b. Japanese Visitor Opinion Survey. Hawaii Visitors Bureau.

Hawaii Visitors Bureau. 1974c. Hawaii Hotel Guide, 1974. Hawaii Visitors Bureau.

Hawaii Visitors Bureau, Annual. Annual Research Reports 1958-1973, inclusive. Hawaii Visitors Bureau.

Honolulu Star Bulletin. 1962. January 30.

Honolulu Star Bulletin. 1974. June 13.

Isaard, W. 1960. Methods of Regional Analysis: An Introduction to Regional Science. The M. I. T. Press.

Kanemoto. 1974. Personal Contact, U. S. Postal Service.

Koebig and Koebig Hawaii. 1972. Statewide Boat Launching Facilities Master Plan, State Department of Transportation Harbors Division.

Onaca, Marsha. 1974. Personal Contact, Office of the Lieutenant Governor, State of Hawaii.

Real Estate Data. 1973. Real Estate Atlas of Hawaii, 2d Tax Division, Counties of Maui and Kalawao, Geographical Ownership. Real Estate Data, Inc.

Review of Economics and Statistics. 1963. Sasaki, K. Military Expenditures and the Employment Multiplier in Hawaii, 45:268-304.

Visitors Publication. 1974. Neighbor Islands, This Week, June 19-25, 1974. Visitors Pulication, Inc.

Weatherford, Wayne. 1974. Personal Contact, Environment Capital Managers, Inc.

APPENDIX D

Guam. 1972. Third Annual Economic Conference of Guam, 1972. Department of Commerce.

Guam. 1972b. Quarterly Review of Business Conditions. Vol. 9, Numbers 1 through 4 inclusive, Economic Research Center, Department of Commerce.

Guam. 1973. 1972 Challenging the Seventies. Economic Research Center, Department of Commerce.

Hawaii. 1973. State of Hawaii Data Book, 1973. Department of Planning and Economic Development.

Hawaii. 1974. State of Hawaii, Growth Policies Plan: 1974-1984. Department of Planning and Economic Development.

Hawaii Visitors Bureau. 1973b. A Study of Westbound Visitors to the Island of Maui. Hawaii Visitors Bureau.

Hawaii Visitors Bureau. 1974. Estimated Number of Japanese Visitors to Hawaii. Hawaii Visitors Bureau.

Hawaii Visitors Bureau. 1974b. Japanese Visitor Opinion Survey. Hawaii Visitors Bureau.

Hawaii Visitors Bureau. 1974c. 1973 Annual Research Report. Hawaii Visitors Bureau.

Hawaii Visitors Bureau. 1974c. Hawaii Hotel Guide, 1974. Hawaii Visitors Bureau.

Hawaii Visitors Bureau. Annual. Annual Research Reports, 1958-1973, inclusive. Hawaii Visitors Bureau.

Honolulu Star Bulletin. 1962. January 30.

Honolulu Star Bulletin. 1974. June 13.

Honolulu Star Bulletin. 1974. July 3.

Honolulu Star Bulletin. 1974b. June 11.

Isard, W. 1960. Methods of Regional Analysis: An Introduction to Regional Science. The M. I. T. Press.

Japan. 1970. Tourism in Japan, 1968-69. Department of Tourism, Ministry of Transportation, Japan National Tourist Organization.

Japan. 1971. Tourism in Japan, 1969-70. Department of Tourism, Ministry of Transportation, Japan National Tourist Organization.

Japan. 1974. Tourism in Japan, 1973. Department of Tourism, Ministry of Transportation, Japan National Tourist Organization.

Kanemoto. 1974. Personal Contact, U. S. Postal Service.

Mainichi Daily News.. 1974. April 19.

Mainichi Daily News, 1974b. June 25.

Mainichi Daily News. 1974c. April 30.

Mainichi Daily News. 1974d. April 11

Onaca, Marsha. 1974. Personal Contact, Office of the Lieutenant Governor, State of Hawaii.

Real Estate Data. 1973. Real Estate Atlas of Hawaii, 2d Tax Division, Counties of Maui and Kalawao, Geographical Ownership. Real Estate Data, Inc.

Review of Economics and Statistics, 1963. Sasaki, K. Military Expenditures and the Employment Multiplier in Hawaii, 45:268-304.

The Sunday Star Bulletin and Advertiser. 1974. June 23.

Visitors Publication. 1974. Neighbor Islands, This Week, June 19-25, 1974. Visitors Publication, Inc.

The Last Section Was Inserted
From Another Separate Document

Library Copy

Office of Environmental Quality Control
Office of the Governor
550 Halekauwila Street
Tani Office Building, Third Floor
Honolulu, Hawaii 96813

RESPONSES TO COMMENTS RECEIVED DURING PUBLIC REVIEW
TO
SEIBU MAKENA MASTER PLAN EIS

SEIBU REAL ESTATE COMPANY, LTD.
1-16-15, Minami-Ikebukuro
Toshima-Ku, Tokyo 171

Neighbor Island Consultants
Suite 104, 80 Pauahi Street
Hilo, Hawaii 96720

COMMENTS RECEIVED DURING PUBLIC REVIEW

INTRODUCTION

During the public review of the Seibu Makena Master Plan EIS, the Maui County Planning Commission received written comments and questions from various State and Federal agencies, as well as members of the general public. All of these statements have been reproduced in their entirety within the first section of this report.

COMMENTS BY GOVERNMENTAL AGENCIES

GEORGE R. ARIYOSHI
GOVERNOR

RICHARD E. MARLAND, PH.D.
DIRECTOR

TELEPHONE NO.
548-6915

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
OFFICE OF THE GOVERNOR
550 HALEKAUWILA ST.
ROOM 301
HONOLULU, HAWAII 96813

RECEIVED
MAY [illegible] 1975
DEPT. OF PLANNING
COUNTY OF MAUI

April 30, 1975

Maui Planning Commission
County of Maui
200 South High Street
Wailuku, Maui, Hawaii 96793

SUBJECT: Environmental Impact Statement for Seibu Makena Master Plan, Makena, Maui

Dear Commissioners,

As requested, this Office distributed the EIS on April 11, 1975. We also instructed that all comments be sent directly to the Planning Commission before May 2, 1975. We do wish to point out that a twenty-day review period is quite short for an adequate review of the EIS. We strongly recommend that thirty days be given for review. This would allow for adequate mail distribution and circulation.

In our evaluation of the EIS, we have found the document to be comprehensive and informative. We offer the following comments:

<u>DRAINAGE</u> p. III-11

Although major design concepts and parameters for drainage are not established, careful consideration must be directed to this subject. Since Ahihi Bay has been declared a natural area reserve, surface run-off may have a detrimental impact on the water quality of the Bay. Thus, this Office recommends more discussion and study on drainage and its effects on the Bay and shoreline.

DESCRIPTION OF THE STRUCTURES

How many stories will the hotel, apartments, and condominiums be?

SOLID WASTE

The EIS does not discuss solid waste disposal. Thus, we strongly recommend a discussion of this topic and include the projected amount, method of disposal, and location of the disposal site.

PLANNED RESIDENTIAL AREA

Will the residential area be fee simple or leasehold?

SOCIAL IMPACT

Since the surrounding area and residents will be directly and indirectly affected by this proposed project, a discussion of the community's sentiments should be included. What are the surrounding residents' reactions toward the proposed action?

A discussion of the social impact resulting from the project should be included such as effect on the current life-style and culture.

We thank you for the opportunity to comment on the EIS. We trust that these comments have been helpful to you. We look forward to receiving the applicant's response.

Sincerely,

Raymond S. Tabata

for Richard E. Marland
Director

University of Hawaii at Manoa

Environmental Center
Maile Bldg. 10 • 2540 Maile Way
Honolulu, Hawaii 96822
Telephone (808) 948-7301

Office of the Director

RECEIVED
MAY 1 1975
DEPT. OF PLANNING
COUNTY OF MAUI

April 30, 1975

Maui Planning Commission
County of Maui
Wailuku, Maui, Hawaii 96793

Gentlemen:

Proposed Seibu-Makena Development
Draft Environmental Impact Statement

The Environmental Center review of the above cited DEIS has been prepared with the assistance of Charles Lamoureux, Botany Department; Tamotsu Sahara, Physical Planning and Construction Office; Glenn Shepherd, Maui Community College; David Tuggle, Anthropology Department; Jerry Johnson, Jacquelin Miller and Richard Scudder, Environmental Center.

The review of the environmental impacts concerning waste disposal, water quality and sewage will be undertaken by Reginald Young of the Water Resources Research Center and will not be covered specifically by the Environmental Center.

General comments

Perhaps the most recurring question raised by each of our reviewers in their evaluation of this draft environmental impact statement deals with the overall socio-economic consideration of this project. The overall estimate of population growth for Maui and the apparent environmental impact for this area seems overwhelming. The DEIS clearly elucidates the probable destruction of archaeological and historical sites, the destruction of the existing social systems, the apparently unavoidable erosional impact, the dangers of flooding to residents of the flood plain, and finally the effect of the entire development on recreational facilities. It is important that the evaluation of the total plan be carefully weighed and perhaps given greater emphasis than our specific comments. Is this project, in fact, in the best interest of the County and the State? We can point out in general terms the possible specific environmental impacts, but what is critical is the overall plan and whether these possible impacts are worth the price of the potential economic gains.

pg. III-1

Tax map keys are given for the various parcels involved in this development. Unfortunately, the tax map keys are not found on figure 3 or any of the other maps of the DEIS. We assume that the small parcels mentioned as being under consideration for future inclusion into the project are those designated by the letter P on figure 3. Is this correct? Does this development include all of the beachfront property in the area shown in figure 3 as the Makena landing area? We note two locations for public beach access on Figure 3, however, it is not clear if any other public access will be provided to the remaining shoreline areas.

Pg. III-4

Who will bear the cost of the development or installation of utilities such as water supply, sewage treatment, underground street lighting, telephone and electric power and cable TV systems as indicated in this paragraph?

Pg. III-8

We note that the existing alignment of the Kihei Road through the project site will be "discontinued for through traffic by terminating that portion of Kihei Road at both ends of the hotel site." How will this discontinuation of the existing road affect the present local residents? Mention is made of three beach access points within the development. The third access point is cited as beach frontage south of Puuolai. We note on Figure 3 this beach frontage is presently shown as private property and is not within the development plan, thus we assume there are in fact only two access routes to the beach, the Makena landing area and the pedestrian right of way adjacent to the hotel site. How will this presumably more restrictive access affect the usage of this beach by the present local residents?

Although the wastewater sewage disposal system will be covered in more detail by the Water Resources Research Center, we do wish to comment specifically on the matter cited on pg. III-11, which indicates that the effluents from the treatment plant will be pumped to storage lagoons located within the golf courses and utilized for irrigation. Will the estimated capacity of the storage lagoons and the amount of water needed for irrigation be adequate to accommodate the amount of effluent generated by the project? Is there any anticipation or provision for possible offshore disposal of effluent? We would appreciate a further description of permeable asphaltic concrete pavements and roof top ponding as cited on pg. III-11. We are not familiar with these "on-site storage" methods.

Pg. III-12

We were pleased to see that all street lighting, telephone and electric systems will be installed underground. We suggest that other types of TV reception systems such as a centralized repeater station might be evaluated in addition to the proposed cable installation.

Pg. III-10

We note that the maximum water demand per day is cited as 4.239 million gallons for the proposed development. What population was used in deriving this estimated figure?

Pg. IV-19

The wastewater treatment plant for the Wailea development is not a part of the Makena area development. Relevance to the proposed Makena project is not indicated.

Pg. IV-20

Will a new substation be required for power to the Makena area? This section on power and communication seems to direct its attention toward the Wailea resort area, not the proposed development at Makena.

Pg. IV-26

The discussion on tsunami inundation should be carefully evaluated. Runup heights and magnitudes for tsunamis generated in the Alaskan region are estimated to be 7.3 feet at Makena. This does not represent maximum runup heights which may be experienced. Historical data indicates runup heights at Makena of 11 feet and 10 feet respectively from waves of the 1946 and 1960 tsunamis. The citation of the 7.3 feet runup has little relevance to the discussion of this development. Undoubtedly more important than tsunami runup is the indication in the draft EIS of the effects of intense Kona storms. If the recorded historic tsunami runup has been 11 feet and the conversations with David Lono indicate that intense Kona storms may exceed tsunami inundation, we can assume that flood waters from Kona storms exceed 11 feet. We assume that this long time resident is speaking from experience, hence perhaps the 25 or 50 year frequency. The 75 or 100 year frequency is assumed to be significantly greater than 11 feet.

Pg. IV-35

In the section on sand transport, what is meant by the sentence "in the absence of surface, littoral currents cannot be generated."

Pg. IV-39

We assume that one of the two columns labeled Total Coliform in Table 4 is actually Fecal Coliform. The correct title should be inserted in the Final EIS.

Pg. IV-43-66

In general the description of the terrestrial ecology of the project site seems quite adequate. The data presented on plants and animals in the area are accurate and the discussion of potential impact and mitigating measures reflect a good knowledge of the terrestrial biology of the area. There are a few minor typographical errors and incorrect spellings of plant names. In Appendix A-1 (pg. A-1) Sida fallax and Waltheria americana are not endemic species but indigenous species. Messerschmidia argentea is not indigenous but exotic. The scientific name of Napaka Kahakai is Scaevola taccada.

Pg. IV-67-97

The section on marine ecology is quite complete and detailed. The survey methods are believed to be adequate to describe the flora and fauna present. We note that the surveys included stations actually south of the projected site

Pg. III-13

In the first phase of development approximately 3,000 dwelling units will be constructed. Assuming that some of these units are occupied by families, we assume that the school development site in the area will proceed concurrently with the first phase. Has the Department of Education been appraised of this development and the selected site and facilities that will be available? Does the Department of Education have any suggestions or reservations about the location of the proposed facilities? We note that 30.1 acres has been set aside for the school site. We assume that this will be sufficient for both an intermediate and an elementary school. Is the intent to include also a high school in this area? How far away are the existing schools and will bussing be necessary? Will the existing high school and/or intermediate school facilities be adequate to accommodate the number of students coming from this development?

Pg. IV-14

The description of the total drainage basin for the drainage area is given as 6,650 acres "of which only approximately 1,000 acres are within the project site." We note, however, on pg. III-1 that only 1020.733 acres are in the total development. Therefore we assume that only 20 acres are not in the drainage basin area (1020.733 - 1000 = 20.733 acres). It would appear from the information given on drainage and storm runoff that the potential flood hazard for this area is great and may be considered of serious environmental concern.

Pg. IV-17

A report from the State Department of Transportation dated 1971 is cited as indicating the estimated number of vehicles per day for the proposed project. However, we note earlier on pg. III-1 that the proposed project land was acquired by the Seibu Real Estate Company in January of 1974. We assume therefore that the Department of Transportation traffic study was not based on this proposed project. On what was the Department of Transportation study based?

The discussion of potential availability of surface water on this and the following page indicates that water requirements for the development are perhaps the most serious deficiency in the entire plan.

The estimated cost of the design and construction of the water transmission system is 11 million dollars. The derivation of these funds includes 4 million dollars from the Maui Board of Water Supply to be reimbursed by set fees for each hotel or multi dwelling unit hook-up in the Kihei-Makena area, and 7 million from the Wailea Land Corporation and SRECL. This 7 million is to be repaid to WLC and SRECL by the MBWS "from normal revenues derived from the system supplying the Maalaea, Kihei, and Makena areas." Does this mean that present residents will be required to assist in paying for a water transmission system required by this development?

and were not restricted to the area immediate adjacent to and offshore from the development.

Pg. IV-110

The list of tax map keys and approximate acreage per individual parcels given on this page does not match the list given on pg. III-1. There seems to be an addition of 8.759 acres for tax key 2-1-06-27. Which list is correct?

Pg. IV-121

Why was 1972 chosen as the final date to match the most recent visitor bureau publication pertaining to visitors on Maui?

Pg. IV-134

There are many grammatical errors primarily in the form of word omissions throughout the text. A typical example is found in the last sentence of this page which is not complete.

Pg. IV-121 to IV-152

The section on socio economic characteristics of the area is quite complete, however the relevance of these detailed socio-economic summaries of the various types of individuals to the environmental impact on the area would be helpful.

Pg. V-1-V-64

It would appear from the foregoing report that one of the most serious environmental impacts generated by this proposed development will be in the socio-economic area which is omitted from the list of potential impacts cited on this page.

We note in each case where the environmental impact has been discussed with associated recommendations that the recommendations are "that the developers should" do a certain item. Does this mean that they may or may not undertake the studies at their own discretion?

Pg. V-4

From the earlier materials presented, we assume that a very large portion of the area suggested for development is in a flood plain area. Earlier discussion had indicated that floods in excess of 11 feet above sea level are known from historic records. At this stage in the project's development, we do not have any data or information as to the location of the buildings. We assume however that structures will be built in these flood plain areas. We note on pg. V-9 that there is a potential 420% increase in the runoff rates of the project site resulting from the development. The inability of the present "natural" deposition of runoff to accommodate this increased expected runoff is recognized. Other methods of dispersion such as ocean outfall, seepage ponds, dry wells, and pond holding areas are suggested as methods to handle the estimated 500 acre feet of runoff produced by a 50 year storm. The environmental impact of these suggested "other methods of dispersion" may be extremely great, thus it is difficult to evaluate the environmental impact of the drainage problem without knowing what specific methods will be required. Recognition of potential soil loss/erosion problems expected during construction are mentioned in the draft EIS. We raise the question, however, as to why the items listed on pg. V-12 as occurring during construction should be permitted. Surely the impacts resulting from soil loss could be minimized by requiring proper attention during construction to the four items cited. The secondary effects of sediment discharge into the marine biologi al communities in addition to the primary soil loss impact are significant.

<u>Pg. V-34</u>

The impact of fine sediments on the nearshore coastal areas should be considered of major importance. Fine sediments reduce water clarity, reduce light penetration thus affecting the growth of coral. The deposition of sediment can cause clogging of the coral polyps and death.

<u>Pg. V-50</u>

The impact of this project on archaeological resources is clearly stated "destruction of numerous prehistoric and historical archaeological sites which are situated within the project site." The sites in this area have not been evaluated by the Hawaii Historic Places Review Board so they are under no legal protection and have received no recognized State evaluation. The survey which has been conducted by the Bishop Museum was a rapid and superficial one. Sites were not recorded in detail, approximate counts were taken, and no attempt has been made to follow up the Museum's recommendation for further survey and excavation as indicated in Section 4. Both surveys and test excavation in the area should be evaluated by the Hawaii Historic Places Review Board. The sites should be divided into those to be salvaged and then destroyed and sites to be preserved and incorporated into the development. It should be remembered that every archaeological site is a non-renewable and unique resource. Unlike many living things of natural features, the value of many sites can be salvaged by research and sites themselves destroyed. These kinds of sites can not stand in the way of the development but they do require money. Other sites should be preserved totally. Developments should be responsible for both.

<u>Pg. V-52</u>

In this section on general uses of the study area the point is made that a number of families residing makai of the project site would move from their homes prior to the completion of construction. Why would they move?

Pg. V-54

A figure of 3 acres was previously cited in the EIS for a park site. Considering the population projected, this does not seem adequate for recreational usage.

Pg. V-56

30 acres is not an adequate figure if one must develop all three school facilities--elementary, intermediate and high. Further having all three school facilities on one campus may not be in the best interest of the students nor in keeping with the policies of the Department of Education.

Pg. V-58

Where would the housing for employees of the project be located? How many units are anticipated. Will they be rented by the developer to the employees or will they be available for purchase? What is the estimated purchase price in the latter case.

Pg. VI 1-8

The "other development alternatives" were discussed briefly. A more specific discussion of alternatives should be included in the final EIS.

We appreciate the opportunity to comment on this DEIS.

Yours very truly,

Jerry M. Johnson
Acting Director

cc: OEQC

UNIVERSITY OF HAWAII

LEEWARD COMMUNITY COLLEGE

May 5, 1975

RECEIVED

MAY 7 [illegible]

DEPT. OF PLANNING

Memorandum

TO: Chairman, Maui Planning Commission
FROM: Bert Y. Kimura, Leeward Community College
SUBJECT: Draft EIS, Seibu-Makena Master Plan

My apologies for this delayed response. Overall, the major environmental impacts of the project have been addressed properly, although in some instances details and more quantitative estimates would be desirable. My specific comments follow:

Introduction (I)

Study Purpose (I,2,3). The final EIS shoould include information with regards to alternative mitigative measures and public response, especially since preliminary studies have already been conducted. It would strengthen the statement considerably.

If this statement is officially submitted by SRECL, they should commit themselves to recommendations made by Neighbor Island consultants. Otherwise the exact intentions of SRECL remain unclear, especially in relation to the proposed objectives on p. II-1.

A discussion should be included demonstrating a definite need for the project.

Description of the Environment (IV)

Land Use (IV-113) What will happen to families presently living within the project site? If relocation is necessary, how and whem will it be done?

Socio-Economic Characteristics (IV-123) Does the current occupancy rate (Table 14) on Maui justify the construction of additional facilities? What is the current and anticipated occupancy rate in the Kihei area in comparison to Maui as a whole?

Environmental Impact (V)

Drainage (V-13) A provision should be made for continual and stringent monitoring of sediment runoff prior to and including the entire construction period. The effectiveness of any sedimentary control plan and activation of specific measures can then be fully evaluated.

Chemical Characteristics, Air Quality (V-38) Likewise, air quality and fugitive dust levels must be constantly checked.

More specific estimates on the impact of increased vehicular traffic are needed. Various air quality diffusion models are available through EPA publications.

[illegible] / Cable Address [illegible]

Biological Characteristics, Sources of Stress (V-48) Pamphlets may not be effective in discouraging organism collection but instead actually encourage <u>more</u> extraction. Residents' and visitors' attention would be attracted by such publications. A more effective measure would be avoidance of any facilities and activities on the shoreline. Provisions and amenities merely create immediate access to marine organisms.

Cultural Characteristics, Additional Employment (V-59,60) It is unclear how the 6,250 jobs generated will affect current unemployment levels, especially since this section suggests that dwelling facilities in the area may be too expensive for those now unemployed. It might be necessary to provide lower income housing to accomodate employees. Commuting from Kahului-Wailuku would be undesirable from the standpoint of energy consumption, air quality degradation and vehicular congestion. Commuting should be discouraged.

Furthermore, this section needs detailed clarification on the following:

(1) the quantity of solid waste anticipated and disposal methods,
(2) aesthetics of proposed contruction relative to existing physical environmental characteristics,
(3) rodent control problems generated by grading operations,
(4) potential environmental impact of the project on the Ahihi-Kinau Natural Area Reserve.

<u>Other Environmental Considerations (VI)</u>

Alternatives (VI-5) Discussion is totally inadequate. There must be other alternative project designs which are economically more desirable and environmentally more compatible. One example might be a different set of land use configurations to minimize environmental shock. This could include undeveloped natural areas within the project boundaries, i.e.; historical/archaeological site. An all-or-nothing attitude is unrealistic and irresponsible.

The consultants have directly and correctly delineated the major adverse environmental effects of the program on Table 24. The program as described in this Draft EIS, will result in additional irreversible commitments (VI-7) and over a long-term period result in a detrimental environmental agitation of the Makena area. Any approval granted should be contingent upon the adoption and execution of all recommendations made in this statement. Finally, a 1-2 year study period must be conducted for collecting additional information and base line data (see, for example, IV-25, 36, 40, 42, 43, 67, 144; V-38,48). Only then should any conclusive decision be made.

BMK

UNIVERSITY OF HAWAII
Water Resources Research Center
Office of the Director

MEMORANDUM May 2, 1975

MEMO TO: Richard E. Marland
Director, OEQC

FROM: Reginald H. F. Young
Asst. Director, WRRC

SUBJECT: EIS, Seibu Makena Master Plan, Maui. Seibu Real Estate Company

We have reviewed the above EIS and have the following comments:

P. V-4. Drainage. Using 24-hour rainfall figures for calculating runoff could lead to erroneous results because peak discharge occurs when high intensity precipitation falls for a few hours with considerably less rainfall before and after the downpour. For example, 8 in. of rainfall distributed evenly over 24 hours gives 0.31 in./hr. But if 6 in. of the total 8 in. fell in 2 hrs., there would be a considerably greater peak discharge following the downpour. And in Hawaii, rainfall intensities of 2-3 in./hr. for several hours are not at all unusual.

The estimations of storm runoff from the project site (p. V-8, Table 19) may be too low. According to the Storm Drainage Standards for Maui County, , the peak flow from an area of 100 acres may be as much as 375 cfs.

Another factor is that when an area is changed from natural to urbanized conditions, there is considerable leveling of the ground surface which results in accelerated runoff. On the original surface there are considerable amounts of small indentations, rocks, and debris which decelerates the flow. But when the area is urbanized, the surfaces are made relatively smooth or level, even on a golf course. This is particularly true of the subject area which presently has a large percentage of the surface covered by aa lava. With the proposed extensive grading, and undoubtedly backfilling of the surface with soil to facilitate planting, there will probably be a net reduction in infiltration rate. The fact that presently there are hardly any defined drainageways attests to the existing high infiltration. But urbanization will change that and it should be taken into consideration.

A third factor has to do with disposal of the runoff. Permitting it to flow into the ocean is clearly undesirable. Alternatively the developers should seriously consider building retention-infiltration ponds (as noted on P. III-11) at various locations on the slope to both retain and permit infiltration into the substrata which is probably highly permeable aa lava. Or, the ponds could be lined and the water retained for irrigating the golf course. If the ponds are strategically located, gravity flow could be utilized for distribution to at least some parts of the golf course.

The need for a high degree of water quality management in this development and cognizance of applicable requirements of PHR Chapters 37-A and/or 38 is commended. However, no indication is given of the type of system that will be used for wastewater treatment, possible disposal well locations, and monitoring schemes for the disposal wells and effluent irrigation areas to assure minimum adverse environmental impact.

Further, since the proposed development is beyond the current limits of existing, conventional utility systems there exists potential for serious consideration of systems/devices/technology for resource conservation, i.e., dual water systems, elimination of the flush water closet, maceration of refuse for collection and treatment with wastewater, etc.

RHFY:jmn

cc: H. Gee
Y. Fok
E. Murabayashi
Env. Ctr.

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

OFFICE OF BUSINESS SERVICES

April 30, 1975

RECEIVED
MAY 2 1975
DEPT. OF PLANNING
COUNTY OF MAUI

Maui Planning Commission
County of Maui
Wailuku, Maui, Hawaii 96793

Gentlemen:

Subject: Seibu Makena Master Plan
Environmental Impact Statement

We have reviewed the subject EIS and submit the following comments:

Future School Site - The plan provides 30 acres for future school purposes. We have no current plans to develop school facilities within the Seibu Makena area pending indications that enrollment increases cannot be adequately accommodated at the new Kihei Elementary-Intermediate School scheduled to open in 1977.

When the enrollment situation justifies school facilities specifically for the Seibu development area, we will initiate a request to the State Department of Accounting and General Services to conduct a site selection study. The study will include consideration of the school site shown on the Seibu Makena master plan plus consideration of alternative locations.

Under State law, prior to acquiring the site, the Department of Accounting and General Services will prepare an EIS specifically for the school site.

Sincerely,

KOICHI H. TOKUSHIGE
Assistant Superintendent
Office of Business Services
KHT:JEE:yk

cc: Office of Environmental Quality Control
Maui District
Dept. of Accounting & General Services

Depending on how the landing is used, there may be gas and oil spills and trash to pollute the shore waters.

Increased residential and recreational use of this area, we assume, will mean loss of marine life due to fishing and collecting. This effect might be mitigated by a public awareness program to discourage destructive activities such as shell collecting.

The historic portion of the EIS provides an interesting chronology, but no attempt was made to identify historic sites, to relate the chronological event to the site and to its overall place in history, to evaluate the site and to prescribe treatment of the site. Similarly, the archaeology section is not as fulsome as it can be. We know more information is available like locating sites which qualify for the State and National Registers. Summing up, *the history and archaeology of the area is not adequate and therefore* the impact of the project on historic and archaelogical values of the areas cannot be determined.

We have found nothing in the EIS which analyzes recreation needs and how they will be met. Chapter VI of the EIS dismisses the idea of a park on Seibu lands because of high acquisition and utility costs. We plan to look into the feasibility of a public park at "Big Beach" and "Little Beach" as well as at La Perouse Bay.

This project is a substantial one. We feel it deserves more analysis by the developer.

We will have additional comments to you in a week or two.

Very truly yours,

Edgar A Hamasu
for CHRISTOPHER COBB
Chairman of the Board

cc: Mr. Manuel Moniz, Jr.
Divisions

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

CHRISTOPHER COBB, CHAIRMAN
BOARD OF LAND & NATURAL RESOURCES

EDGAR A. HAMASU
DEPUTY TO THE CHAIRMAN

DIVISIONS:
CONVEYANCES
FISH AND GAME
FORESTRY
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

April 30, 1975

RECEIVED
MAY 3 1975
[illegible]T. OF PLANN[illegible]
[illegible]NTY OF

Maui Planning Commission
County of Maui
Wailuku, Maui, Hawaii 96793

Gentlemen:

We appreciate the opportunity to review the EIS for Seibu's proposed plan for its Makena lands.

The three copies provided us were insufficient. For this reason we have not completed our review and will be submitting additional comments by mid-May. We find that six copies are usually necessary to ensure adequate staff review.

One of the three copies sent us was loaned to the staff of the Hawaii Natural Area Reserve System. They will be forwarding comments direct to you.

We find that the impact of wildlife values is adequately addressed. We note that there are small areas of habitat for the Hawaiian stilt north of Puu Olai which should not be altered. While these lie outside the project limits, the project should be designed so as to minimize disturbance to these areas during and after construction.

The EIS says development will increase the runoff of 50-year storms by 80% for the total drainage basin and a 420% increase for the project site. Various ways will be used to handle the 500 acre feet of runoff. We suggest that sewage treatment plans need to be more fully developed before the total effects of land drainage can be determined. We also note that water chemistry data have not been collected to establish a baseline for determining the effects o increased drainage on shore waters.

Although a boat landing is proposed, details are lacking from which to determine possible environmental effects. We assume this will involve dredging and consequently turbidity and sedimentation.

GEORGE R. ARIYOSHI
Governor of Hawaii

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
NATURAL AREA RESERVES SYSTEM COMMISSION
1179 Punchbowl Street, Honolulu, Hawaii 96813
Phone 548-2529

Commission Members:
D. Elmo Hardy
John A. Maciolek
Robert E. Nelson
Glenn T. Yamashita
Richard S. Shomura
Gordon A. Macdonald

RECEIVED
MAY 12 1975
DEPT. OF PLANNING
COUNTY OF MAUI

May 10, 1975

TO: Maui County Planning Commission
FROM: Natural Area Reserves System Commission
REGARDING: Seibu Environmental Impact Statement

Parts of this statement have been reviewed by this Commission for the projected environmental impacts from a Makena land development plan that would draw a projected 17,000 new residents during the next five years. Our major responsibility is the continued high natural quality of the Ahihi-Kinau Natural Area Reserve which is acknowledged as the most important inshore marine area known in Hawaii, particularly because of its great variety of native species. This region has long been protected from degradation by its remoteness, but the large new residential community of 17,000 and additional 1000 tourists per day will radically transform its present isolated condition. The increased cost to the State for enforcing Regulation 7 protecting the Reserve is not represented in the EIS. Potential changes in the marine ecosystems were outlined in the statement and noted as potential irreversible commitments of resources. These changes mostly would result from runoff or percolation of silt, nutrients, or toxic chemicals, such as pesticides. One potential pesticide problem not explored in the EIS is the entrance of chlordane into surface runoff and ground water and into marine waters from residences treated with this chlorinated hydrocarbon for termite control purposes.

There is inadequate discussion of the economic impact of the increased, nearly island-wide competition for limited fresh water between a large, newly developed Makena community and existing and new agricultural industries, especially sugar and diversified agriculture. There is no mention of adverse impacts upon native Hawaiian stream life if additional streams are severely dewatered because of any newly developed water catchment systems that would result from attempts to meet the increased human demands for water.

The opportunity to review this environmental statement is appreciated.

Sincerely,

for John A. Maciolek,
Acting Chairman

jm:sm

GEORGE R. ARIYOSHI
GOVERNOR

E. ALVEY WRIGHT
DIRECTOR

DEPUTY DIRECTORS
DOUGLAS S. SAKAMOTO
WALLACE AOKI

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

IN REPLY REFER TO:
ATP 8.3074

May 2, 1975

RECEIVED
[illegible]

Maui Planning Commission
County of Maui
Wailuku, Hawaii 96793

Dear Sirs:

Subject: Draft EIS, Seibu-Makena Master Plan

In reference to the subject environmental statement, please furnish us the data for the trip generation and traffic study in order to verify the published traffic data. The published traffic volumes seem to be exceedingly high, well over the capacities of our roadways.

Sincerely,

E. Alvey Wright

E. ALVEY WRIGHT
Director

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801

GEORGE A. L. YU
DIRECTOR OF HEALTH

Audrey W. Mertz, M.D., M.P
Deputy Director of Health

Henry N. Thompson, M.A
Deputy Director of Health

James S. Kumagai, Ph
Deputy Director of He

In reply, please refer to:
File: EPHS -

May 5, 1975

<u>MEMORANDUM</u>

To: Dr. Richard E. Marland, Interim Director
Office of Environmental Quality Control

From: Deputy Director for Environmental Health

Subject: Draft Environmental Impact Statement (EIS) for Implementation of the Proposed Seibu Makena Master Plan, Maui

Thank you for allowing us to review and comment on the subject EIS.

Staff comments are as follows:

(1) Our comments are being submitted late since 15 days is not an adequate time period for the review of an EIS.

(2) The availability of drinking water remains a significant problem for the proposed project. The transmission of water from the West Maui mountains should have an adverse impact upon the future availability of water to: (a) communities who already depend upo the West Maui mountains water sources for their drinking water needs; as well as (b) communities who already are scheduled to hook-up to the West Maui mountains water sources in the immediate future.

(3) The proposed private sewage treatment plant, although satisfying existing water quality standards, is not entirely desirable. The hook-up of the proposed project to a regional sewage treatment plant would be preferable. However, the State is not funding any faciliti for the subject area in the foreseeable future.

We realize that the statements are general in nature due to preliminary plans being the sole source of discussion. We, therefore, reserve the right to impose future environmental restrictions on the project at the time final plans are submitted to this office for review.

James S Kumagai
JAMES S. KUMAGAI, Ph.D.

cc: Maurice Kruth

GEORGE R. ARIYOSHI
GOVERNOR

JOHN FARIAS, JR.
CHAIRMAN, BOARD OF AGRICULTURE

YUKIO KITAGAWA
DEPUTY TO THE CHAIRMAN

STATE OF HAWAII
DEPARTMENT OF AGRICULTURE
1428 SO. KING STREET
HONOLULU, HAWAII 96814

RECEIVED
MAY 19 1975
DEPT. OF PLANNING
[illegible]

May 15, 1975

MEMORANDUM

To: Maui Planning Commission

Subject: EIS for Seibu Makena Master Plan

The Department of Agriculture has reviewed this statement for agricultural impact. The area, environmental conditions, and probable impacts are adequately assessed. Soil erosion and biological impacts are assessed adequately within the scope of the study.

The proposed recycling of treated wastewater as irrigation water is recommended as part of an overall water conservation policy. There is a real question as to the availability of water for development of the Makena area. This question is left open until further studies of water sources and distribution systems are completed. This is a major unresolved area of concern.

The Department finds no other conditions warranting further review.

John Farias Jr

John Farias, Jr.
Chairman, Board of Agriculture

JF:d:h

MEMORANDUM

May 12, 1975

RECEIVED
MAY 12 1975
DEPT. OF PLANNING
COUNTY OF MAUI

TO: Maui County Planning Commission
County Building
Wailuku, Maui

FROM: Dick Mayer

RE: Environmental Impact Statement for the Seibu Makena Master Plan

At this time I am reluctant to comment in depth on all of the questions which the EIS raises. For example, I have serious questions about the affect of poor premiums on construction projects, 2) the necessity of constructing this project considering the lack of indication for a market for such an extensive program, 3) the lack of consideration for the cost to the County for the long term operation and maintenance of the sewer system, county roads and water system. Although these facilities will be constructed by Seibu there is no mention made of the large amounts of money that will be needed to maintain these facilities.

Although I have many other questions I will await the filing of a request for a general plan amendment before commenting in depth. I find it difficult to make overall assessments of the Environmental Impact until I know exactly what Seibu is planning in the Makena area.

By and large I find extensive evidence in the Environmental Impact Statement submitted by the Seibu Real Estate Company to support the Planning Commission's refusal to grant a general plan amendment if and when it occurs.

I look forward to the future public hearings which the Planning Commission will hold on the anticipated general plan amendment request.

DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY SUPPORT COMMAND, HAWAII
APO SAN FRANCISCO 96558

AFZV-SG-EC

1 MAY 1975

RECEIVED
MAY 5 1975
DEPT. OF PLANNING
COUNTY OF MAUI

Maui Planning Commission
County of Maui
Wailuku, Maui, Hawaii 96793

Dear Sir:

The Draft Environmental Impact Statement for the Implementation of the Proposed Seibu Makena Master Plan was reviewed by this office.

The following comments are offered:

1. The EIS document could have been much smaller if Chapter IV, Description of the Environment, was condensed. Too much effort and attention was given to this section which in effect overshadowed the sections on Environmental Impact and Related Recommendations (Chapter V) and Other Environmental Considerations (Chapter VI). The supporting in-depth studies in Chapter IV could have been placed in the Appendix.

2. A section on air pollution is completely missing. This very important section must be included in this DEIS. Air pollution from all sources, especially vehicles, should be considered and the possible effects on the air quality defined.

It is hoped that the comments offered will help in adequately evaluating the DEIS.

We thank you for the opportunity to comment on the DEIS.

Sincerely,

LEE C. HERWIG, JR.
Colonel, MSC
Environmental Consultant to Commander,
U.S. Army Support Command, Hawaii

CF:
Dr. R.E. Marland, OEQC

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
BLDG. 230, FT. SHAFTER
APO SAN FRANCISCO 96558

PODED-P

1 May 1975

Chairman, Maui Planning Commission
County of Maui
Wailuku, Hawaii 96793

Dear Sir:

We have reviewed the draft environmental impact statement for Seibu Makena Master Plan and offer the following comments:

a. This statement has been reviewed on the basis that it represents "the initial evaluation of the proposed Seibu Makena Master Plan," and that "this document would, in the future, be refined and supplemented by more detailed environmental impact analyses for specific aspects of the project, i.e. sewage treatment plant" (page I1). The statement recognizes the numerous significant and wide-ranging impacts of this project and appears to be well documented. The approach of providing future supplemental statements as detailed design is completed seems both appropriate and necessary for a project of this scope.

b. The proposed construction of a two-lane launching ramp at Makena (page III-6) will require a Department of the Army permit under Section 10 of the River and Harbor Act of 1899. While its impact is discussed in page V-42 under Marine Ecology, its impact upon the coastal processes should also be mentioned, page V-34.

c. Regional frequency data for the project area is presented on plate 13 of the Flood Hazard Information Study, Island of Maui, Report R39, prepared by the Pacific Ocean Division, U.S. Army Corps of Engineers. Peak discharges for a 50-year frequency flood range from 500 to 600 cfs per square mile, compared to about 300 cfs per square mile, as calculated from the data presented on pages IV-14 and V-6 of the statement.

d. In light of the existing Maui County Flood Plain and Tsunami Inundation Area Ordinance, the basis for selection of 50-year flood protection (Page V-13) should be discussed. The potential tsunami runup conditions appear reasonable.

e. The backshore sand dunes referred to on page IV-36 should be recognized as protective structures against high wave action. Care should be taken to retain the dune lines and to protect the vegetation on the sand dunes and on erodable shores.

f. A more definitive discussion of the differences between the Kihei Civic Development Plan designations and the Seibu Makena proposal would aid in determining the consistency of the proposal with the general plan for the area. Figure 14, showing the general plan and referenced on page IV-110, is not included in the statement. Figure 13 is repeated in its place.

g. The discussion of cultural characteristics of the project site, page IV-98, includes several recommendations made by Bishop Museum for additional Phase I and II studies of certain areas. Since the National Register potential of these areas or sites may depend on conduct of these studies, a determination on whether these studies will be conducted, and subsequent coordination with the State Historic Preservation Officer and the Advisory Council on Historic Preservation should be made.

Sincerely yours,

KISUK CHEUNG
for Chief, Engineering Division

Copy furnished:
Office of Environmental Quality Control
State of Hawaii
550 Halekauwila Street
Honolulu, Hawaii 96813

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
440 Alexander Young Building, Honolulu, Hawaii 96813

May 6, 1975

RECEIVED
MAY 1975

Maui Planning Commission
County of Maui
Wailuku, Maui, Hawaii 96793

Dear Sirs:

The Soil Conservation Service has reviewed the Seibu Makena Master Plan Environmental Impact Statement. We have the following comments to offer:

Page I-2: The draft EIS states "...SRECL has not committed itself to the implementation of these measures at this time. Alternative mitigative measures were considered for each section but are not discussed in this report." SCS feels the alternatives should be discussed to allow a means to reasonably evaluate the proposed project.

Page III-11: The draft EIS does not state whether the use and effectiveness of depressions, permeable asphaltic concrete pavements and rooftop ponding will be based upon hydrologic determinations. Runoff may be such that only a small percentage of the design storm runoff will be retained as proposed.

Page IV-2: The "K" value for the Makena series should be 0.32 rather than 0.49 as stated.

Page IV-16: The Soil Conservation Service does not regard 10 tons per acre as a reasonable amount of soil loss on developed or undeveloped lands. The SCS recommends that not over 4 tons per acre per year be the maximum limit on agricultural lands in the Makena and Oanapuka series. The SCS has not established recommendations for other than agricultural land.

Page V-4: The SCS recommends the 100-year frequency storm be used as the design storm for urban areas as opposed to a 50-year frequency storm.

RECEIVED
WOODDELL, MUKAI
& ICHIKI
MAY 9 9 53 AM '75

Pages V-13 and 14: The grading and sediment control plan should also include measures to insure sufficient water and irrigation facilities at the project site prior to land clearing; minimal vegetation removal; clearing of small areas, as opposed to large block clearing; clearing and grading should be considered during periods of minimal adverse weather conditions, that is during drier periods.

Table 24: A projected impact not shown in Table 24 and not discussed elsewhere concerns the effect of removing the area from agricultural uses. What is the effect or impact? How much agricultural land could be considered prime farm land?

Thank you for the opportunity to review this draft environmental impact statement.

Sincerely,

Francis C. H. Lum

Francis C. H. Lum
State Conservationist

cc: OEQC, Honolulu, HI

May 9, 1975

RECEIVED
MAY 12 1975
DEPT. OF PLANNING
COUNTY OF MAUI

Mr. Yoshikazu Matsui
Chairman of the Board
Planning Commission
County of Maui
200 S. High Street
Wailuku, Maui 96793

Dear Mr. Matsui:

The undersigned residents and landowners of Makena wish to hereby object to the Environmental Impact Statement and development plan submitted by Seibu for Makena. We request that the County of Maui direct Seibu to submit a revised Environmental Impact Statement and development plan that will cover the 500 acres for which Seibu has urban zoning and that the development plan conform to the County of Maui General Plan as adopted in 1970.

The Kihei-Civic Development and the County General Plan both called for Makena to be developed as resort-residential community with a heavy emphasis on residential. To quote from the plan, " With the growth of Wailea, Makena is expected to grow into a seconday resort-residential community that may someday resemble Honolulu's Kahala district." The Seibu Company was well aware of the County General Plan when they purchased the lands at Makena for development.

From the statement that has been presented to the County, it appears that the decision was made in Tokyo not to follow the County General Plan but instead to change Makena to another condominium development. The Seibu plan ignores the residential nature of Makena and changes 290 acres from residential to apartment. According to the Impact Statement there will be 1707 fewer single family residential units and 2346 more apartment units than called for in the County General Plan. The Impact Statement does not discuss the reasons for the change nor does it cover the effect of this change from the General Plan on the environment of Makena. Furthermore it appears that most of the apartment units will be in the initial 500 acres for which Seibu has received Urban zoning.

The Environmental Impact Statement also implies, that we, the present residents of Makena, will give up our land and our homes as their development progresses. We have no desire to give up our land or our homes or to be crowded out of Makena by a condominium development. We live in a very small area in comparison to the land purchased by Seibu. Makena Landing and the small residential area

Mr. Yoshikazu Matsui
May 9, 1975

should be protected and kept residential in nature as called for in the General Plan, and Seibu should be directed to follow the General Plan and the desires of the present residents of Makena.

We therefor again request that the County of Maui find the Environmental Impact Statement to be inadequet because it does not conform to the County General Plan nor does it concern itself with the added environmental impact of the condominium apartments instead of homes. We do not wish Makena to become another Kihei and we hope that the County will listen to the desires of the present residents rather than the views of the developer.

Sincerely,

Leslie M. Agorastos

Leslie M. Agorastos

Nancy R. King
Garfield King
Dugal B. Mike
Nadie K. Makua
Mary K. Cockett
Christopher K. Cockett
Mabel H. Wong
Helen P. Ferreira
Cecilia Aki
Rosabelle Kala
David Chang

SEIBU PLAN INFORMATION

Proposed Zoning

Acres

	General Plan	Seibu
R-2 R-3	423	168
A-1	30	326
A-2	30	
Hotel	27	37.8
Commercial	25	24

Units

R-2 R-3	2184	477
A-1 A-2	1946	4292
Hotel	1000	1200

Difference

	Acres	Units
R-2	+ 54	- 187
R-3	-348	-1520
A-1	+136	+ 820
A-2	+134	+1526

Drop 1707 single family residential
Add 2346 apartment units.

RESPONSES TO CONCERNS/QUESTIONS FROM GOVERNMENTAL AGENCIES AND THE GENERAL PUBLIC

INTRODUCTION

The following concerns and questions from governmental agencies and the general public have, in some cases, been condensed, separated, consolidated, or paraphrased by topic from the formal submittals which are presented in the previous section of this report. In addition, all comments and responses have been segregated by topic. The comments/responses from governmental agencies and the general public were handled in this manner in order to facilitate (1) a point-by-point discussion of the validity, significance and relevance of the comments; (2) discussion as to how each comment was evaluated and considered in planning the proposed action (State Enviromental Quality Commission, 1974); and (3) reference to specific types of concerns, i.e. drainage.

COMMENTS/RESPONSES

Sewage Treatment and Effluent

Comment: Will the estimated capacity of the storage lagoons and the amount of water needed for irrigation be adequate to accomodate the amount of effluent generated by the project? Is there any anticipation or provision for possible offshore disposal of effluent (University of Hawaii, Environmental Center)?

be necessary

Responses: Storage lagoons would be designed to accommodate the amount of effluent generated by the project. Effluent will be used to irrigate the golf courses. As a result, there is no anticipation or provision for the offshore disposal of effluent. It should also be noted that preliminary discussion with an adjacent landowner has been made regarding the potential re-use of a portion of the wastewater which would be generated by the proposed sewage treatment plant. Should this additional type of re-use become a reality, wastewater would be pumped to an off-site destination.

4 mgd

Comment: The wastewater treatment plant for the Wailea development is not part of the Makena area development. Relevance to the proposed Makena project is not indicated (University of Hawaii, Environmental Center).

Response: The intent of Chapter IV is to describe existing conditions of the project site and study area. During preparation of this document, it was felt the reviewers of this EIS, who were aware of the new sewage treatment plant and transmission line development in the Kihei-Wailea area, would wonder why Seibu would not continue the transmission line development to the project site and "hook-up" into the new treatment plant at Kihei.

Comment: No indication is given of the type of system that will be used for wastewater treatment, possible disposal well locations, and monitoring schemes for the disposal wells and effluent irrigation areas to assure minimum adverse environmental impact (University of Hawaii, Water Resource Research Center).

Response: Such data would not be available until preliminary site layout, grading drainage and sewage treatment plant design plans are prepared, however, such facilities will be designed in accordance with the Department of Health standards.

Comment: Since the proposed development is beyond the current limits of existing, conventional utility systems, there exists potential for serious consideration of systems/devices/technology for resource conservation, i.e. dual water systems, elimination of the flush water closet, maceration of refuse for collection and treatment with wastewater, etc. (University of Hawaii, Water Resource Research Center).

Response: Concur with this comment. Seibu intends to consider these alternative type of utility systems in conjunction with more detailed planning and design of a wastewater management and refuse disposal system for the project site.

Comment: We suggest that sewage treatment plans need to be more fully developed before the total effects of land drainage can be determined. We also note that water chemistry data has not been collected to establish a baseline for determining the effects of increased drainage on shore waters (State Department of Land and Natural Resources).

Response: Future sewage treatment plant design plans and specifications would be done concurrently with more detailed hydrologic and water chemistry studies. It is not believed, however, that detailed sewage treatment plans would provide a better basis for assessing surface runoff (land drainage?).

Comment: The proposed private sewage treatment plant, although satisfying existing water quality standards, is not entirely desirable. The hook-up of the proposed project to a regional sewage treatment plant would be preferable. However, the State is not funding any facilities for the subject area in the foreseeable future (State Department of Health).

Response: It is agreed that hook-up to the plant in Kihei is desirable, but because of the cost and the lack of capacity of the planned Kihei facility hook-up is not possible.

Comment:	The proposed recycling of treated wastewater as irrigation water is recommended as part of an overall water conservation policy (State Department of Agriculture).
Response:	As indicated on page III-11, the re-use of wastewater from the proposed sewage treatment plant would be a design objective of Seibu Real Estate Co., Ltd. (SRECL).

Boat Launching Facility

Comment: Although a boat landing is proposed, details are lacking from which to determine possible environment effects. We assume this will involve dredging and consequently, turbidity and sedimentation (State Department of Land and Natural Resources).

Response: Development of a boat ramp would probably require so dredging from an isolated area of the shoreline. Su operations would, temporarily, generate turbidity in the waters adjacent to the ramp area. Prior to such development, evaluations of this project would be ma by appropriate government agencies before constructi is permitted.

We concur with the DLNR comment that boat users may litter the nearshore waters around the ramp area wit trash. Adequate trash facilities and maintenance wil be provided to alleviate the problem. However, gas and oil spills would probably be rare.

Comment: The proposed construction of a two-lane launching ram at Makena (page III-6) will require a Department of the Army permit under Section 10 of the River and Harbor Act of 1899. While its impact is discussed in page V-42 under Marine Ecology, its impact upon the coastal processes should also be mentioned, page V-34 (Army Corps of Engineers).

Response: The impact of the launching on coastal processes will necessarily be reviewed by government agencies prior to commencement of construction.

Terrestrial Biology

Comment: We note that there are small areas of habitat for the Hawaiian Stilt north of Puu Olai which should not be altered. While these lie outside the project limits, the project should be designed so as to minimize disturbance to these areas during and aft construction (State Department of Land and Natural Resources).

Response: Seibu would attempt to minimize disturbance to the habitat of the Hawaiian Stilt through proper drainage design and necessary precautions during constructi n.

Comment: There are a few minor typographical errors and incorrect spellings of plant names. In Appendix A-1 (page A-1) Sida fallax and Waltheria americana are not endemic species but indigenous species. Messerschmidia argentea is not indigenous but exotic. The scientific name of Napaka Kahakai is Scaevola taccada (University of Hawaii, Environmental Center).

Response: Agree.

Recreation/Collection of Marine Organisms

Comment: Increased residential and recreational use of this area, we assume, will mean loss of marine life due to fishing and collecting. This effect might be mitigated by a public awareness program to discourage destructive activities such as shell collecting (State Department of Land and Natural Resources).

Response: Seibu agrees to undertake such a program through the use of informational brochures.

Comment: We have found nothing in the EIS which analyzes recreation needs and how they will be met. Chapter VI of the EIS dismisses the idea of a park on Seibu lands because of high acquisition and utility costs. We plan to look into the feasibility of a public park at "Big Beach" and "Little Beach" as well as La Perouse Bay (State Department of Land and Natural Resources).

Responses: An adequate recreational "needs analysis" requires basic knowledge concerning the present leisure time characteristics of future residents of the project site. This information is presently unavailable. It is believed that Seibu's proposed on-site provisions for swimming (fresh water), sunbathing, boating, golf, horseback riding, bicycling, and tennis, as well as off-site accessibility to fishing, snorkeling, sunbathing would provide both future residents and visitors with numerous recreational opportunities.

During the past 15 - 16 years, various governmental agencies concerned with public recreation have considered "Big" and Little Beaches" as a potential public park site. Seibu would support DLNR's acquisition in the vicinity of these beaches for development of a public park.

Comment: Pamphlets may not be effective in discouraging organism collection, but instead actually en ou more extraction. Residents' and visitors' atte would be attracted to such publications. A mor effective measure would be avoidance of any facilities and activities on the shoreline. Provisions and amenities merely create immediate access to marine organisms (Leeward Community College).

Response: It is believed that the educational media should be attempted first before it is ruled out. As indicated by the EIS, limited amounts of shoreline are included in the project site.

Comment: A figure of 3 acres were previously cited in the EIS for a park site. Considering the population projected, this does not seem adequate for recreational usage (University of Hawaii, Environmental Center).

too small

Response: The 3 acres proposed for a park are only a port o of the recreational area and facilities proposed. Seibu plans to provide a swimming pool at the Hotel-Village Center (p. III-5), two 18-hole go f courses (p. III-7), a boat launching facility in the Makena Landing area (p. III-6), tennis courts, as well as a separate system of paths for pedestrians, horseriding, bicycling and gol carts. In addition, the future population would also be able to utilize the nearby shoreline for fishing, swimming, sunbathing, snorkeling, boating and other marine recreational activities.

In addition, public beach access would be provided in the Makena Landing and Hotel areas and on the Seibu parcel south of Puu Olai fronting Big Beach.

Air Quality

Comment: Air quality and fugitive dust levels must be constantly checked during construction (Leeward Community College).

NOT ANSWERED

Response: Agree. In light of Chapter 43 of the State Department of Health Regulations, the State Department of Health would be responsible for the monitoring of air quality.

Comment: More specific estimates on the impact of increased vehicular traffic are needed. Various air quality diffusion models are available through EPA publications (Leeward Community College).

Response: It is believed that the impact upon air quality is adequately addressed for the reviewer to assess the secondary effects resulting from increased vehicular traffic.

Comment: A section on air pollution is completely missing. This very important section must be included in this DEIS. Air pollution from all sources, especially vehicles, should be considered and the possible effects on the air quality defined (U.S. Department of the Army).

Response: On page V-38, brief comments are presented concerning the types of air pollutants which would be generated from an increased amount of vehicular traffic. No attempt was made to project quantities since no basic assumptions could be made regarding the type of automobiles which would be used within the project site. Further studies will be made and measures taken, such as minimizing traffic within the project, to insure that EPA and the Department of Health ambient air quality standards are met.

General Socio-Economic Characteristics

Comment: It is unclear how the 6,250 jobs generated will affect current unemployment levels, especially since this section suggests that dwelling facilities in the area may be too expensive for those now unemployed. It might be necessary to provide lower income housing to accommodate employees. Commuting from Kahului-Wailuku would be undesirable from the standpoint of energy consumption, air quality degradation and vehicular congestion. Commuting should be discouraged (Leeward Community College).

Response: Seibu is committed to a program of providing employee housing designed to meet the economic capabilities of the eventual employees of the project.

Comment: There are many grammatical errors primarily in the form of word omissions throughout the text. A typical example is found in the last sentence of this page which is not complete (University of Hawaii, Environmental Center).

Response: The last sentence on p. IV-134 should read: "The number of repeat visits to Maui in all classes (2nd, 3rd and 4th or more visits) is below the State percentage for these classes."

Comment: The section on socio-economic characteristics (p. IV-121 to IV-152) of the area is quite complete; however, the relevance of these detailed socio-economic summaries of the various types of individuals to the environmental impact on the area would be helpful (University of Hawaii, Environmental Center).

Response: The intent of this section is to acquaint reviewers of the EIS with existing trends of tourism in Maui, as well as population, employment and income trends occurring in the Kihei-Kamaole-Wailea area. It is believed that such data provides the reviewer with a better basis for assessing socio-economic impact evaluations made in Chapter V.

Comment: It would appear from the foregoing report (pp. V-1 to V-64) that one of the most serious environmental impacts generated by this proposed development will be in th socio-economic area which is omitted from the list of potential impacts cited on this page (University of Hawaii, Environmental Center).

Response: The discussions presented on pp. V-53 to V-64 describe the impacts to population, recreation, public services (excluding utilities), primary and secondary employment and income to the Kihei-Makena area as well as governmental revenues and costs to both the County of Maui and the State of Hawaii.

Comment: Does the occupancy rate (Table 14) on Maui justify the construction of additional facilities? What is the current and anticipated occupancy rate in the Kihei area in comparison to Maui as a whole (Leeward Community Center)?

Response: An evaluation of whether or not current hotel occupancy rate on Maui of 79.6% (January, 1975) justifies the construction of additional facilities is not considered a relevant discussion within the EIS. Rather, the function of the EIS is to provide more objective analyses of the tourism economy which the reviewer can utilize to evaluate the "justification" of additional hotel facilities.

No occupancy data is known to be available for the Kihei area which would be adequate for comparison and projection.

Historical/Archaeological Sites

Comment: The historic portion of the EIS provides an interesting chronology, but no attempt was made to identify historic sites, to relate the chronological event to the site and to its overall place in history, to evaluate the site and to prescribe treatment of the site. Similarly, the archaeology section is not as fulsome as it can be. We know more information is available like locating sites which qualify for the State and National Registers. Summing up, the history and archaeology of the area is not adequate and therefore the impact of the project on historic and archaeological values of the areas cannot be determined (State Department of Land and Natural Resources).

Response: All known available historical/archaeological information regarding the project site was included in the EIS. Bishop Museum has an on-going contract with DLNR to provide data for evaluating which sites qualify for the State and National Registers; however, at the time this report was prepared, DLNR officials indicated that such data was not available when queried regarding this information.

Comment: Historical/archaeological sites should be divided into those to be salvaged and then destroyed and sites to be preserved and incorporated into the development. It should be remembered that every archaeological site is a non-renewable and unique resource. Unlike many living things of natural features, the value of many sites can be salvaged by research and sites themselves destroyed. These kinds of sites cannot stand in the way of the development but they do require money. Other sites should be preserved totally. Developments should be responsible for both (University of Hawaii, Environmental Center).

Response: The preservation of selected historical/archaeological sites is being considered for the proposed development. Further studies as to relative values and costs of salvage and/or preservation would be performed as site planning proceeds. It is anticipated that selected historical/archaeological sites will be restored when feasible.

Comment:	The discussion of cultural characteristics of the project site, page IV-98, includes several recommendations made by Bishop Museum for additional Phase I and II studies of certain areas. Since the National Register potential of these areas or sites may depend on conduct of these studies, a determination on whether these studies will be conducted, and subsequent coordination with the State Historic Preservation Officer and the Advisory Council on Historic Preservation should be made (Army Corp. of Engineers).
Response:	See previous response.

EIS Purpose and Procedure/Criteria for Decision-Making/Mitigative Measures

Comment: The approach of providing future supplemental statements as detailed design is completed seems both appropriate and necessary for a project of this scope (Army Corp. of Engineers).

Response: Seibu will provide supplemental statements or data as required by appropriate government agencies.

Comment: Is this project, in fact, in the best interest of the County and the State (University of Hawaii, Environmental Center)?

Response: This EIS was prepared in accordance with Hawaii Revised Statutes, Chapter 343 in order to assist the Maui County Planning Commission in its attempt to evaluate this question. It is believed that the EIS provides adequate information and assessment to provide for this evaluation.

Comment: This project is a substantial one. We feel it deserves more analysis by the developer (State Department of Land and Natural Resources).

Response: This comment does not indicate specific areas of inadequacy. It is believed that the concerns raised by the EIS and other comments have been adequately answered.

Comment: The EIS document could have been much smaller if Chapter IV, Description of the Environment, was condensed. Too much effort and attention was given to this section which in effect overshadowed the sections on Environmental Impact and Related Recommendations (Chapter V) and Other Environmental Considerations (Chapter VI). The supporting in-depth studies in Chapter IV could have been placed in the Appendix (U.S. Department of the Army).

Response: Comments concerning format and presentation of data within the EIS are appreciated. However, it is believed that a comprehensive presentation is required of the existing environment in order that each reviewer may make an adequate evaluation of impact analyses and related recommendations.

Comment: We note in each case where the environmental impact has been discussed with associated recommendations that the recommendations are "that the developers should" do a certain item. Does this mean that they may or may not undertake the studies at their own discretion (University of Hawaii, Environmental Center)?

Response: The proposed mitigative measures appear to be most practicable at this time, however, during the preliminary design stage other alternative measures may be found to more effective or more desirable.

Comment: The final EIS should include information with regards to alternative mitigative measures and public response especially since preliminary studies have already been conducted (Leeward Community College).

Response: At the time of this report, there are no rules or regulations which require this type of additional information.

Comment: If this statement is officially submitted by SRECL, they should commit themselves to recommendations made by Neighbor Island Consultants. Otherwise the exact intentions of SRECL remain unclear, especially in relation to the proposed objectives on p. II-1 (Leeward Community College).

Response: The proposed mitigative measures appear to be most practicable at this time; however, during the preliminary design stage, the alternative measures may be found to be more effective or desirable.

Comment: We realize that the statements are general in nature due to preliminary plans being the sole sources of discussion. We, therefore, reserve the right to impose future environmental restrictions on the project at the time final plans are submitted to this office for review (State Department of Health).

Response: Seibu recognizes this possibility.

Comment: A discussion should be included demonstrating a definite need for the project (Leeward Community College).

Response: It is believed that the incorporation of a "defini of need" in any EIS inappropriate because of th "unnecessary invitation" for subjective statements within the EIS. This decision as to whether or no the project is needed rests with the Maui County Planning Commission.

project's development, we do not have any data or information as to the location of the buildings. We assume, however, that structures will be built in these flood plain areas (University of Hawaii, Environmental Center).

Response: At this time, Seibu has not located buildings in any of its preliminary land use plans, however, during the design of its preliminary site plans Seibu will minimize construction within the flood plain or construct buildings therein so as to minimize flood damage.

Comment: In the section on sand transport, what is meant by the sentence "in the absence of surface, littoral currents cannot be generated" (University of Hawaii, Environmenta Center).

Response: Typographical error made in this sentence which should read: "In the absence of surf, littoral currents cannot be generated".

Tsunami Inundation/Coastal Processes

Comment: The discussion on tsunami inundation (p. III-26) should be carefully evaluated. Runup heights and magnitudes for tsunamis generated in the Alaskan region are estimated to be 7.3 feet at Makena. This does not represent maximum runup heights which may be experienced. Historical data indicates runup heights at Makena of 11 feet and 10 feet respectively from waves of the 1946 and 1960 tsunamis. The citation of the 7.3 feet runup has little relevance to the discussion of this development. Undoubtedly more important than tsunami runup is the indication in the draft EIS of the effects of intense Kona storms. If the recorded historic tsunami runup has been 11 feet and the conversations with David Lono indicates that intense Kona storms may exceed tsunami inundation, we can assume that flood waters from Kona storms exceed 11 feet. We assume that this long time resident is speaking from experience, hence perhaps the 25 or 50 year frequency. The 75 or 100 year frequency is assumed to be significantly greater than 11 feet (University of Hawaii, Environmental Center).

Response: Based on empirical evidence obtained in other tsunami-prone areas in Hawaii, the Corps of Engineers sometimes computes the 100-year frequency runup height as equal to approximately 25% greater than the 1946 runup height (considered a 50-year frequency). Utilizing this method, the 100-year frequency runup at Makena would be approximately 13.75 feet.

Comment: From the earlier materials presented, we assume that a very large portion of the area suggested for development is in a flood plain area. Earlier discussion had indicated that floods in excess of 11 feet above sea level are known from historic records. At this state in the

Response: Information presented in EIS concurs with this comment. However, only preliminary drainage studies have been completed at this time. Specific design objectives will be established when preliminary drainage design plans are initiated.

Comment: Regional frequency data for the project area is presented on plate 13 of the Flood Hazard Information Study, Island of Maui, Report R39, prepared by the Pacific Ocean Division, U.S. Army Corps of Engineers. Peak discharges for a 50-year frequency flood range from 500 to 600 cfs per square mile, compared to about 300 cfs per square mile, as calculated from the data presented on pages IV-14 and V-6 of the statement (Army Corps of Engineers).

Response: It is believed that the difference between Corp of Engineer and NIC estimates is the fact that the SCS method was utilized in developing 50-year peak discharges.

Comment: We would appreciate a further description of permeable asphaltic concrete pavements and roof top ponding as cited on pg. III-11. We are not familiar with these "on-site storage" methods (University of Hawaii, Environmental Center).

Response: Permeable asphalt paving is constructed to permit the passage of water through the interstitial voids between the aggregate mass. This asphalt concrete is characterized by a high void ratio and an accordingly low bearing strength. The asphalt can be constructed by either using a specially graded aggregate mix with 4 to 5% penetration asphalt or by placing an uncompated mix. The major uses for permeable asphalt are to promote fast drying (for tennis court surfaces) or to relieve hydraulic pore pressures (paved drainage channels). Due to the poor strength characteristics and low life expectancy based resulting from traffic usage compounding the loss of asphalt binder from water percolation, the use of permeable asphalt is not recommended for vehicular roadways.

[illegible] ?

?

Rooftop ponding is a method of temporary storm water storage which detains water on the roofs of buildings in order to permit the gradual runoff of storm water. As a result, the anticipated peak drainage flows of a given storm drainage system are reduced. The reduction permits the construction of smaller storm drains, channels and greater infiltration of storm water into the ground.

Comment: The "K" value for the Makena series should be 0.32 rather than 0.49 as stated (U.S. Soil Conservation Service).

Response: Agree.

Comment: The Soil Conservation Services does not regard 10 tons per acre as a reasonable amount of soil loss on developed or undeveloped lands. The SCS recommends that not over 4 tons per acre per year be the maximum limit on agricultural lands in the Makena and Oanapuka series. The SCS has not established recommendations for other than agricultural land (U.S. Soil Conservation Service).

Response: This recommendation would be considered during preparation of preliminary plans when design objectives, mitigative measures would be evaluated in greater detail. However, at this time, prior to the initiation of preliminary drainage plans, Seibu has not yet determined any design objectives for soil loss.

Comment: The description of the total drainage basin for the drainage area is given as 6,650 acres "of which only approximately 1,000 acres are within the project development. We note, however, on pg. III-1 that only 1020.733 acres are in the total development. Therefore, we assume that only 20 acres are not in the drainage basin area (1020.733 - 1000 = 20.733 acres). It would appear from the information given on drainage and storm runoff that the potential flood hazard for this area is great and may be considered of serious environmental concern (University of Hawaii, Environmental Center).

Response: 1020 acres was assumed in the development of drainage calculations for the total drainage basin and project site. The EIS addresses the concern for drainage and related flood potential.

Response: Information presented in EIS concurs with this comment. However, only preliminary drainage studies have been completed at this time. Specific design objectives will be established when preliminary drainage design plans are initiated.

Comment: Regional frequency data for the project area is presented on plate 13 of the Flood Hazard Information Study, Island of Maui, Report R39, prepared by the Pacific Ocean Division, U.S. Army Corps of Engineers. Peak discharges for a 50-year frequency flood range from 500 to 600 cfs per square mile, compared to about 300 cfs per square mile, as calculated from the data presented on pages IV-14 and V-6 of the statement (Army Corps of Engineers).

Response: It is believed that the difference between Corp of Engineer and NIC estimates is the fact that the SCS method was utilized in developing 50-year peak discharges.

Comment: We would appreciate a further description of permeable asphaltic concrete pavements and roof top ponding as cited on pg. III-11. We are not familiar with these "on-site storage" methods (University of Hawaii, Environmental Center).

Response: Permeable asphalt paving is constructed to permit the passage of water through the interstitial voids between the aggregate mass. This asphalt concrete is characterized by a high void ratio and an accordingly low bearing strength. The asphalt can be constructed by either using a specially graded aggregate mix with 4 to 5% penetration asphalt or by placing an uncompated mix. The major uses for permeable asphalt are to promote fast drying (for tennis court surfaces) or to relieve hydraulic pore pressures (paved drainage channels). Due to the poor strength characteristics and low life expectancy based resulting from traffic usage compounding the loss of asphalt binder from water percolation, the use of permeable asphalt is not recommended for vehicular roadways.

where it [illegible] ?

Rooftop ponding is a method of temporary storm water storage which detains water on the roofs of buildings in order to permit the gradual runoff of storm water. As a result, the anticipated peak drainage flows of a given storm drainage system are reduced. The reduction permits the construction of smaller storm drains, channels and greater infiltration of storm water into the ground.

Comment: The "K" value for the Makena series should be 0.32 rather than 0.49 as stated (U.S. Soil Conservation Service).

Response: Agree.

Comment: The Soil Conservation Services does not regard 10 tons per acre as a reasonable amount of soil loss on developed or undeveloped lands. The SCS recommends that not over 4 tons per acre per year be the maximum limit on agricultural lands in the Makena and Oanapuka series. The SCS has not established recommendations for other than agricultural land (U.S. Soil Conservation Service).

Response: This recommendation would be considered during preparation of preliminary plans when design objectives, mitigative measures would be evaluated in greater detail. However, at this time, prior to the initiation of preliminary drainage plans, Seibu has not yet determined any design objectives for soil loss.

Comment: The description of the total drainage basin for the drainage area is given as 6,650 acres "of which only approximately 1,000 acres are within the project development. We note, however, on pg. III-1 that only 1020.733 acres are in the total development. Therefore, we assume that only 20 acres are not in the drainage basin area (1020.733 - 1000 = 20.733 acres). It would appear from the information given on drainage and storm runoff that the potential flood hazard for this area is great and may be considered of serious environmental concern (University of Hawaii, Environmental Center).

Response: 1020 acres was assumed in the development of drainage calculations for the total drainage basin and project site. The EIS addresses the concern for drainage and related flood potential.

Comment: We note on pg. V-9 that there is a potential 420% increase in the runoff rates of the project site resulting from the development. The inability of the present "natural" deposition of runoff to accommodate this increased expected runoff is recognized. Other methods of dispersion such as ocean outfall, seepage ponds, dry wells, and pond holding areas are suggested as methods to handle the estimated 500 acre feet of runoff produced by a 50-year storm. The environmental impact of these suggested "other methods of dispersion" may be extremely great, thus it is difficult to evaluate the environmental impact of the drainage problem without knowing what specific methods will be required (University of Hawaii, Enviromental Center).

Response: The extent to which specific methods of dispersion would be used to alleviate surface runoff will not be determined until preliminary drainage design is undertaken by Seibu. The information which would become evident at that time would be 1) the actual design flows which we can expect, and 2) how much of the drinage can Seibu feasibly detain in its ponding efforts. The latter concern would begin to provide some basic data to make a more refined evaluation of any potential drainage problem.

Comment: The SCS recommends the 100-year frequency storm be used as the design storm for urban areas as opposed to a 50-year frequency storm (U.S. Soil Conservation Service).

Response: This recommendation would be incorporated into future evaluations for drainage design.

Comment: Recognition of potential soil loss/erosion problems expected during construction are mentioned in the draft EIS. We raise the question, however, as to why the items listed on pg. V-12 as occurring during construction, should be permitted. Surely the impacts resulting from soil loss could be minimized by requiring power attention during construction to the four items cited. The secondary effects of sediment discharge into the marine biological communities in addition to the primary soil loss impact are significant (University of Hawaii, Environmental Center.

Response: Seibu intends to minimize soil loss/erosion during construction. If Maui County's proposed Soil Erosion and Sedimentation Control Ordinance is enacted before June 15, 1975, any decision regarding the amount of permitted soil loss would be made by the County Department of Public Works. If said ordinance is not adopted by June 15, 1975, then permitted soil losses will be determined by the regulations of the State Department of Health.

The secondary effects of sedimentation are specifically addressed on pg. V-46 to V-47.

Comment: A provision should be made for continual and stringent monitoring of sediment runoff prior to and including the entire construction period. The effectiveness of any sedimentary control plan and activation of specific measures can then be fully evaluated (Leeward Community College).

Response: Seibu has not yet determined specific drainage design objectives, however, Maui County's proposed Soil Erosion and Sedimentation Control Ordinance (if enacted before June 15, 1975) would, in part, provide for a monitoring of grading operations which Seibu would undertake.

Comment: Although major design concepts and parameters for drainage are not established (p. III-11) careful consideration must be directed to this subject. Since Ahihi Bay has been declared a natural area reserve, surface run-off may have a detrimental impact on the water quality of the Bay. Thus, this Office recommends more discussion and study on drainage and its effects on the Bay and shoreline (State Office of Environment Quality Control).

Response: This comment is significant in light of the Natural Area Reserve designation, which has been applied to adjacent waters and lands south of the project site. However, a clarification should be made to the comment in light of the fact that only the southern half of Ahihi Bay is a portion of the Ahihi-Kinau Natural Area Reserve.

As suggested by this aspect of the Development Proposal (p. III-11), Seibu Real Estate Co., Ltd. (SRECL) intends to minimize the amount of sedimentation and direct surface runoff into the nearshore waters by attempting to detain flows and sediments into settling basins where flows would be filtered in the substrate before entering the nearshore waters. In terms of Ahihi Bay, no surface discharge outlets would be developed by Seibu which would direct surface runoff into this area.

Comment: Permitting surface runoff to flow into the ocean is clearly undesirable. Alternatively the developers should seriously consider building retention-infiltration ponds (as noted on P. III-11) at various locations on the slope to both retain and permit infiltration into the substrata which is probably highly permeable aa lava. Or, the ponds could be lined and the water retained for irrigating the golf course. If the ponds are strategically located, gravity flow could be utilized for distribution to at least some parts of the golf course (University of Hawaii, Water Resources Research Center).

Response: Seibu's Makena Master Plan, as well as information presented in the EIS, reflect this consideration and concern toward surface runoff. Seibu will be constructing retention-infiltration ponds and where possible will use the retained water for irrigation.

Comment: Potential changes in the marine ecosystems were outlined in the statement and noted as potential irreversible commitments of resources. These changes mostly would result from runoff of resources. These changes mostly would result from runoff or percolation of silt, nutrients, or toxic chemicals, such as pesticides. One potential pesticide problem not explored in the EIS is the entrance of chlordane into surface runoff and ground water and into marine waters from residences treated with this chlorindated hydrocarbon for termite control purposes (State Department of Land and Natural Resources, Natural Area Reserves).

Response: Chlordane may be used during the construction of structures, i.e. concrete slabs; however, it is not believed that the amount of chlordane compound ions, reaching the nearshore waters during construction would alter the nearshore marine environment. This prediction is based on the fact that chlordane is normally not a contamination "problem" in ground or surface waters because of its breakdown characteristics in soils (Farm Chemical Handbook, 1972).

Comment: The grading and sediment control plan should also include measures to insure sufficient water and irrigation facilities at the project site prior to land clearing; minimal vegetation removal; clearing of small areas, as opposed to large block clearing; clearing and grading should be considered during periods of minimal adverse weather conditions, that is during drier periods (U.S. Soil Conservation Service).

Response: Consideration would be given to this recommendation in subsequent design phases. However, Maui County's existing Grading Ordinance and proposed Soil Erosion and Sedimentation Control Ordinance would give the County the authority to review and approve Seibu's grading plans as well as request for more stringent grading controls, if deemed required.

Comment: The draft EIS does not state whether the use and effectiveness of depressions, permeable asphaltic concrete pavements and rooftop ponding will be based upon hydrologic determinations. Runoff may be such that only a small percentage of the design storm runoff will be retained as proposed (U.S. Soil Conservation Service).

Response: Agree. Use of permeable AC and rooftop ponding would retain a small amount of the design storm runoff. Use of silting basins and lagoons would be based upon hydrologic determinations and the design objective for drainage which would not be established until preliminary drainage design plans are initiated.

Comment: We have noticed that the EIS lacks detail on how Seibu plans to handle drainage. We believe this concern should be addressed (Department of Land and Natural Resources).

Response: Seibu will not have any additional drainage plans prepared, or available for review, until such time that the development process "requires" submittal of preliminary design drawings. Seibu believes that the EIS is adequate for the assessment of environmental impacts caused by altered drainage conditions.

?

Water Supply

Comment: There is a real question as to the availability of water for development of the Makena area. This question is left open until further studies of water sources and distribution systems are completed. This is a major unresolved area of concern (State Department of Agriculture).

Response: Water supply has been a concern of Seibu's during the planning of the proposed project. Harold Stearns, a local geologist, indicates that, at least, a 20 mgd source probably exists between Iao and Waihee Valleys. A tentative agreement (pp. IV-18 and IV-19) between Seibu, Wailea Land Company, Hawaiiana Investment Company, Kahului Development Company has been made to develop these resources which are believed to be available. Confirmation of preliminary studies by more thorough hydrological studies, i.e., test drilling, has not been undertaken at this time. The tentative agreement (p. IV-19) establishes the framework for the related distribution system.

Comment: We note that the maximum water demand per day is cited as 4.239 million gallons for the proposed development. What population was used in deriving this estimated figure? (University of Hawaii, Environmental Center).

Response: 4.239 million gallons per day is a typo/editing error which should read 4.0 million gallons per day. This figure is based on a population of 17,784 persons using approximately 210 gallons per person per day. The remaining 265,360 gpd is projected for use by other commercial areas, i.e., shops, and the potential future school site.

Comment: The availability of drinking water remains a significant problem for the proposed project. The transmission of water from the West Maui mountains should have an adverse impact upon the future availability of water to: (a) communities who already depend upon the West Maui mountains water sources for their drinking water needs; as well as (b) communities who already are scheduled to hook up the West Maui mountains water sources in the immediate future (State Department of Health).

Response: Water for the development of Makena is expected to be provided through the development of sources in the West Maui Mountains and the construction of transmission lines to the Kihei-Wailea-Makena areas. The above-mentioned tentative agreements between Seibu, other private venturers and the County of Maui Board of Water Supply to develop and distribute these water resources is being finalized.

The development and transmission of this water resource is part of a comprehensive program presently undertaken by the County of Maui, aimed at providing adequate water for all areas of Maui on a long-term basis. Prior agreements reached between the County of Maui and East Maui Irrigation Company for the utilization of water in the East Maui area is indicative of the County's program to involve both public and private agencies in a comprehensive program of water resource development, designed to meet the needs of the total community. This comprehensive program includes the long-range considerations and needs of agriculture and as well as domestic uses.

Comment: There is inadequate discussion of the economic impact of the increased, nearly island-wide competition for limited fresh was between a large, newly developed Makena community and existing and new agricultural industries, especially sugar and diversified agriculture (State Department of Land and Natural Resources, Natural Area Reserves Commission).

Response: See the response to the prior comment immediately above.

Comment: The discussion of potential availability of surface water indicates that water requirements for the development are perhaps the most serious deficiency in the entire plan. The estimated cost of the design and construction of the water transmission system is 11 million dollars. The derivation of these funds includes 4 million dollars from the Maui Board of Water Supply to be reimbursed by set fees for each hotel or multi-dwelling unit hook-up in the Kihei-Makena area, and 7 million from the Wailea Land Corporation and SRECL. This 7 million is to be repaid to WLC and SRECL by the MBWS "from normal revenues derived from the system supplying the Maalaea, Kihei, and Makena areas." Does this mean that present residents will be required to assist in paying for a water transmission system required by this development (University of Hawaii, Environmental Center)?

Response: Provisions for water supply have been a great concern of Seibu throughout the planning of this project. It is believed that the tentative formation of the Central Maui Water System provides a feasible basis for development of additional water supply to the Central Maui area. Present and future residents in the area will continue to pay the regular published user fees, presently $.41 per 1000 gallons.

Comment: With respect to the question of water development, we believe the problems are being adequately addressed. The State has drilled a well, Well No. 3925-01 in the 350-foot elevation of the development area. Chlorine content is 600 parts per million. This, however, can be mixed with water being brought to the area by the Board of Water Supply. Mixing is presently practiced successfully in the Kawaihae area of the island of Hawaii. We believe this can also be practiced at Makena to conserve Makena's water supply (State Department of Land and Natural Resources).

Response: Since the decisions being made concerning water supply are tentative and preliminary, this alternative will be considered by Seibu as more detailed plans are prepared for the development of a water source and transmission system.

Comment: There is no mention of adverse impacts upon native Hawaiian stream life if additional streams are severely dewatered because of any newly developed water catchment systems that would result from attempts to meet the increased human demands for water (State Department of Land and Natural Resources and Natural Area Reserves Commission).

Response: This subject was not addressed within the EIS because (1) there are no perennial streams within the project site, (2) the proposed water supply would come from the West Maui Mountains and (3) the obtaining of fresh water from the Mountains would not affect stream ecology since the source of water would be from wells and tunnels rather than streams.

Primary Impacts Upon Makena Residents

Comment: We note that the existing alignment of the Kihei Road through the project site will be "discontinued for through traffic by terminating that portion of Kihei Road at both ends of the hotel site". How will this discontinuation of the existing road affect the present local residents (University of Hawaii, Environmental Center).

Response: This impact is specifically addressed on p. V-15, which indicates:

> "Such re-routing would necessitate present Makena residents, living adjacent to the shoreline, to ultimately drive their vehicles mauka and through the proposed development in order to drive south of Makena. Such conditions are in contrast to the present, direct access afforded by the continuous Kihei Road."

It should be noted that both during construction and as the project is implemented no local residents would be denied access from Kihei Road to their homes.

Comment: The Environmental Impact Statement also implies, that we, the present residents of Makena, will give up our land and our homes as their development progresses. We have no desire to give up our land or our homes or to be crowded out of Makena by a condominium development. We live in a very small area in comparison to the land purchased by Seibu. Makena Landing and the small residential area should be protected and kept residential in nature as called for in the General Plan, and Seibu should be directed to follow the General Plan and the desires of the present residents of Makena (Some residents/landholders of Makena and University of Hawaii, Environmental Center).

Response: The EIS only indicates that some residents may wish to relocate. As the project proceeds, there will be changes which will have some effect on persons presently residing near the proposed development. Some changes may be considered "better" (improved water system, roadways, public services and facilities) by existing residents, while others may be considered "negative" (increased population, construction noise and dust). Should the negative effects substantially outweigh the positive, there may be some residents who would seek residential alternatives.

However, Seibu is committed to a program of minimizing any inconveniences or hardships within its control, which would adversely affect residents of nearby properties. Such measures would include control of dust and noise, provision of adequate access, when required, and maintaining communication with the community regarding potential problems. Seibu recognizes its responsibilities to the existing residents, and will do its best to be a good neighbor.

Comment: Since the surrounding area and residents will be directly and indirectly affected by this proposed project, a discussion of the community's sentiments should be included. What are the surrounding resident reactions toward the proposed action? In addition, h would the proposed project affect current lifestyle and culture?

Response: These comments are relevant since a portion of the Maui community would be affected by the proposed project. Community sentiments were not specifically addressed in the EIS; however, lifestyle and cultural effects were briefly discussed in Chapters V (recreation) and Chapter VI (relocation of some existing residents).

Community sentiments have been expressed by a number of Maui residents during the past 1-1/2 years during the State Land Use Boundary review. There has been widespread opposition to the project from most persons attending these hearings; at the same time, several of the residents of the Makena area have expressed desire for the project, while others have not. Those opposing the project generally express a fear of lifestyle changes being generated by the increasing urbanization of Maui, while proponents of the project envision gains to Maui's economic base through more dollars being brought to the Island, and additional employment. In addition, some Makena residents feel that the Makena area will receive some improvements, i.e. better roads, County water and other utilities, which might not otherwise be "brought" to the area.

Comment: The list of tax map keys and approximate acreage per individual parcels given on p. IV-110 does not match the list given on p. III-1. There seems to be an addition of 8.759 acres for tax key 2-1-06-27. Which list is correct (University of Hawaii, Environmental Center)?

Response: The list on p. III-1 is correct. The list given on p. IV-110 does not reflect the deletion of the beachfront property at Big Beach from the project site.

Comment: On Figure 3 (Proposed Development Plan), does the symbol "P" represent the land parcels which are being considered for future inclusion into the project site (University of Hawaii, Environmental Center)?

Response: As shown in the legend for Figure 3, the cross-hatched areas represent the land parcels being considered for future inclusion into the project site. The symbol "P" designates lands which are not under Seibu's agreement of sale with Ulupalakua Ranch, or lands which are owned by other private landholders.

Comment: Does the proposed development include all of the beachfront property, shown in Figure 3, as the Makena Landing area (University of Hawaii, Environmental Center)?

Response: Figure 3 is somewhat confusing in light of numerous legend designations converging in this area. For clarification, the proposed Makena Landing area would include approximately 4.8 acres of land makai of the proposed shoreline road to the Hotel. With specific reference to Figure 3, the 4.8 acres is situated makai of the proposed shoreline road, approximately between the letter "P" in the phrase "Public Beach Access" and the second "A" in the phrase "MAKENA LANDING".

Public Beach Access/Shoreline Concerns

Comment: Mention is made of three beach access points within the development. The third access point is cited as beach frontage south of Puu Olai. We note on Figure 3 this beach frontage is presently shown as private property and is not within the development plan, thus we assume there are in fact only two access routes to the beach, the Makena landing area and the pedestrian right-of-way adjacent to the hotel site. How will this presumably more restrictive access affect the usage of this beach by the present local residents (University of Hawaii, Environmental Center)?

Response: Prior to November, 1974, Seibu intended to develop an 8.9-acre parcel, and a related beach access, along a portion of Big Beach, (south of Puu Olai). This proposal was withdrawn in November 1974, when the public indicated that it wanted all of this area to be within a park south of Puu Olai.

Should appropriate public agencies not proceed with the immediate acquisition and development of a park along the south side of Puu Olai, Seibu will provide a public beach access to this parcel as part of the first phase of the construction.

The assumption that present public beach access is available on the south side of Puu Olai is not valid as no legal access presently exists in this area.

Comment: In addition to the public beach access points proposed for the Makena Landing and Hotel area, will any other access points be provided along other portions of the remaining shoreline (University of Hawaii, Environmental Center)?

Response: See previous response.

Comparison of Seibu Proposal and Existing General Plan Designations

Comment: We request that the County of Maui direct Seibu to submit a revised Environmental Impact Statement and development plan that will cover the 500 acres for which Seibu has urban zoning and that the development plan conform to the County of Maui General Plan as adopted in 1970 (Makena Residents and Landholders).

Response: Seibu has no comment to the request for a revised EIS; however, our review of the existing County General Plan indicates that development in conformance with this Plan would generate a greater population and greater potential for alteration of the nearshore marine environment. The nearshore marine environment would be highly susceptible to potential alteration when residential/condominium development is situated directly along the shoreline. This land use configuration provides a more limited land area by which drainage may be retained within the project and limited amount of substrate for treated sewage effluent to filter through before entering the nearshore waters.

Comment: We request that the County of Maui find the Environmental Impact Statement to be inadequate because it does not conform to the County General Plan, nor does it concern itself with the added environmental impact of the condominium apartments instead of homes. We do not wish Makena to become another Kihei and we hope that the County will listen to the desires of the present residents rather than the views of the developer (Makena Residents and Landholders).

Response: The response to the previous comment by residents and landowners at Makena generally describes Seibu's rationale for attempting to amend the existing General Plan designations.

It is true that most apartment units would be developed in the 500 acres for which Seibu has received urban zoning.

In comparison, with the County General Plan, the Seib project would propose a maximum of 2,346 more condominium apartments, 832 less hotel rooms, 856 less single family residential units. Applying the same occupancy assumptions to the General Plan densities which were used in developing population projection for Seibu, it is believed that the following comparis of daily census population can be made:

	Visitors	Residents	Total Daily Resident/Visitor
Existing Gen. Plan	3,367	10,618	13,985
Seibu Master Plan	3,296	7,741	11,037

Comment: The Kihei-Civic Development and the County General Plan both called for Makena to be developed as resort-residential community with a heavy emphasis on residential. To quote from the plan, "With the growth of Wailea, Makena is expected to someday resemble Honolulu's Kahala district." The Seibu Company was well aware of the County General Plan when they purchased the lands at Makena for development (Makena Residents and Landholders).

Response: Seibu was aware of the County General Plan when it acquired the rights to purchase lands at Makena.

Comment: From the statement that has been presented to the County, it appears that the decision was made in Tokyo not to follow the County General Plan but instead to change Makena to another condominium development. The Seibu plan ignores the residential nature of Makena and changes 290 acres from residenti to apartment. According to the Impact Statement ther will be 1707 fewer single family residential units and 2346 more apartment units than called for in the County General Plan. The Impact Statement does not discuss the reasons for the change nor does it cover the effect of this change from the General Plan on the environment of Makena. Furthermore it appears that most of the apartments units will be in the initial 500 acres for which Seibu has received urban zoning (Makena Residents and Landholders and army Corps of Engineers).

Response: See previous responses in this section of the report.

Alternatives

Comment: Discussion of alternatives is totally inadequate. There must be other alternative project designs which are economically more desirable and enviromentally more compatible. One example might be a different set of land use configurations to minimize environmental shock. This could include undeveloped natural areas within the project boundaries, i.e., historical/archaeological site. An all-or-nothing attitude is unrealisti and irresponsible (University of Hawaii, Environmental Center and Leeward Community College).

Response: A few additional comments here may put the alternatives section of the report into perspective. The intent of this section is to generally describe known alternatives to the proposed project which could attain the objectives of the proposed action (p. II-1) or provide different alternative land uses with differe environmental impacts. As indicated on pp. VI-5 to VI-6, the development of a resort/commercial/residentia community at Makena could be done by Seibu, or some other developer. In other words, either Seibu develops this area or sells its acquisition rights to some other developer who would develop the property for similar uses, or for some other different uses, i.e. public park.

If another developer purchases the property for resort/residential uses, his easiest approach to developing the project site would be to follow the existing General Plan designations which provide for extensive urbanization of the shoreline. Such a development at Makena could, in comparison with the Seibu Plan, cause:

1) Potentially greater alterations to the nearshore waters and related marine community; and

2) Greater restriction on use of the entire Makena shoreline by the general public.

An alternative to shoreline urbanization of the area for resort/commercial/residential uses is to move development mauka of the shoreline. This alternative generally resembles Seibu's proposal and in comparison with the first alternative substantially reduces the potential for alteration of the nearshore environment and allows for uses of the Makena shoreline by both visitors and residents.

If a governmental agency purchases the property for recreational purposes, acquisition and development costs would be extremely high. If such funds could be obtained, however, the potential for impact to both the terrestrial and marine environments would be less than the previous two alternatives, and use of the entire Makena area could be made by the general public. At the same time, however, this alternative would not provide additional dollars and employment to the Maui economy which would result from implementation of the first two alternatives.

A fourth alternative would be for Seibu to sell a portion, i.e., half of its acquisition right to a governmental agency for its development of a park. Sharing of development costs between the two agencies would reduce financial commitments for both parties; however, it is believed that the financial obligation, i.e. acquisition and utility developments, for the governmental agency would remain as the primary obstacle for this alternative implementation. If for some reason, the respective governmental agency obtained funds, potential impact to the nearshore environment would be less than the second alternative but greater than the third. However, use of the Makena area as both a major public recreation and private resort area may generate excessive amounts of traffic in the area which would be detrimental to both land uses.

A fifth alternative would be for Seibu to sell its rights to acquire the project site to some private or public agency for the purpose of agricultural development. This alternative has been seriously considered by Ulupalakua Ranch. By actual experimentation and feasibility analyses, the Ranch considered developing the area into more productive pasture, truck farming and sorghum. Upon completion of these informal instudies and experimentation, the Ranch concluded that it was infeasible to undertaken these agricultural enterprises because of existing soil and climatological conditions, lack of a readily available water resource (without considerable expense), and high labor costs.

Comment: A projected impact not shown in Table 24 and not discussed elsewhere concerns the effect of removing the area from agricultural uses. What is the effect or impact? How much agricultural land could be considered prime farm land (U.S. Soil Conservation Service)?

Response: See previous response.

Comment: The draft EIS states "...SRECL has not committed itself to the implementation of these measures at this time. Alternative mitigative measures were considered for each section but are not discussed in this report." SCS feels the alternatives should be discussed to allow a means to reasonably evaluate the proposed project (U.S. Soil Conservation Service).

Response: As development proceeds mitigative measures and alternatives will be considered to determine the most effective and desirable measures to be taken.

School Facilities

Comment: In the first phase of development approximately 3,000 dwelling units will be constructed. Assuming that some of these units are occupied by families, we assume that the school development site in the area will proceed concurrently with the first phase. Has the Department of Education been appraised of this development and the selected site and facilities that will be available? Does the Department of Education have any suggestions or reservations about the location of the proposed facilities? We note that 30.1 acres has been set aside for the school site. We assume that this will be sufficient for both an intermediate and an elementary school. Is the intent to include also a high school in this area? How far away are the existing schools and will bussing be necessary? Will the existing high school and/or intermediate school facilities be adequate to accommodate the number of students coming from this development (University of Hawaii, Environmental Center)?

Response: Informal coordination was made with the DOE, Maui District office, during the preparation of the EIS. The concerns presented to SRECL in June, 1974 were similar to those comments given by the DOE in their formal response to this EIS which indicates:

> "We have no current plans to develop school facilities within the Seibu Makena area pending indications that enrollment increases cannot be adequately accommodated at the new Kihei Elementary-Intermediate School scheduled to open in 1977."
>
> "When the enrollment situation justifies school facilities specifically for the Seibu development area, we will initiate a request to the State Department of Accounting and General Services to conduct a site selection study. The study will include consideration of the school site shown on the Seibu Makena master plan plus consideration of alternative locations."

In addition, it should also be noted that the County General Plan designates a high school site mauka of Maui Meadows subdivision.

In light of DOE's concerns and comments, as well as the existing General Plan designations, it is believed that the remaining questions related to this comment by the Environmental Center are not relevant at this time. Such questions would be appropriate if DOE decides to develop an additional facility in the Kihei-Makena area.

Comment: The plan provides 30 acres for future school purposes. We have no current plans to develop school facilities within the Seibu Makena area pending indications that enrollment increases cannot be adequately accommodated at the new Kihei Elementary-Intermediate School scheduled to open in 1977.

When the enrollment situation justifies school facilities specifically for the Seibu development area, we will initiate a request to the State Department of Accounting and General Services to conduct a site selection study. The study will include consideration of the school site shown on the Seibu Makena master plan plus consideration of alternative locations.

Under State law, prior to acquiring the site, the Department of Accounting and General Services will prepare an EIS specifically for the school site (State Department of Education).

Response: Seibu will continue to cooperate with the Department of Education in this regard.

Traffic

Comment: A report from the State Department of Transportation dated 1971 is cited as indicating the estimated number of vehicles per day for the proposed project. However, we note earlier on page III-1 that the proposed project land was acquired by the Seibu Real Estate Company on January of 1974. We assume therefore that the Department of Transportation traffic study was not based on this proposed project. On what was the Department of Transportation study based (University of Hawaii, Enviromental Center)?

Response: Department of Transportation (DOT) officials indicated in June 1974 that the 1971 projections, which were prepared for the proposed Kihei-Ulupalakua Road project, were (in 1971) based on condominium/residential projects being planned for the Kihei-Wailea area. No assumptions were made for the proposed Seibu addition. The draft EIS which is being circulated for the new Piilani Highway project "utilizes" the 1971 DOT projections which do not consider the population densities suggested by the Kihei-Civic Development Plan for the Makena area.

Comment: Please furnish us the data for the trip generation and traffic study in order to verify the published traffic data. The published traffic volumes seem to be exceedingly high, well over the capacities of our roadways (State Department of Transportation).

Response: The assumptions and general discussion of the traffic analysis developed for the EIS on pp. V-15, V-24 to V-31.

Solid Waste, Power and Communication Systems

Comment: We were pleased to see that all street lighting, telephone and electric systems will be installed underground. We suggest that other types of TV reception systems such as a centralized repeater station might be evaluated in addition to the proposed cable installation (University of Hawaii, Environmental Center).

Response: This comment is certainly a possible alternative method for providing TV reception to the Makena area. Since the method of providing TV receipt to the area is still being considered (p. III-13) at the time of this report, other alternatives would definitely be evaluated in future planning.

Comment: Will a new substation be required for power to the Makena area? This section on power and communication seems to direct its attention toward the Wailea resort area, not the proposed development at Makena.

Response: HELCO has not determined (p. III-12) whether or not a substation is required at Makena. Discussions with Maui Electric indicate that the availability of a substation at Wailea suggests to the reviewer that an additional substation at Makena may not be required.

Comment: Who will bear the cost of the development of installation of utilities such as water supply, sewage treatment, underground street lighting, telephone and electric power and cable TV systems as indicated on page III-4 (University of Hawaii, Environmental Center)?

Response: On pages IV-18 and 19, the costs of providing water supply is described in greater detail.

Opposed to information presented on p. III-4, the on-site costs of developing a complete wastewater collection, treatment and effluent disposal system, would be completely borne by SRECL (see p. III-11 for greater detail).

On-site underground street lighting, telephone, electri power and cable TV systems would be completely develope by SRECL, except for the potential installation of a switching station by Maui Electric within the project site.

Comment: The EIS does not discuss solid waste disposal. Thus, we strongly recommend a discussion of this topic and include the projected amount, method of disposal, and location of the disposal site (State Office of Environmental Quality Control and Leeward Community College).

Response: Assuming that each resident and visitor generates approximately 8.9 lbs/day upon ultimate development of the project (Miura, 1975), it can be estimated that the future resident/tourist population would generate approroixmately 53 tons/day. Other refuse generated by commercial enterprises in the project site are expected to generate approximately 7 tons per day. Seibu envisions that all solid waste material would be collected by County and/or private refuse agencies and hauled to a County landfill site designated.

Other Concerns

Comment: Chapter V needs detailed clarification on the following:

(1) aesthetics of proposed construction relative to existing physical environmental characteristics.

(2) rodent control problems generated by grading operations.

(3) potential environmental impact of the project on the Ahihi Kinau Natural Area Reserve (Leeward Community College).

Response: Since a site layout of buildings has not been prepared, it is not possible to adequately assess the impact upon aesthetics.

No rodent control measures have been decided upon at this time.

Potential environmental impact the Reserve is discussed on pp. V-40, 41, 47, 48 and 49.

Comment: How many stories will the hotel apartments and condominiums be (State Office of Environmental Quality Control)?

Response: This is a valid concern in light of views that would be afforded to future residents of the project site, as well as other residents of Maui. At the time of this report, no preliminary architectural drawings have been prepared; thus, no precise decisions have been made in this area.

Comment: We assume that one of the two columns labeled Total Coliform in Table 4 is actually Fecal Coliform. The correct title should be inserted in the Final EIS (University of Hawaii, Environmental Center).

Response: Last column (from left to right) should be labeled "Fecal Coliform".

Comment: Will the residential area be fee simple or leasehold (State Office of Environmental Quality Control)?

Response: Seibu intends to primarily develop the proposed residential areas for fee simple sale.

Comment: The Ahihi-Kinau Natural Area Reserve has long been protected from degration by its remoteness, but the large new residential community of 17,000 and additional 1000 tourists per day will radically transform its present isolated condition. The increased cost to the State for enforcing Regulation 7 protecting the Reserve is not represented in the EIS (State Department of Land and Natural Resources and Natural Area Reserves Commission).

Response: Opposed to some of the information presented on p. V-14 and Appendix p. E-2, the ultimate population generated by the proposed project would be approximately 3,296 visitors and 7,741 residents.

The increased cost to the State for enforcing Regulation 7 cannot be adequately determined until trends of additional usage of the area would be established by future residents of the project site.

Comment: In light of the existing Maui County Flood Plain and Tsunami Inundation Area Ordinance, the basis for selection of 50-year flood protection (Page V-13) should be discussed. The potential tsunami runup conditions appear reasonable (Army Corps of Engineers).

Response: Seibu would adhere to the rules and regulations established by the Maui County Flood Plan and Tsunami Inundation Area Ordinance.

Comment: The backshore sand dunes referred to on page IV-36 should be recognized as protective structures against high wave action. Care should be taken to retain the dune lines and to protect the vegetation on the sand dunes and on erodable shores.

Response: The utilization of the backshore sand dunes has not been determined at this time.

Comment: I have serious questions about the affect of poor premiums on construction projects, 2) the necessity of constructing this project considering the lack of indication for a market for such an extensive program 3) the lack of consideration for the cost to the County for the long term operation and maintenance of the sewer system, county roads and water system. Although these facilities will be constructed by Seibu there is no mention made of the large amounts of money that will be needed to maintain these facilities (Richard Mayer).

Response: The purpose of the EIS is not to justify the proposed development, but rather to provide a basis for review by appropriate governmental agencies and the general public.

As stated on pp. V-63 and 64, Environmental Capital Managers, Inc. prepared a benefit-cost analysis of the project. This study, considers project impact on public cost which, for Maui County was estimated to generate the following annual costs upon ultimate development of the project:

General Government	$541,366
Public Safety	772,790
Highways and Streets	353,875
Recreation	142,758
	$1,810,789

On the other hand, the annual additional revenues to the County, which would be generated upon ultimate development of the project, would be approximately $4,048,592.

Comment: Although I have many other questions I will await the filing of a request for a general plan amendment before commenting in depth. I find it difficult to make overall assessments of the Environmental Impact until I know exactly what Seibu is planning in the Makena area (Richard Mayer).

Response: It is believed that the EIS adequately describes Seibu's development proposal on pp. III-1 to III-14.

Comment:	Where would the housing for employees be located? How many units are anticipated. Will they be rented by the developer to the employees or will they be available for purchase? What is the estimated purchase price in the latter case (University of Hawaii, Environmental Center).
Response:	Seibu is committed to a program of providing employee housing designed to meet the economic capabilities of the eventual employees of the project. The precise number, price and terms of rental and/or purchase have not been determined at this time.