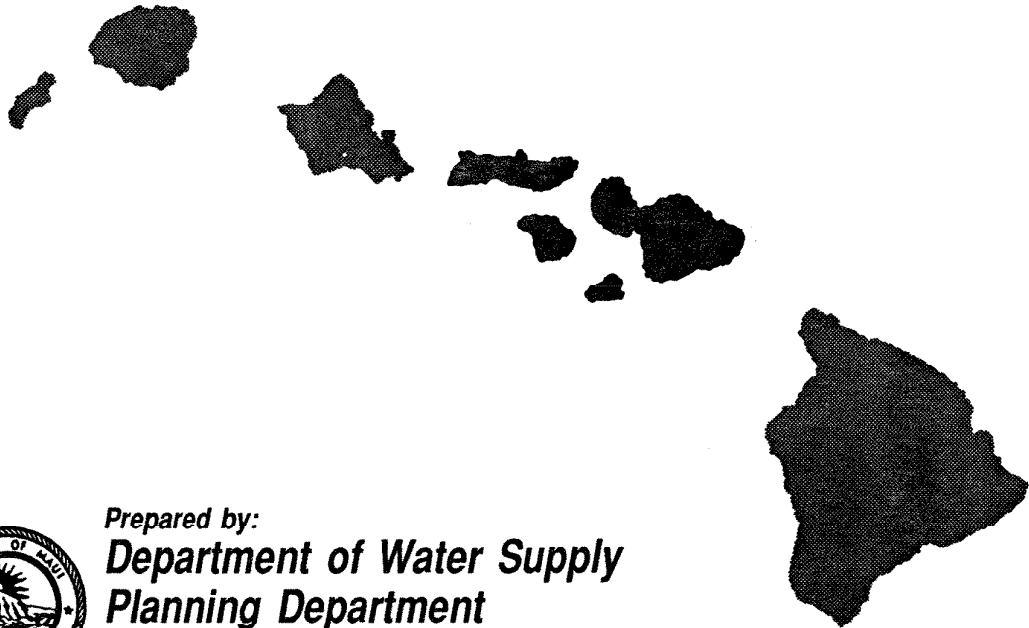


HAWAII WATER PLAN

MAUI COUNTY WATER USE AND DEVELOPMENT PLAN



Prepared by:
**Department of Water Supply
Planning Department
County of Maui**



**Commission on Water Resource Management
Department of Land and Natural Resources
State of Hawaii**

March 1990



JOHN WAIHEE
Governor

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COMMISSION ON WATER RESOURCE MANAGEMENT

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Preface

In 1987, the State Legislature passed the State Water Code (HRS Chapter 174C) to protect and manage Hawaii's surface and ground water resources. Part III of the State Water Code calls for the formulation of a Hawaii Water Plan, an integrated program for the protection, conservation, and management of the waters of the State. The **Maui County Water Use and Development Plan** is one of seven subplans which collectively comprise the Hawaii Water Plan.

The Maui County Water Use and Development Plan, adopted by Maui County ordinance and endorsed by the Mayor on October 19, 1990, will serve as a continuing long-range guide for water resource development in the County.

On November 14, 1990, the State Commission on Water Resource Management accepted the Maui County Water Use and Development Plan for incorporation into the Hawaii Water Plan, with the following stipulations:

- (1) The Water Use and Development Plan (WUDP) will be reviewed and revised by the County and resubmitted to the Commission by July 1, 1991. The Commission would provide the County with supplemental assistance funds for this initial plan revision period. Thereafter, because the WUDP obtains its primary directions from the Hawaii Water Plan, periodic plan reviews and revisions, at the County's expense, will be timed to coincide with the review process of the Hawaii Water Plan.
- (2) Amendments to the County's WUDP are to be adopted by ordinance and transmitted to the Commission within ten working days from their date of adoption for review, acceptance, and incorporation into the Hawaii Water Plan.

EXECUTIVE SUMMARY

MAUI COUNTY WATER USE AND DEVELOPMENT PLAN

TABLE OF CONTENTS

<u>Title</u>	<u>Page</u>	<u>Title</u>	<u>Page</u>
EXECUTIVE SUMMARY	1		
Island of Maui	2	4.2 Wailuku-Kahului	19
Island of Molokai	2	4.3 Kihei-Makena	20
Island of Lanai	2	4.4 Paia-Haiku	20
Island of Kaho'olawe	8	4.5 Makawao-Pukalani-Kula	20
Background	8	4.6 Hana	20
ISLAND OF MAUI	9	5.0 WATER DEVELOPMENT	
1.0 INTRODUCTION	9	PLANS	20
1.1 Surface Water Systems	9	5.1 Surface Water Development Plans	21
1.2 Groundwater Systems	9	5.1.1 Lahaina Sector	21
		5.1.2 Wailuku Sector	23
2.0 WATER RESOURCES		5.1.3 Central Sector	23
INVENTORY	9	5.1.4 Koolau Sector	23
2.1 Surface Water		5.1.5 Kahikinui Sector	24
Resources Inventory	11	5.1.6 Hana Sector	24
2.2 Groundwater Resources		5.2 Groundwater Development Plans	24
Inventory	11	5.2.1 Lahaina Sector	26
		5.2.2 Wailuku Sector	27
3.0 WATER USE INVENTORY	13	5.2.3 Central Sector	27
3.1 Surface Water Use Inventory	13	5.2.4 Koolau Sector	27
3.1.1 Lahaina Sector	13	5.2.5 Kahikinui Sector	27
3.1.2 Wailuku Sector	15	5.2.6 Hana Sector	27
3.1.3 Central Sector	15		
3.1.4 Koolau Sector	15	6.0 SUMMARY AND	
3.1.5 Kahikinui Sector	15	CONCLUSIONS	28
3.1.6 Hana Sector	15	ISLAND OF MOLOKAI	29
3.2 Groundwater Use Inventory	15	1.0 INTRODUCTION	29
3.2.1 Lahaina Sector	15	1.1 Surface Water Systems	29
3.2.2 Wailuku Sector	17	1.2 Groundwater Systems	29
3.2.3 Central Sector	17		
3.2.4 Koolau Sector	17	2.0 WATER RESOURCES	
3.2.5 Kahikinui Sector	17	INVENTORY	29
3.2.6 Hana Sector	17	2.1 Surface Water Resources Inventory	31
		2.2 Groundwater Resources Inventory	31
4.0 COMMUNITY PLANS	17		
4.1 Lahaina	19		

<u>Title</u>	<u>Page</u>
3.0 WATER USE INVENTORY	31
3.1 Surface Water Inventory	33
3.1.1 Central Sector	33
3.1.2 Northeast Sector	33
3.1.3 Southeast Sector	36
3.1.4 West Sector	36
3.2 Groundwater Use Inventory	36
3.2.1 Central Sector	36
3.2.2 Northeast Sector	36
3.2.3 Southeast Sector	36
3.2.4 West Sector	36
4.0 COMMUNITY PLANS	36
4.1 Kaluakoi	36
4.2 Department of Water Supply	37
4.3 Molokai Ranch	37
4.4 Dept. of Hawaiian Home Lands	37
4.5 Molokai Irrigation System	37
4.6 Alpha U.S.A.	38
5.0 WATER DEVELOPMENT PLANS	38
5.1 Surface Water Development Plans	38
5.2 Groundwater Development Plans	38
5.2.1 Central Sector	38
5.2.2 Northeast Sector	42
5.2.3 Southeast Sector	42
5.2.4 West Sector	42
6.0 SUMMARY AND CONCLUSIONS	42
ISLAND OF LANAI	43
1.0 INTRODUCTION	43
1.1 Surface Water Systems	43
1.2 Groundwater Systems	43
2.0 WATER RESOURCES SUMMARY	43
2.1 Surface Water Resources Inventory	45

<u>Title</u>	<u>Page</u>
2.2 Groundwater Resources Inventory	45
3.0 WATER USE INVENTORY	45
3.1 Surface Water Use Inventory	45
3.2 Groundwater Use Inventory	47
4.0 COMMUNITY PLANS	47
5.0 WATER DEVELOPMENT PLANS	48
6.0 SUMMARY AND CONCLUSIONS	48
ISLAND OF KAHO'OLAWÉ	
1.0 INTRODUCTION	49
2.0 WATER RESOURCES SUMMARY	49
2.1 Surface Water Resource Inventory	49
2.2 Groundwater Resource Inventory	49
3.0 WATER USE INVENTORY	50
4.0 COMMUNITY PLANS	50
5.0 WATER DEVELOPMENT PLANS	50
5.1 Groundwater Development	50
5.2 Surface/Rain Water	51
5.3 Desalinization	51
5.4 Importation	51
6.0 SUMMARY	51
LIST OF PLATES	iv
APPENDIX List of Figures Ordinance	

LIST OF PLATES

<u>Plate No.</u> <u>No.</u>	<u>TITLE</u>	Page
1	Island of Maui Total Water Resources	3
1A	Island of Maui Water Resources Summary	4
2	Island of Molokai Total Water Resources	5
2A	Island of Molokai Water Resources Summary	6
3	Island of Lanai Total Water Resources	7
4	Island of Maui Aquifer Sectors	10
5	Island of Maui 1987 Potential Groundwater Sustainable Yield	12
6	Island of Maui 1987 Surface Water Use Inventory	14
7	Island of Maui 1987 Groundwater Use Inventory	16
8	Island of Maui Community Plans Boundaries	18
9	Island of Maui Year 2010 Surface Water Use	22
10	Island of Maui Year 2010 Groundwater Use	25

LIST OF PLATES (CONTINUED)

<u>Plate No.</u>	<u>Title</u>	<u>Page No.</u>
11	Island of Molokai Aquifer Sectors	30
12	Island of Molokai 1988 Potential Groundwater Sustainable Yield	32
13	Island of Molokai 1988 Surface Water Use Inventory	34
14	Island of Molokai 1988 Groundwater Use Inventory	35
15	Island of Molokai Year 2010 Surface Water Use	39
16	Island of Molokai Year 2010 Groundwater Use	40
17	Island of Lanai Aquifer Sectors	44
18	Island of Lanai 1987 Potential Groundwater Sustainable Yield	46

MAUI COUNTY WATER USE & DEVELOPMENT PLAN

EXECUTIVE SUMMARY

The Maui County Water Use and Development Plan is made up of three parts:

1. A bill for an ordinance containing the policy and legislative direction required by the County Administration and Council,
2. A technical report containing the general information and specific directions as well as the intentions of the participating parties, and
3. This executive summary report, to assist the Mayor, the County Council, the Planning Commission, the Water Department, State and County agencies and the people of Maui County in their water use and development decisions.

The Maui County Water Use and Development Plan Committee, the Planning Department and the Department of Water Supply prepared this Plan to define acceptable directions for water source development, a major expenditure that impacts communities and corporations.

This document has been prepared using the Community Plans as a base. It is a guideline to future land use planning, water source development, resource protection, water quality goals, and where appropriate, to prioritize water use.

Maui County has large surface and ground water resources. Much of the surface water has been developed and made productive by the extensive development for agricultural water use.

Development of groundwater resources has only begun.

The following summarizes the current and potential water resources by island.

ISLAND OF MAUI

Maui Island has the potential for producing as much as 452 million gallons per day (MGD) of potable groundwater sustainable yield, sufficient to meet the estimated requirements for the next 20 years. Less than 40 MGD of those groundwater resources has been developed.

Comparison between surface and ground water available, and current and projected use (Plates 1 and 1A), shows the surplus water available in the six sectors of Maui.

**ISLAND OF MAUI
(MILLION GALLONS PER DAY)**

<u>1987</u>	<u>Surface</u>	<u>Ground</u>
Available	333.3+	452.0
In Use	333.3	20.9
Potential Surplus		431.1
<u>2010</u>	<u>Surface</u>	<u>Ground</u>
Available	341.3	452.0
In Use	341.3	* 56.3
Potential Surplus		395.7

(*Net of recharge)

ISLAND OF MOLOKAI

On Molokai, the total potable groundwater is projected to be about 83 MGD, of which less than 10 percent has been developed. Until additional drilling and production takes place, it is not possible to accurately determine the practical limits of these aquifers. Based on current information, we can compare available capacity, present use and future use (Plates 2 and 2A).

Molokai has the potential for an additional 66.0 MGD available in aquifer capacity in 2010 but funding is necessary to develop these expensive sources.

**ISLAND OF MOLOKAI
(MILLION GALLONS PER DAY)**

<u>1987</u>	<u>Surface</u>	<u>Ground</u>
Available	5.0	75.0
In Use	5.0	4.7
Potential Surplus	0	70.3
<u>2010</u>	<u>Surface</u>	<u>Ground</u>
Available	5.0	75.0
In Use	4.8	9.0
Potential Surplus	.2	66.0

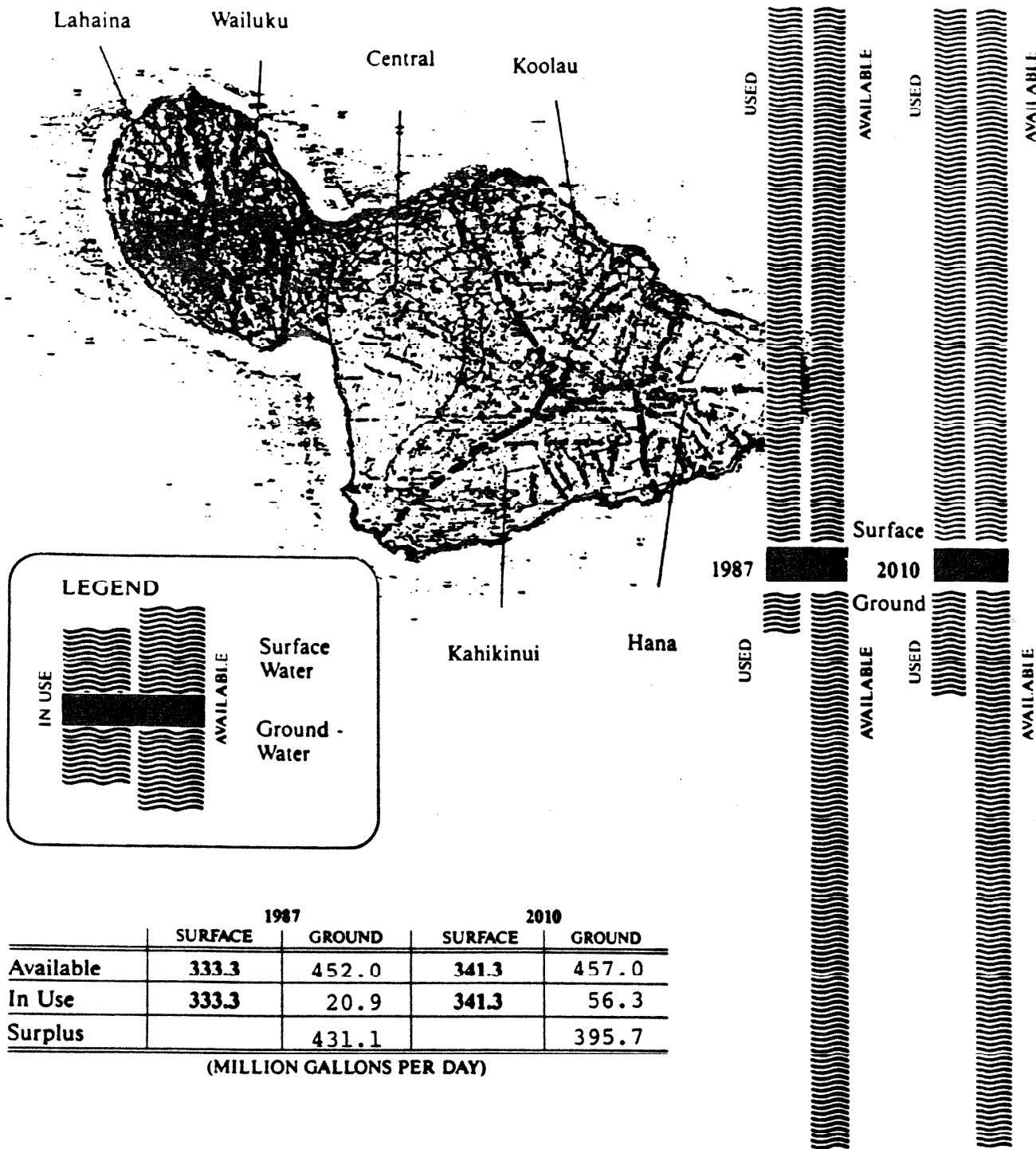
ISLAND OF LANAI

Lanai's potential potable groundwater resources are not clearly defined (Plate 3). Based on present estimates subject to change, the total Lanai Island summary for year 2010 is:

**ISLAND OF LANAI
(MILLION GALLONS PER DAY)**

<u>1987</u>	<u>Surface</u>	<u>Ground</u>
Available		6.0
In Use		2.8
Potential Surplus		3.2
<u>2010</u>	<u>Surface</u>	<u>Ground</u>
Available		6.0
In Use		3.9
Potential Surplus		2.1

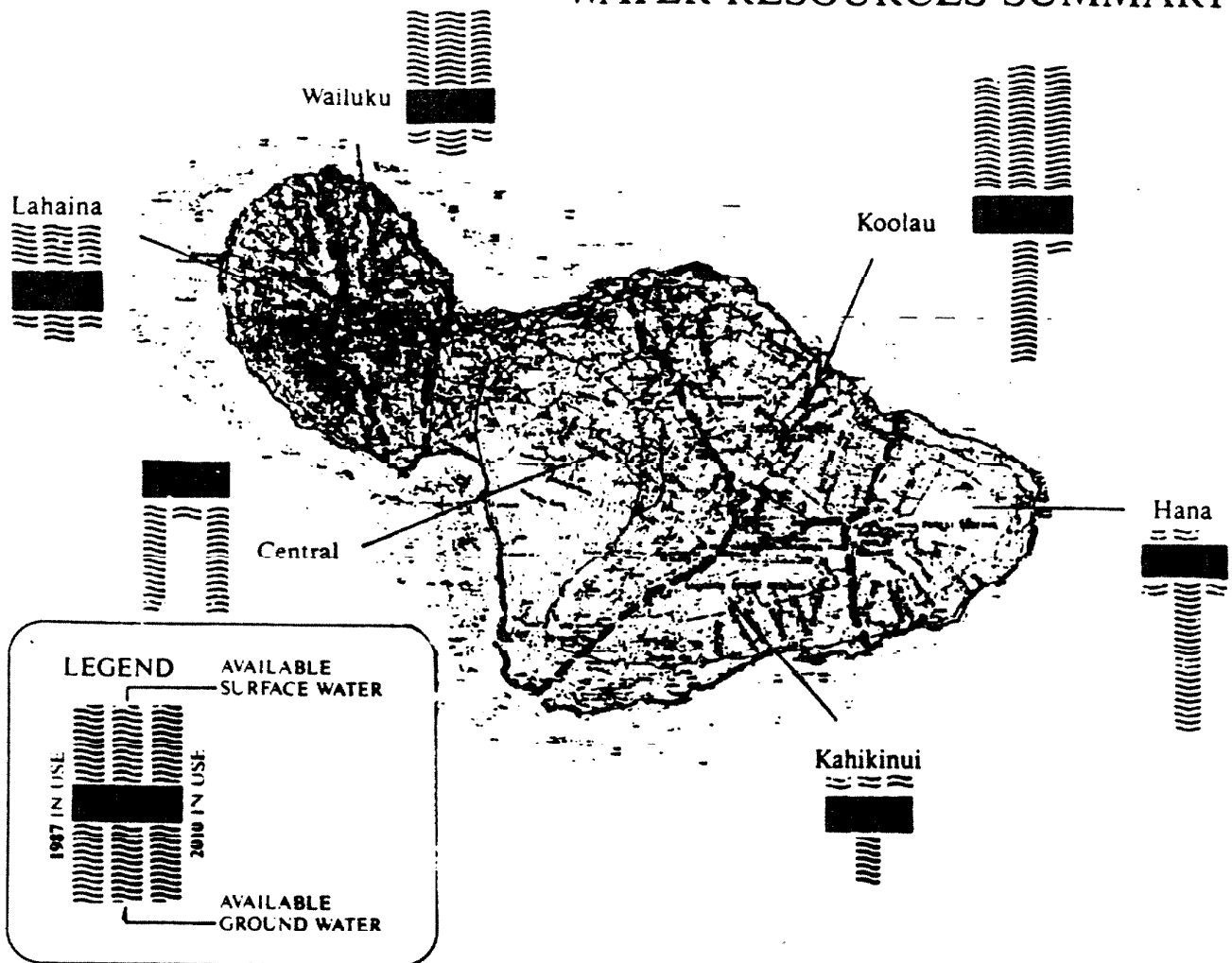
ISLAND OF MAUI TOTAL WATER RESOURCES



	1987		2010	
	SURFACE	GROUND	SURFACE	GROUND
Available	333.3	452.0	341.3	457.0
In Use	333.3	20.9	341.3	56.3
Surplus		431.1		395.7

(MILLION GALLONS PER DAY)

ISLAND OF MAUI WATER RESOURCES SUMMARY

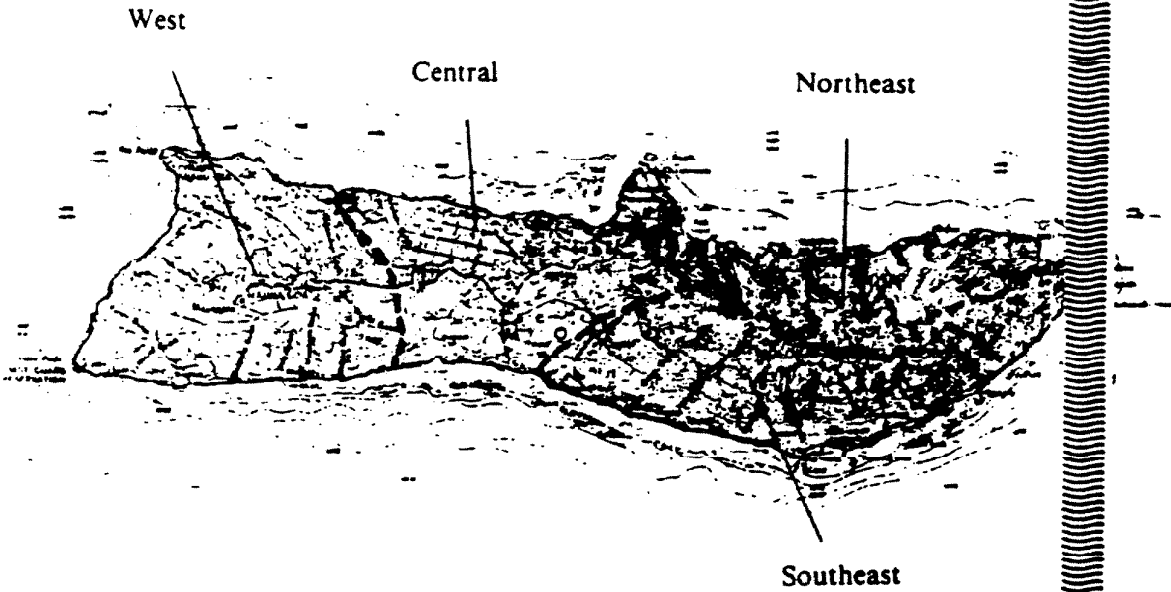
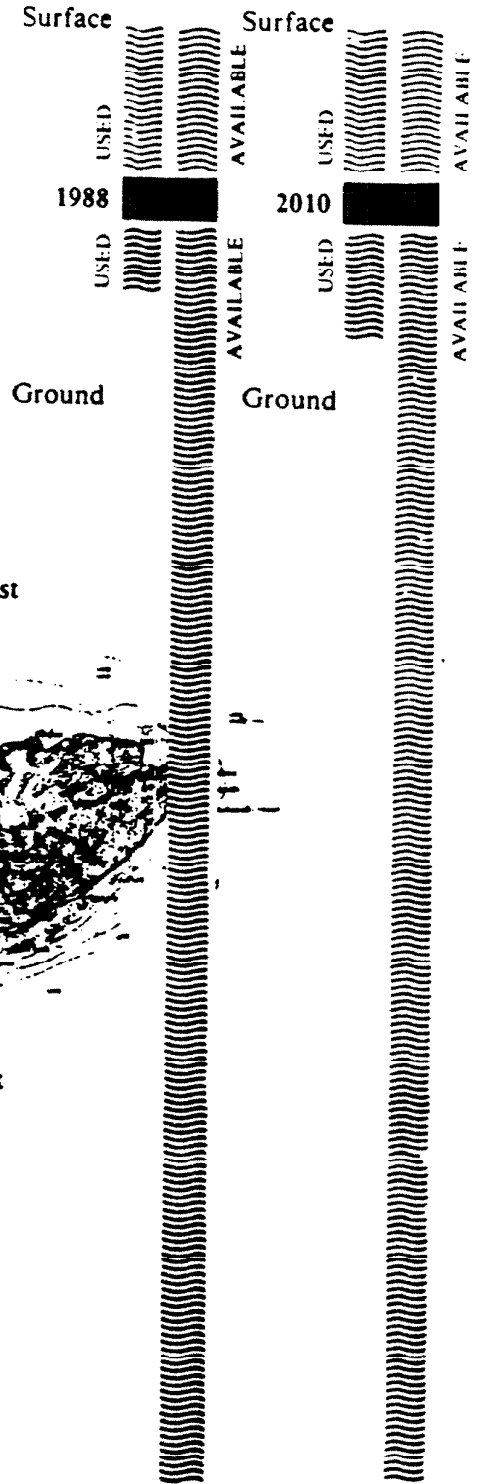
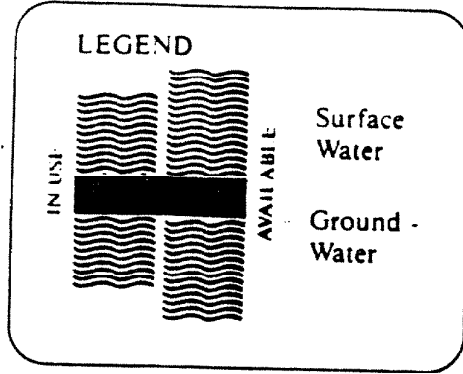


AQUIFER SECTORS	1987 IN USE		AVAILABLE INVENTORY		2010 PROJECTED	
	SURFACE	GROUND	SURFACE	GROUND	SURFACE	GROUND
Lahaina	56.2	27.9	56.2	39	56.3	25.7
Wailuku	107.3	15.6	107.3	36	107.3	22.7
Central	0.0	171.6*	0.0	22	0.0	173.6
Koolau	169.6	0.0	169.6	186	177.6	8.5
Kahikinui	0.1	0.0	0.1	36	.1	0.0
Hana	0.1	0.1	0.1	133	0.0	0.3
Total	333.1	215.2	333.3	452	341.3	230.8

(MILLION GALLONS PER DAY)

*All non-potable.

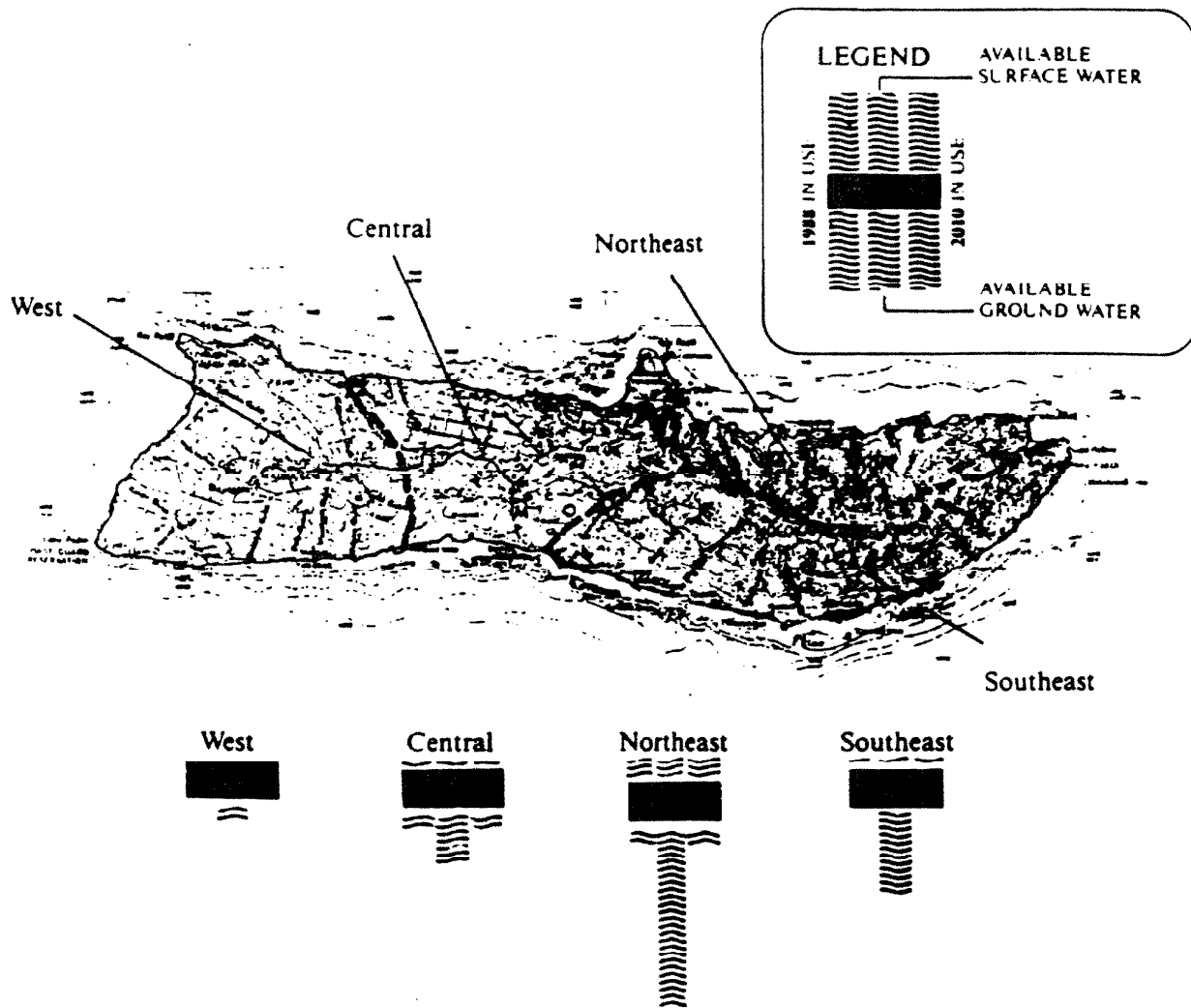
ISLAND OF MOLOKAI TOTAL WATER RESOURCES



	1988		2010	
	SURFACE	GROUND	SURFACE	GROUND
Available	5.0	83.0	5.0	83.0
In Use	5.0	4.7	4.8	9.0
Surplus		78.3	.2	74.0

(MILLION GALLONS PER DAY)

ISLAND OF MOLOKAI WATER RESOURCES SUMMARY



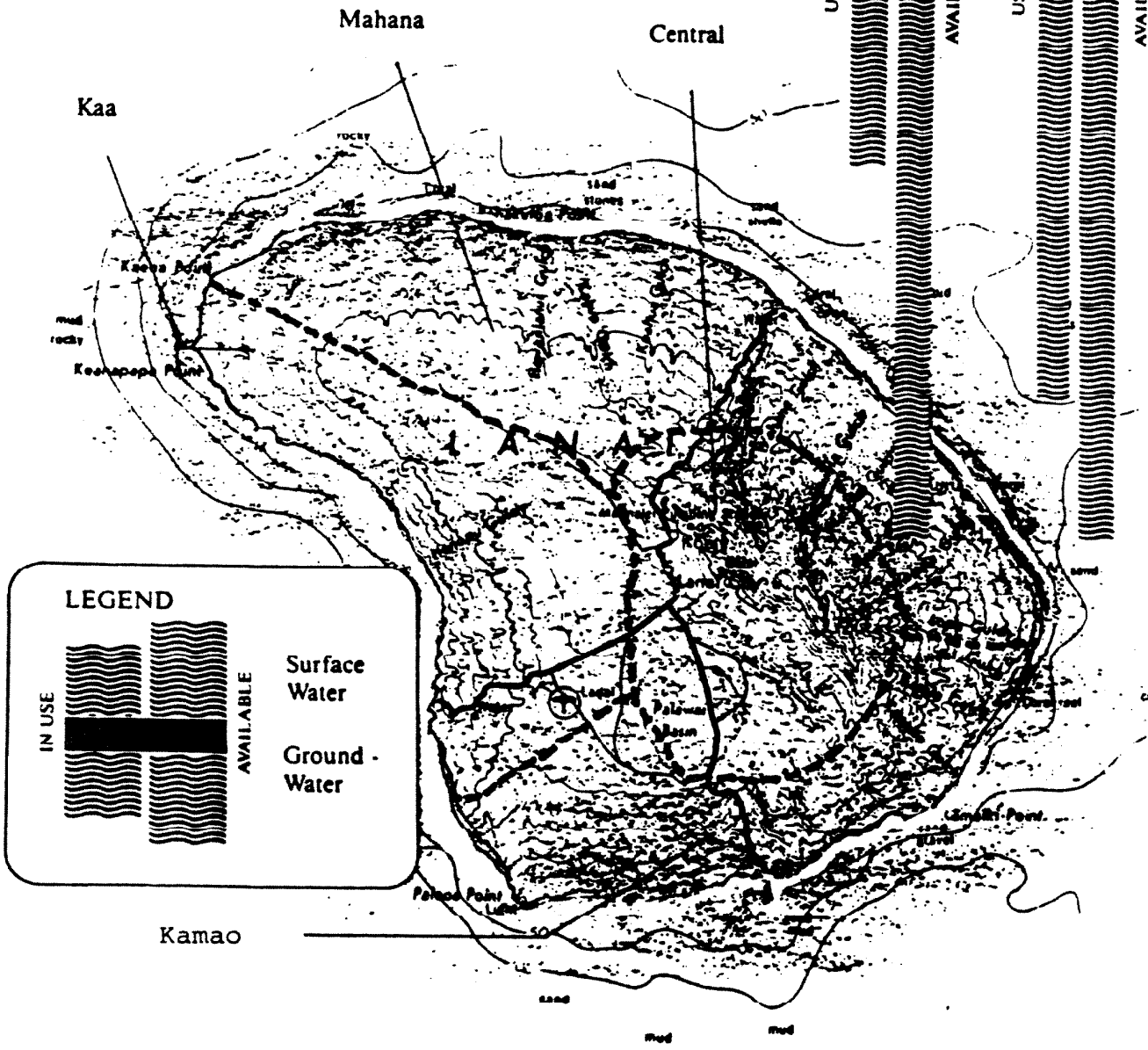
AQUIFER SECTORS	1988 IN USE		Available Inventory 2010 PROJECTED			
	SURFACE	GROUND	SURFACE	GROUND	SURFACE	GROUND
West	0.0	0.0	0.0	4	0.0	0.0
Central	0.1	1.06	0.1	11	0.0	5.31
Northeast	4.84	2.7	4.84	44	4.8	2.7
Southeast	0.11	0.92	0.11	24	0.0	.97
Total	5.05	4.68	5.05	83	4.8	8.98

(MILLION GALLONS PER DAY)

ISLAND OF LANAI TOTAL WATER RESOURCES

	1988		2010	
	SURFACE	GROUND	SURFACE	GROUND
Available		6.0		6.0
In Use		2.8		3.86
Surplus		3.2		1.4

(MILLION GALLONS PER DAY)



ISLAND OF KAHO'OLAWÉ

Kaho'olawe, now uninhabited, was habitable in the recent past. Initial research indicates that there is substantial surface water and some groundwater. Decisions regarding future use must be made before preparing detailed plans.

BACKGROUND

The State Legislature's passage of the Hawaii Water Code (Act 45, SLH 1987) in 1987 marks a major change in the process of water source development in Hawaii. This Act provides the State of Hawaii with its first comprehensive approach to water protection, quality control, use and development.

Pursuant to the Act, the State must complete the Hawaii Water Plan by June 30, 1990. Each County's input must be submitted prior to this date to be included in the Hawaii Water Plan.

The Hawaii Water Plan, which incorporates each County's plan, has five clear goals:

1. Attain the highest reasonable and beneficial use of water.
2. Properly develop and conserve State water resources.
3. Control State waters for navigation, sanitation and similar public purposes.
4. Meet the needs for water quality as expressed by Environmental Protection Agency, the State Water Resources Protection Plan and the State Water Quality Plan.
5. Implement the policies expressed in Act 45, SLH 1987.

The Water Code directed the State Water Commission to provide each county with a

Water Resources Protection Plan (an inventory of existing surface and groundwater resources). Maui County assisted the State in developing this inventory.

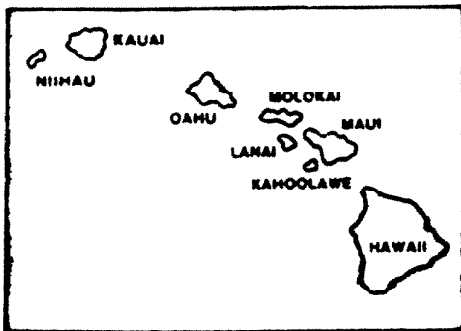
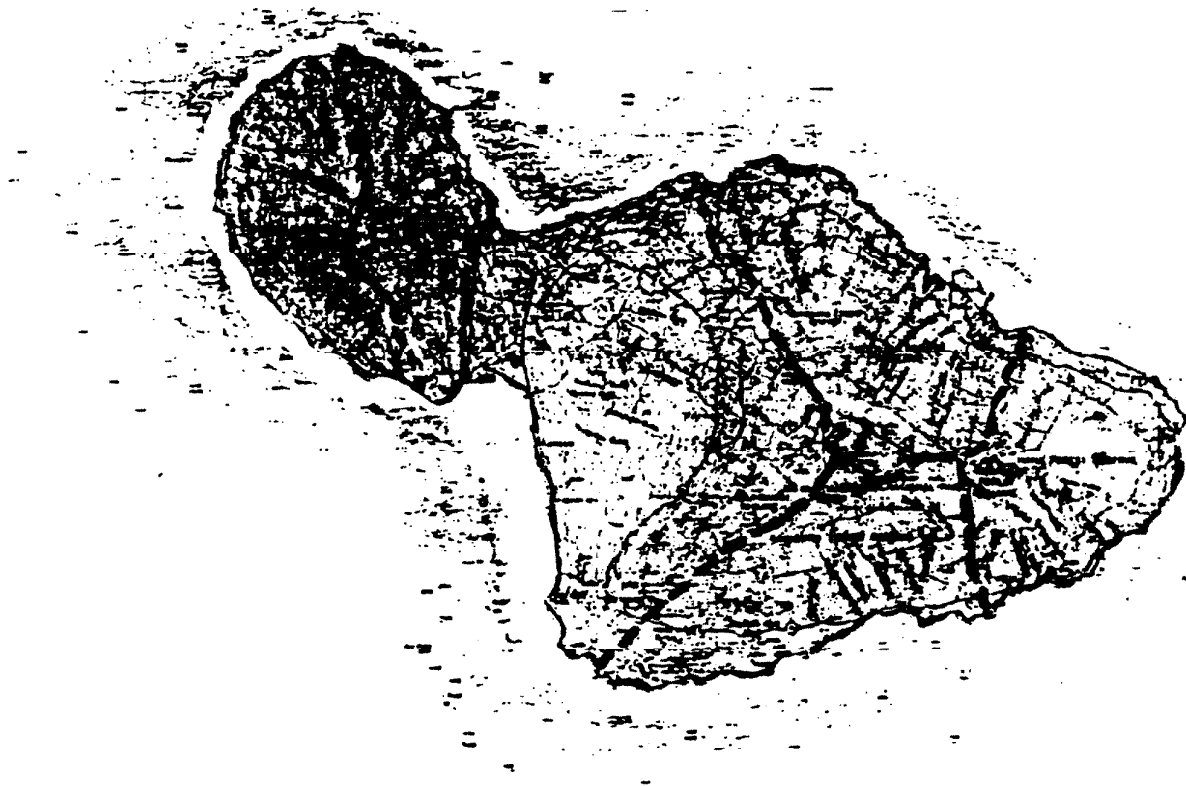
To develop the Maui Water Plan, the County Departments of Planning and Water Supply worked with major land owners, private water purveyors, the State Department of Land and Natural Resources and the Department of Hawaiian Home Lands to inventory existing uses and identified future uses to the year 2010. Future needs were matched to existing or potential resources using the available geologic information.

The Maui Water Plan will be integrated into the Hawaii Water Use and Development Plan.

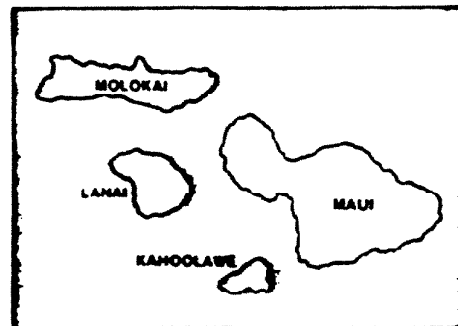
Maui County is made up of four islands, each with different water resources, ownership patterns and development plans. One summary plan, divided into four island chapters, has been prepared to accommodate these variances. The technical reports, with the bulk of the information, are similarly separated into island chapters.

County geological resources show sufficient water available for future needs. However, most of the easily obtained water has been developed. Additional water sources will be expensive to reach, produce and transport, since the available water is in the wet areas of the island while development is taking place in the dry areas. The Maui Water Plan identifies additional water sources which can be developed at an acceptable cost while remaining within the limits of the water resource.

MAUI



STATE OF HAWAII



MAUI COUNTY

ISLAND OF MAUI

1.0 INTRODUCTION

The Island of Maui averages 80 inches of rainfall a year (2,840 MGD). Seventy five percent of that rain falls on Haleakala, East Maui and on the northeast lower windward slopes.

The East Maui Irrigation (EMI) system transports an average of 164 MGD of this surface water to the cane fields of Hawaiian Commercial and Sugar, (HC&S), a subsidiary of Alexander & Baldwin. This is the largest single use of water in the County.

Groundwater has been used for more than a century. The major wells in operation belong to HC&S, C. Brewer, KaaNapali, Pioneer Mill, Kapalua and the Maui Department of Water Supply. These wells, with a total production level of 215 MGD (mostly non-potable), are mainly used for agriculture. About 21 MGD are used for domestic, industrial and commercial purposes.

1.1 SURFACE WATER SYSTEMS

Over 60 percent of the water used in the United States comes from surface water sources. The water is often pumped directly from rivers and streams. Catchment systems (dams and reservoirs) have also been built in many areas to assure a constant supply of water.

The Federal Safe Drinking Water Act of 1986, as amended, applies in all cases of surface water and groundwater supplied by public and private systems.

The Act requires treatment for all surface waters. This substantially increases the cost of operating a surface water system. As a result, wells, rather than surface sources, are often the preferred choice for new water sources of private and public water suppliers.

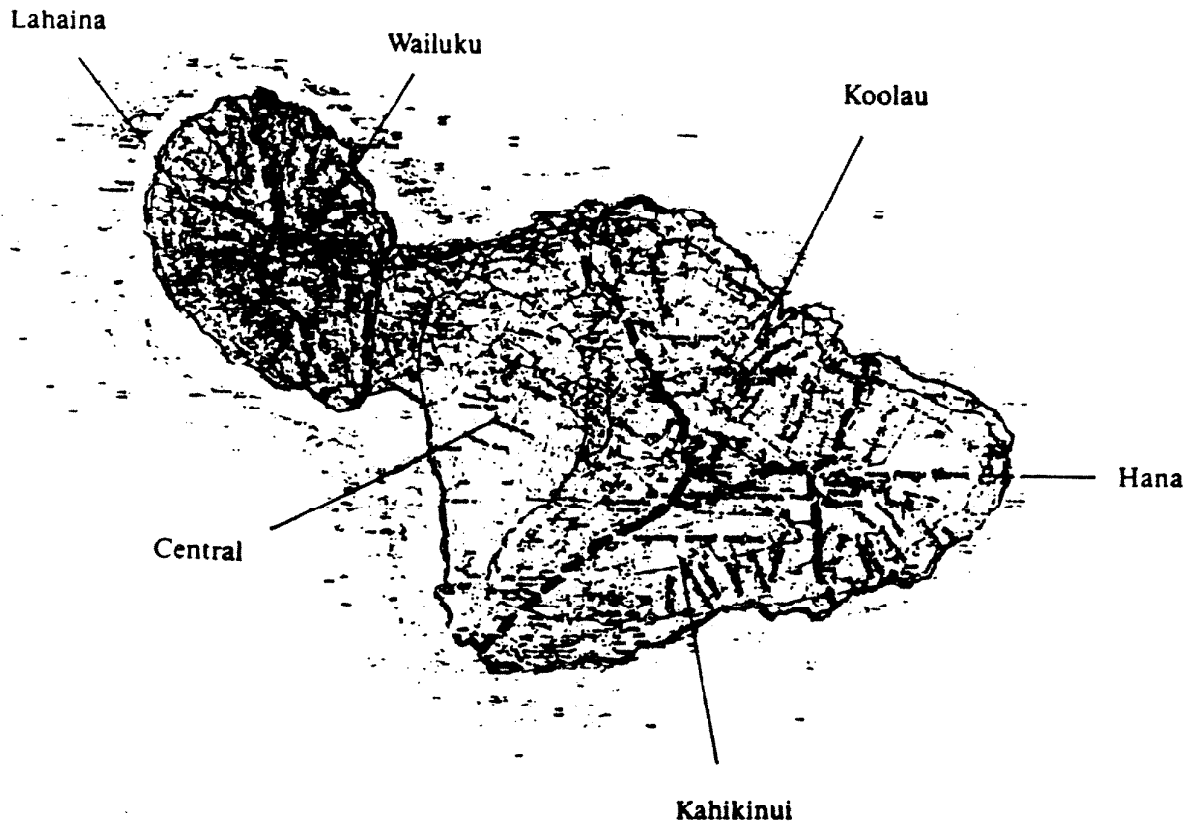
1.2 GROUNDWATER SYSTEMS

While significant development of groundwater has occurred on Maui, geologists report there are considerable undeveloped quantities. Potable ground water resources may total as much as 452 MGD. Most of this is on the windward side, far from proposed leeward developments.

2.0 WATER RESOURCES INVENTORY

The Island of Maui is divided into six aquifer sectors. Each sector, made up of several aquifer systems, operates relatively independently. The six sectors are Lahaina, Wailuku, Central, Koolau, Kahikinui and Hana (Plate 4). This report uses these sectors as the unit for analyzing and discussing water resources inventory.

ISLAND OF MAUI AQUIFER SECTORS



2.1 SURFACE WATER RESOURCES INVENTORY

The State Water Commission is responsible for providing an inventory of surface waters and recommendations for excedent levels (amount of water which can be taken from the stream). For the present, interim instream flow standards are status quo withdrawals. This issue of the report assumes that the amount used is the amount available.

2.2 GROUNDWATER RESOURCES INVENTORY

Rain percolating through the ground and collecting in a containment creates groundwater resources. This water may collect on impervious underground layers and behind lava dikes, creating high level perched water. This water may overflow, creating natural streams or springs.

Water that is not trapped continues flowing to the sea in a high level aquifer. Such aquifers may be within a few feet of the surface and are susceptible to contamination by nitrates, phosphates, pesticides and permeate from septic tanks, leach fields and cesspools. Though their use is fairly common in other areas, shallow aquifers are not generally used for domestic water on Maui.

If water continues to diffuse through the layers of rock, sand, soil and gravel, it will reach sea level. Fresh water has a lower density than seawater and will float on the salt water. Most of the fresh water lies below sea level, shaped much like a lens. This fresh water is the source of

much of the groundwater available in the State.

Because of the irregularities in the rock at or near sea level, this basal water "lens" is actually broken up into many sectors or systems. Therefore, a well in one area may not draw on water from a "lens" in an adjacent but separated sector.

The quantity of water available in an aquifer depends on several factors:

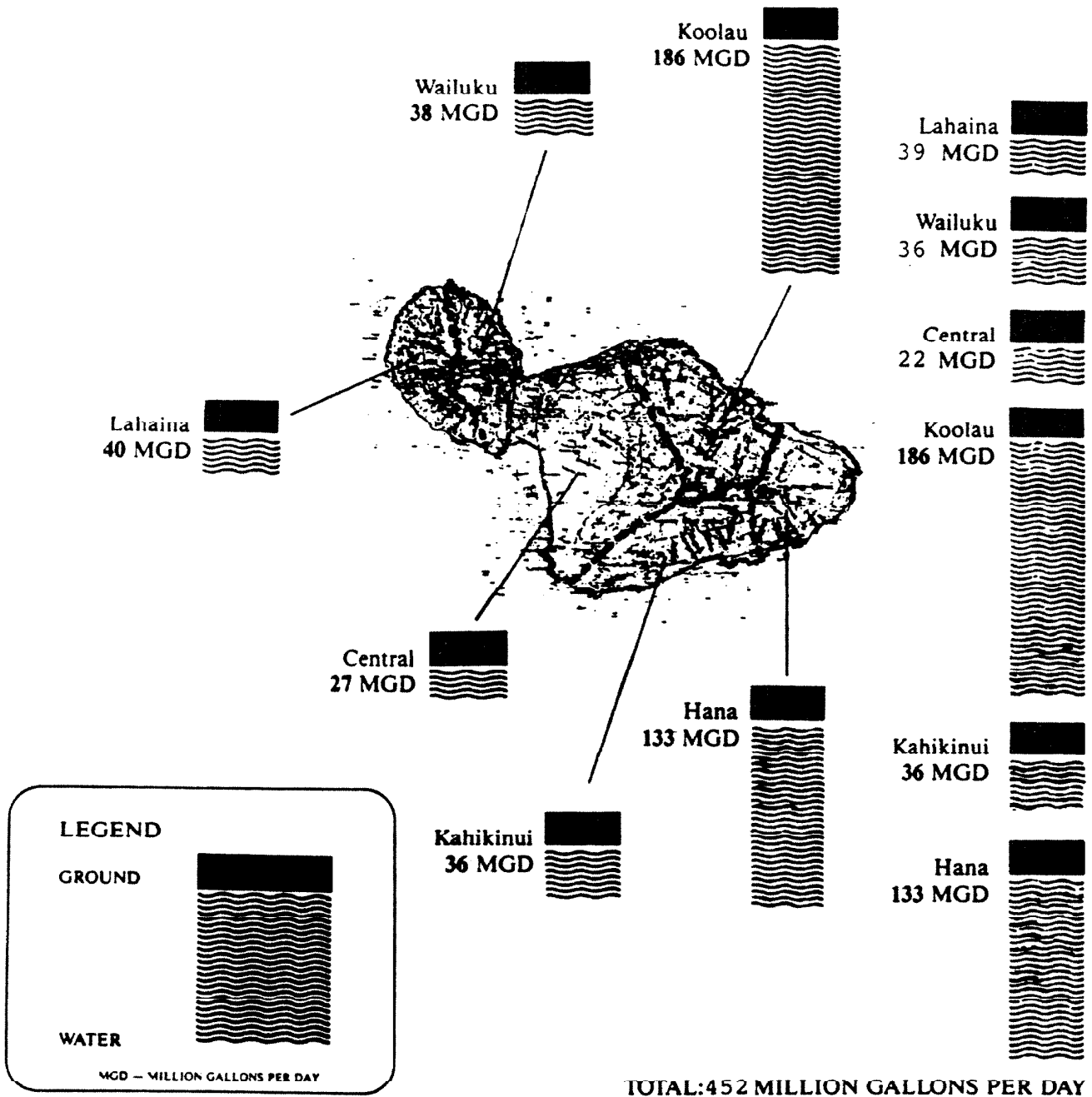
- the average rainfall in an area
- the rate at which water diffuses through the rock
- the access of the "lens" to seepage into the ocean
- the amount of irrigation taking place above that "lens."

The several hundred million gallons of water per day used to irrigate the cane fields in the Central sector greatly increases the amount of water which can be drawn from that aquifer. This "recharge" phenomena changes the actual sustainable yield for an aquifer.

State geological data in general does not compensate for the recharge occurring from irrigation. Adjustments will be made to the current sustainable yields as data becomes available. Sustainable yields, adjusted for recharge, are available for the Lahaina Sector. This data is included in the technical report.

The current sustainable yields by sector (Plate 5) suggest that the available groundwater for Maui totals approximately 452 Million Gallons per Day (MGD), distributed as:

ISLAND OF MAUI 1987 POTENTIAL GROUNDWATER SUSTAINABLE YIELD



AQUIFER SECTOR	POTENTIAL YIELD
Lahaina:	39 MGD
Wailuku:	36 MGD
Central:	22 MGD
Koolau:	186 MGD
Kahikinui:	36 MGD
Hana:	133 MGD
TOTAL:	452 MGD

These numbers represent the potential groundwater source unadjusted for recharge. However, they will need to be adjusted to determine the practical sustainable yield.

3.0 WATER USE INVENTORY

For the purpose of this report, water comes from only two sources: Surface and ground. Any source from a stream, open ditch or which shows surface influence (becomes cloudy when it rains, etc.) is considered a surface source. Well or tunnel sources which do not show surface influence are considered groundwater.

For uses such as sugar cane cultivation, water is obtained from one or more aquifer sectors and used in another. Considerable recharge can take place and greatly increase the capacity of the aquifer where the water is used. For simplification, we will consider the water as "used" in the sector it is obtained from. When community plans and water development plans are discussed, that water will then be "transferred" from one sector to another.

3.1 SURFACE WATER USE INVENTORY

The water used (withdrawn) in each sector (Plate 6) is summarized:

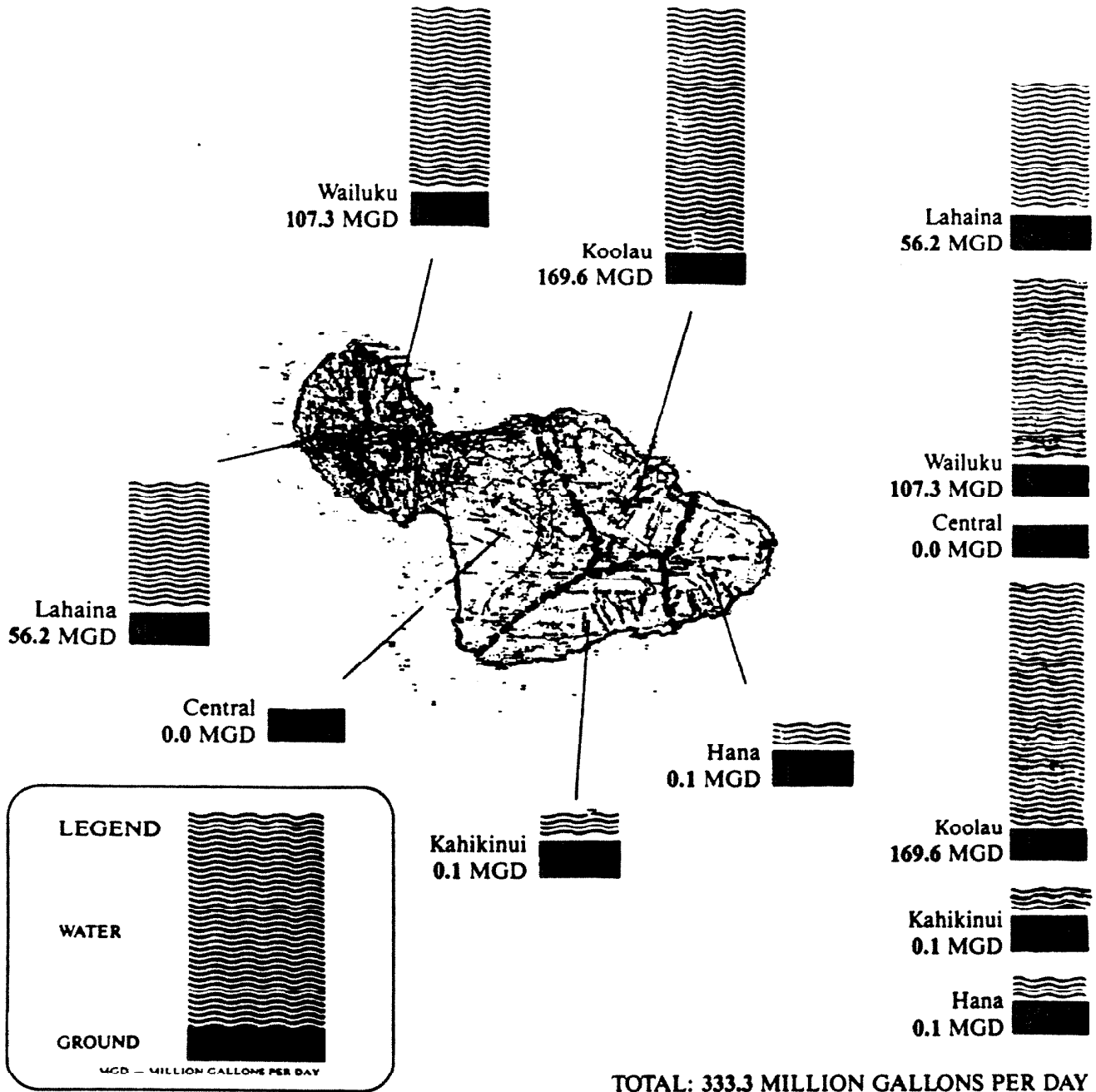
Lahaina:	56.2 MGD
Wailuku:	107.3 MGD
Central:	0.0 MGD
Koolau:	169.6 MGD
Kahikinui:	0.1 MGD
Hana:	0.1 MGD
TOTAL:	333.3 MGD

3.1.1 LAHAINA SECTOR

The Lahaina Sector includes the communities of Olowalu, Lahaina, Kaanapali, Napili and Kapalua. Surface water is used for sugar cane by Pioneer Mill, pineapple by Maui Pineapple, commercial by Kapalua and domestic water by the Department of Water Supply. A total of 56.2 MGD were used in 1987.

USER AVERAGE	DAILY (MGD)
Pioneer Mill	45.2
Maui Pineapple Co. Ltd	4.5
Kapalua	3.6
Department of Water Supply	2.5
Other domestic sources	0.4
TOTAL:	56.2

ISLAND OF MAUI 1987 SURFACE WATER USE INVENTORY



3.1.2 WAILUKU SECTOR

The Wailuku Sector includes portions of Kahului, most of Wailuku, Waihee, Kahakuloa and Waiehu. The major users of surface water from this sector are Wailuku Agribusiness and HC&S, with a total average consumption of 107.3 MGD, as tabulated below.

USER	DAILY AVG (MGD)
Wailuku Agribusiness	26.7
Hawaiian Commercial & Sugar	25.0
Other diversions from W.A.B.	55.6
TOTAL:	107.3

3.1.3 CENTRAL SECTOR

No surface water usage is recorded for the Central Sector, including the valley area and the west side of Haleakala, which receives very little rain.

3.1.4 KOOLAU SECTOR

The Koolau Sector has small population centers and uses only a small amount of water. It is a major source of surface water for the pineapple and cane fields of the Central Sector. A total of 169.6 MDG of surface water is transported from the Koolau sector for HC&S, Maui Pineapple and the Department of Water Supply.

USER	DAILY AVG (MGD)
Hawaiian Commercial & Sugar	164.0
Maui Pineapple Co. Ltd.	0.2
Department of Water Supply	5.4
TOTAL:	169.6

3.1.5. KAHIKINUI SECTOR

The only recorded use of surface water in Sector is the approximately 0.1 MGD used by ranches.

3.1.6. HANA SECTOR

In the Hana Sector, the only recorded use of surface water is the Department of Water Supply's .1 MGD to supply the community of Koali. There is no accurate data on catchment use.

3.2 GROUNDWATER USE INVENTORY

The groundwater used in each sector (Plate 7) is:

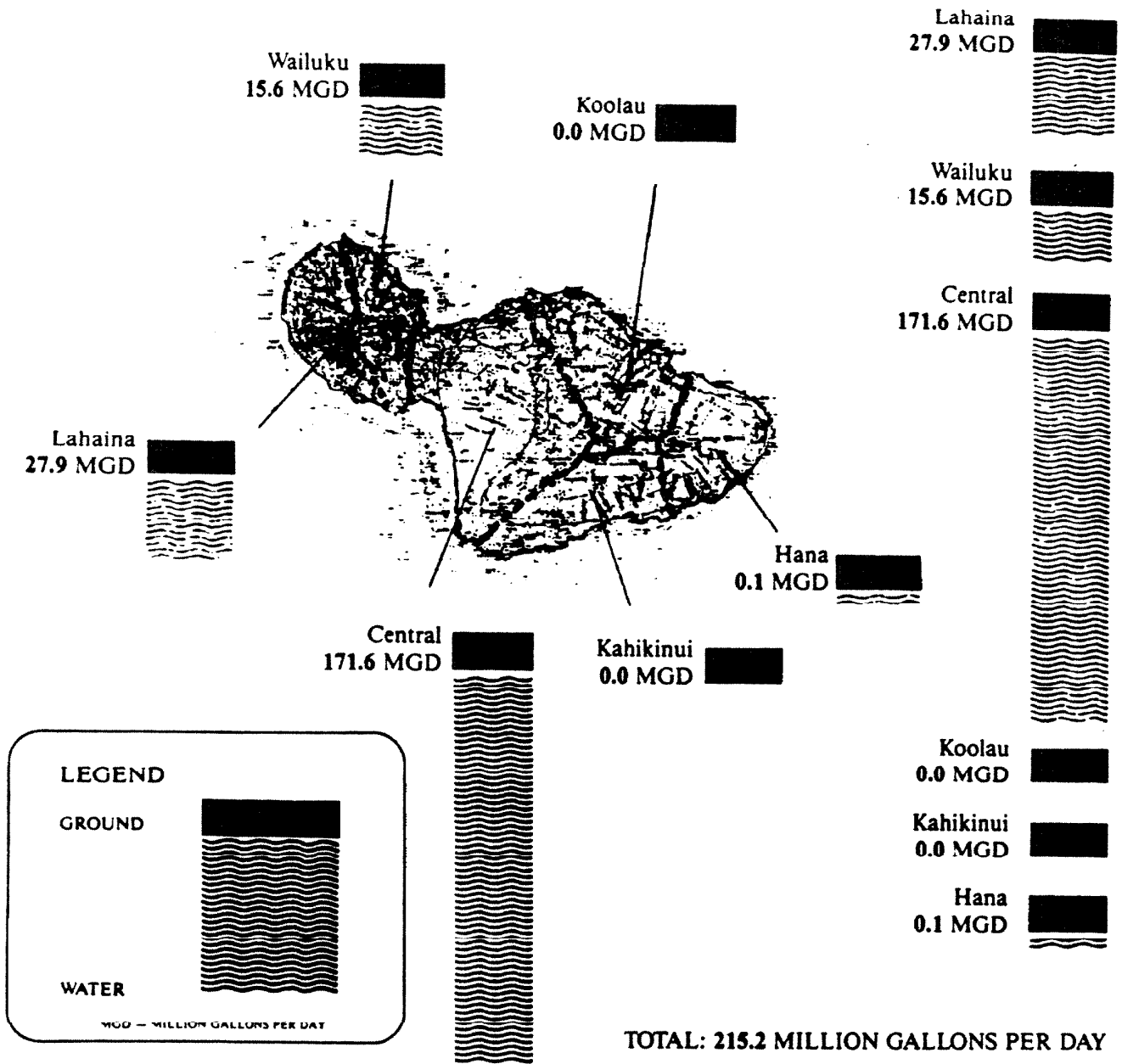
Lahaina:	27.9 MGD
Wailuku:	15.6 MGD
Central:	171.6 MGD
Koolau:	0.0 MGD
Kahikinui:	0.0 MGD
Hana:	0.1 MGD
TOTAL:	215.2 MGD

Much of this groundwater, including 20.2 MGD in Lahaina and 171.6 MGD in Central is non-potable.

3.2.1 LAHAINA SECTOR

The major uses of ground water in the Lahaina Sector are Pioneer Mill, Kaanapali Resort and the Department of Water Supply. The water used by Pioneer Mill is non-potable with chlorides greater than 250 ppm (parts per million).

ISLAND OF MAUI 1987 GROUND WATER USE INVENTORY



LAHAINA SECTOR	
USER	DAILY AVG (MGD)
Pioneer Mill	20.2
Kaanapali Resort	4.5
Department of Water	3.2
TOTAL:	27.9

3.2.2 WAILUKU SECTOR

The Department of Water Supply is large user of groundwater in the Wailuku Sector, averaging 15.1 MGD from sector sources in 1987. An additional .5 MGD from small wells were used for parks and landscaping.

USER	DAILY AVG (MGD)
Department of Water Supply	15.1
Landscaping and parks	0.5
TOTAL:	15.6

3.2.3 CENTRAL SECTOR

The major users of the non-potable groundwater in the Central Sector were HC&S, the Wailea and Makena resorts and the Maui Pineapple cannery. A small amount of potable groundwater is used by ranchers on Haleakala.

USER	DAILY AVG (MGD)
Hawaiian Commercial & Sugar	167.0
Maui Pineapple Co. Ltd.	0.8
Resort landscaping and parks	3.7
Grazing	0.1
TOTAL:	171.6

(Note the pristine sustainable yield for this sector is 27 MGD and current withdrawals

far exceed that number. Approximately 200 MGD of surface water and essentially all of the 171.6 MGD is applied for irrigation, resulting in a very large recharge increasing the aquifer capacity.)

3.2.4 KOOLAU SECTOR

There are no significant groundwater users in the Koolau Sector.

3.2.5 KAHIKINUI SECTOR

There are no significant groundwater users in the Kahikinui Sector.

3.2.6 HANA SECTOR

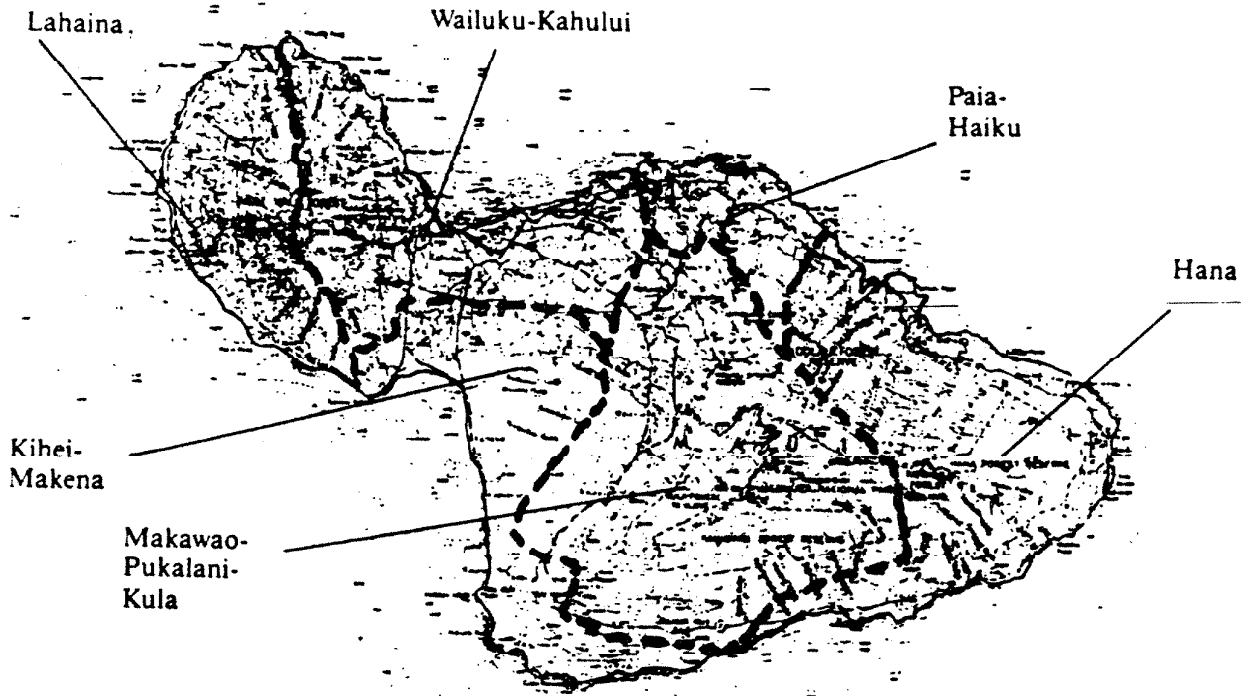
The Department of Water Supply is the only significant user of groundwater in the Hana Sector, averaging 0.1 MGD. The Hana Ranch has several wells in this sector, but their use is not available.

4.0 COMMUNITY PLANS

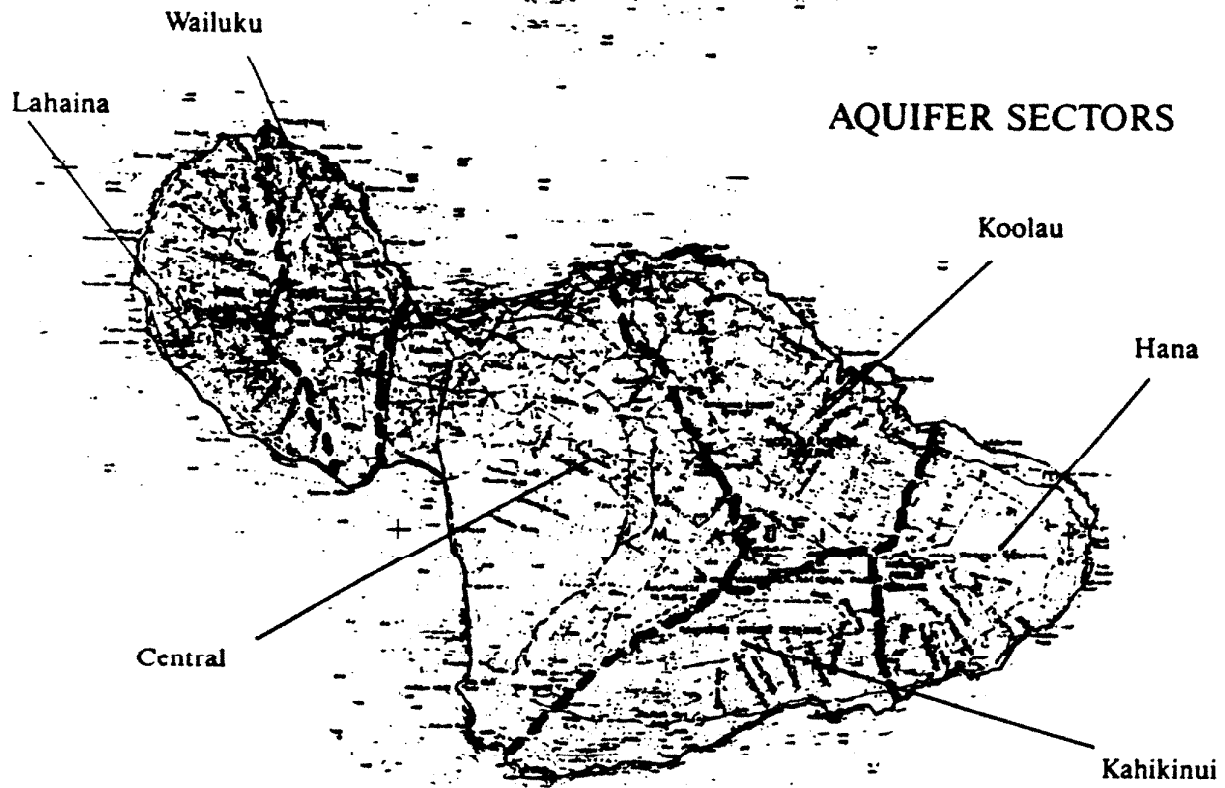
The Department of Water Supply, the Planning Department and the other members of the Water Code Committee used the approved Maui County Community Plans as guidelines in developing projections for future use.

These plans, which give direction to the development of each community to the year 2000, do not directly address water use nor do they exactly correspond to the Aquifer Sectors as defined on Plate 1. Some areas do not have sufficient water resources in their sector. Therefore, there may be some difficulty in making direct correspondence between Aquifer Sectors and Community Plan boundaries (Plate 8).

ISLAND OF MAUI COMMUNITY PLANS BOUNDARIES



AQUIFER SECTORS



Additionally, the community plans include the 20 years from 1980 to 2000. The Maui Water Plan covers the 20 years from 1990 to 2010. The community plans include total land and potential development in excess of the 2000 developments.

For the purpose of this report, it was assumed that population growth would continue at the rate suggested in the community plan. If Water Department records suggest otherwise, water use growth rates were used to project potential long-term consumption.

4.1 LAHAINA

The Lahaina Community Plan projected a population of 20,000 in the year 2000, a growth rate of 2.7 percent a year. The water department records show a growth in total water consumption of approximately 4.7 percent a year.

Based on the community plan, the Department of Water Supply has developed plans for the installation of new well and surface water capacity to meet the demand of 10.8 MGD in 2010 by drilling and installing five new wells.

Other growth, not included in the community plan, may take place. The State Housing, Finance and Development Corporation's (HFDC) proposed 1,134 acre residential community in the Lahaina area is in the planning stages.

Preliminary estimates for the HFDC's project indicate an average daily demand of approximately 3 MGD to service the planned community.

The Kaanapali Resort, served by the Kaanapali Water Corp., is also planning additional developments in North and South Beach Makai, Project District 3 and South Beach Mauka. These areas currently have an average daily demand of 2.5 MGD, served by wells in the Lahaina Sector at Honokowai and Mahinahina. By the year 2010, consumption is expected to increase to 6.74 MGD of groundwater. Additional sources are planned from USGS Sector "B". Treatment of surface water, desalinization, development of high level dike water or the transport of water from other aquifers is under consideration.

The Kapalua Resort is served by the private Kapalua Water Co. which presently supplies the resort with surface water at the rate of approximately 3.6 MGD. The resort plans several additional hotel and residential developments in the next 20 years. An additional 1.58 MGD of water will be needed to supply domestic consumption and an additional 1.5 MGD will be taken from the ditch to supply water to an additional golf course.

Complementing this increase in use, the Pioneer Mill Co. expects a decrease in use of about 16.2 MGD (1.6 MGD surface, 14.7 MGD groundwater) as some agricultural lands are taken out of agricultural use and converted to urban use.

4.2 WAILUKU-KAHULUI

The Wailuku-Kahului Community Plan projects growth and major developments in the 20 year period. The Department of Water Supply has made separate projections for this community plan area

and combined projections with the Kihei-Makena plan. The Wailuku-Kahului Community Plan area lies within both the Wailuku and the Central Aquifer Sectors.

4.3 KIHEI-MAKENA

The Kihei-Makena Community Plan projects a resident population of 22,900 at the end of the 20 year period. The combined population for Kihei-Makena-Wailuku-Kahului-Paia-Haiku in the year 2010 is expected to be more than 67,000. This growth rate of about 3.6 percent per year is slightly lower than the 3.8 percent per year from 1980 to 1986.

Based on the conclusions of the Norman Saito Report on Central Maui and the recommendations of the Department of Water Supply, the total water production requirements for Central Maui, including Paia, increase from about 15.1 MGD in 1987 to about 30.5 MGD in the year 2010. This is a projected growth rate in water usage of about three percent per year.

4.4 PAIA-HAIKU

The Paia-Haiku Community Plan projects a population of about 6,800 people at the end of the 20 year plan. The Paia-Haiku Community Plan covers lands that are both in the Central and the Koolau Sectors and is supplied with water from Central Maui System (20 percent) and the Makawao System (80 percent). The projections for increase in water use for this area are included in the expansion planned for both the Central Maui and Makawao Systems.

4.5 MAKAWAO-PUKALANI-KULA

The Makawao-Pukalani-Kula Community Plan projected a population of between 17,000 and 20,000 by the year 2000. However, the Department of Water Supply has recorded an increase in water usage at a rate of approximately 4.7 percent per year between 1980 to 1987 and therefore, has projected water use to increase to 5.3 MGD from the present 2.4 MGD.

The major source of supply for Makawao, Pukalani and Haiku comes from the EMI ditch system through a special agreement which will be re-negotiated in 1990. Though the County can use as much as 16 MGD, available water can drop to very low levels during drought, therefore, storage needs to be improved.

4.6 HANA

The Hana Community Plan projects a population increase from 1,400 in 1980 to 2,300 in 2000, a 2.5 percent annual growth rate. Since water use has been increasing at an annual rate of two percent, the Department of Water Supply expects to limit system developments to one new well of approximately .5 MGD pump capacity.

5.0 WATER DEVELOPMENT PLANS

Each of the large water users of Maui has cooperated with and provided plans to the Maui Water Code Committee. These plans may not yet define type of water source location or total consumption. Where the type of water sources are not defined, groundwater sources are assumed. If the amount of use is not clear, the largest likely use is assumed.

The schedule for implementation of the water projects has been deferred with the exception of the Department of Water Supply projects. It is premature to specify dates for water sources when the project or development is still in the conceptual design phase.

In cases of water development on the West side of Maui, future development of groundwater may involve new techniques and systems. Though currently uneconomical relative to existing sources, these options may address the use of brackish groundwater sources (such as in Kihei, Maalaea and Olowalu) for domestic purposes. Technologies available include reverse osmosis, electrophoresis and solar-powered stills. These methods all reduce the chloride levels in the water from levels greater than 250 parts per million (PPM) to acceptable levels below 150 PPM.

5.1 SURFACE WATER DEVELOPMENT PLANS

Surface water development is planned for the Lahaina and Koolau Sectors.

In Lahaina, the use of surface water for agriculture is being transferred to domestic and commercial use. The total surface water use is expected to increase by 0.1 MGD.

In the Koolau Sector, additional development of the Upper and Lower Waiakamoi storage and transmission systems will increase withdrawal from the watershed by about 8.0 MGD. While only minimal improvements are planned for the intake structures, the improved

transmission and storage facilities will substantially increase the capture of water which overflows existing storage.

An additional 18.3 MGD of agricultural usage is projected by Wailuku Agribusiness, though no changes in the intakes or total withdrawal are planned. The increase will use available water not required for the Wailuku Agribusiness crop and currently used for other agriculture.

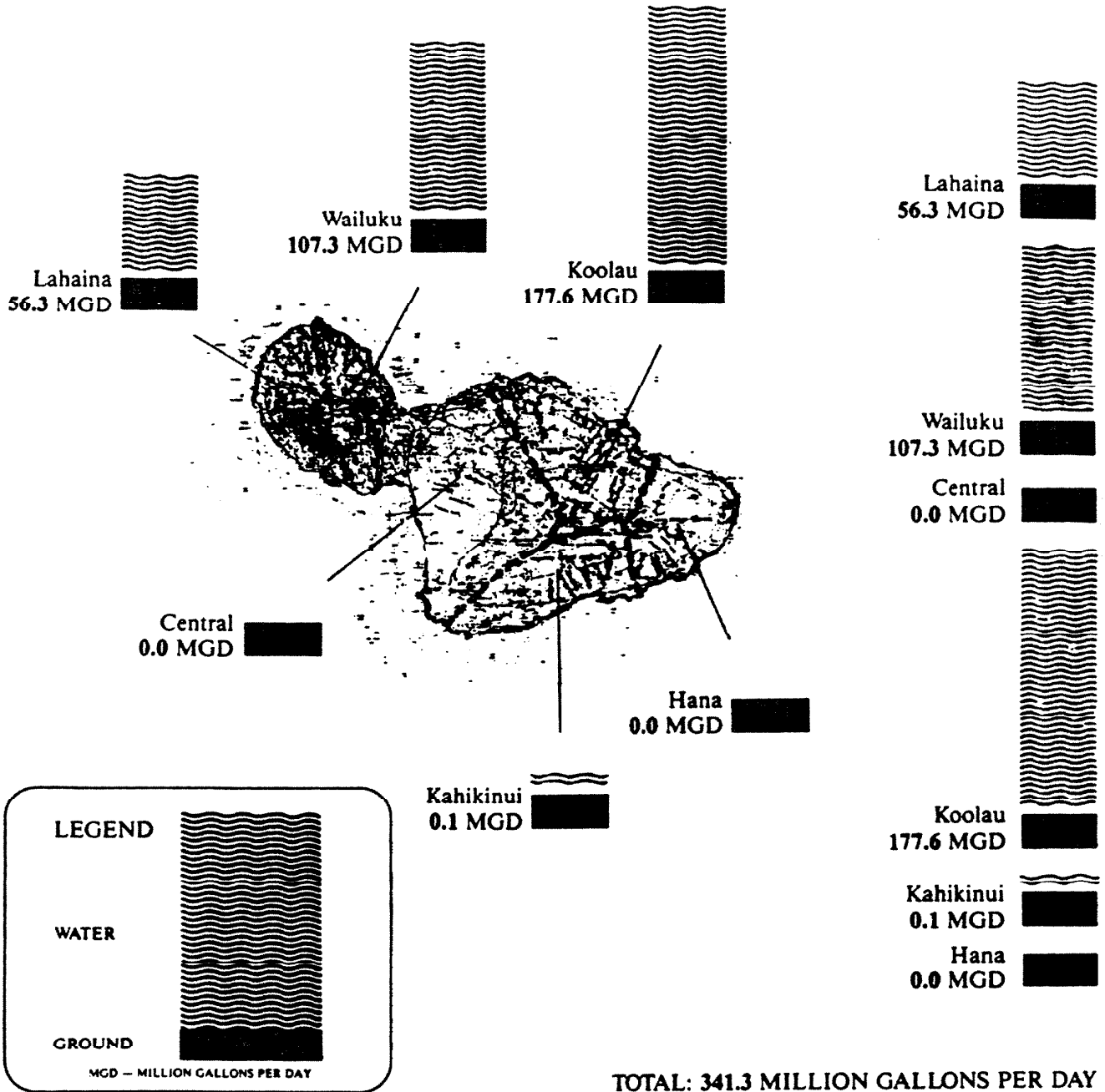
A summary of the changes in planned use is summarized below and on Plate 9.

SECTOR	CHANGE IN USE
Lahaina	+0.1 MGD
Wailuku	0.0 MGD
Central	0.0 MGD
Koolau	+8.0 MGD
Kahikinui	0.0 MGD
Hana	-0.1 MGD
TOTAL:	+8.0 MGD

5.1.1 LAHAINA SECTOR

The changes in surface water use planned for from 1987 to 2010 will cause only a minor increase in the average withdrawals from the streams in this sector. Kapalua will eliminate the use of surface water, replacing up to .61 MGD with wells for domestic purposes. An additional 1.5 MGD will be withdrawn from the ditch for an additional golf course at Kapalua.

ISLAND OF MAUI YEAR 2010 SURFACE WATER USE



The Department of Water Supply will construct a new treatment plant at Mahinahina with a capacity ranging from 2.5 MGD to 3.0 MGD, replacing the untreated water from the Alaeloa intake. This increase in domestic water usage will be compensated by a decrease in water available to Pioneer Mill Company. The net effect of these changes is projected to be an increase of 0.1 MGD.

5.1.2 WAILUKU SECTOR

There are no development plans for surface water in the Wailuku Sector. The existing use of surface water at Wailuku Agribusiness is projected to increase from 26.7 MGD to about 45 MGD as existing crop matures. The increased water will come from existing surface water source capacity presently used for other purposes.

5.1.3. CENTRAL SECTOR

No changes are planned for the Central Sector.

5.1.4 KOOLAU SECTOR

The Department of Water Supply prepared a County-wide source study for the municipal water system in February 1988. The study projected a large increase in total water consumption in upcountry Maui, including Makawao, Pukalani, Haiku, Upper and Lower Kula. Based on these projections, a series of surface water system improvements are planned.

The present Kamole Treatment Plant will reach capacity by year 2006. By then, its capacity will be increased from the present 8 MGD to the planned 12 MGD.

Additionally, a number of reservoirs and other source improvements are planned for Upper and Lower Kula. The Upper Kula improvements include the 36 inch transmission pipeline (Appendix Figure 1) now under construction, a 100 million gallons reservoir at Waiakamoi (Appendix Figure 2) now being designed, expansion of the Olinda Treatment Plant (Appendix Figure 3), and the projects listed below and illustrated in the attached figures in the appendix.

UPPER KULA IMPROVEMENTS

Project	Est. Cost	Fig
		(millions)
36" Transmission Pipeline	\$ 7.500	1
100 MG Kahakapao Reservoir	13.000	2
Intakes west of Waiakamoi	.080	3
Intake and pipeline repair	.420	4
Expand Olinda Plant to 2.5 MGD	.315	5
50 MG Mahanalua Reservoir	5.400	6
75 MG Waihou Reservoir	12.000	7

These projects will increase the capacity of the Upper Kula system from the present .85 MGD to about 2.5 MGD to meet the anticipated consumption of 1.6 MGD.

The Lower Kula improvements include modifying piping, controls and raising the walls of the Piiholo Reservoir (Appendix Figure 8), improving intakes (Appendix Figures 9, 10 and 11) and building a treatment plant (Appendix Figure 12).

LOWER KULA IMPROVEMENTS

PROJECT	EST. COST	
	(Millions)	FIG
Raise Piiholo Reservoir walls	\$ 6.357	8
Modify piping & controls, Piiholo	.030	8
Relocate E. Waiakeoi intake	.239	9
New intake, Kailua Stream	.390	10
Intakes, 10th Branch, Kailua	.390	11
2.5 MGD L. Kula treatment plant	5.980	12
Check valves, W. & Mid. Puoho	.105	13
300 MG Kailua reservoir	23.144	14

These projects are expected to increase the Lower Kula system capacity from the present 2.2 MGD to about 6.2 MGD to meet the expected consumption increase of 4 MGD.

5.1.5 KAHIKINUI SECTOR

No changes are planned for the Kahikinui Sector.

5.1.6 HANA SECTOR

No significant changes are planned for the Hana Sector. The Department of Water Supply currently uses a stream source for 0.1 MGD to supply part of Hana Town and Koali which will be phased out as soon as a new well is installed in the Koali area.

5.2 GROUNDWATER DEVELOPMENT PLANS

Groundwater development is planned in the Lahaina, Wailuku, Central, Koolau and Hana Sectors.

While total use in the Lahaina Sector

shows a decrease due to reduced agricultural pumping by Pioneer Mill, there is an increase in domestic use by the Department of Water Supply, the HFDC, Kaa-napali and Kapalua resorts. The net result reduces withdrawal from the Lahaina Sector aquifer by about 2.2 MGD.

In the Wailuku Sector, the Department of Water Supply will increase withdrawal from existing wells and install several new wells in that sector for an increase in total withdrawal of about 7.1 MGD.

Several saline water agricultural wells will be installed at the Wailea and Makena resorts for use on golf courses.

Since there is insufficient low-cost water available in the Wailuku Sector for the next 20 year's growth, the Department of Water Supply is working with developers to extend the Central Maui water system in the direction of the Koolaus. Withdrawals of 8.5 MGD of domestic water are expected by 2010.

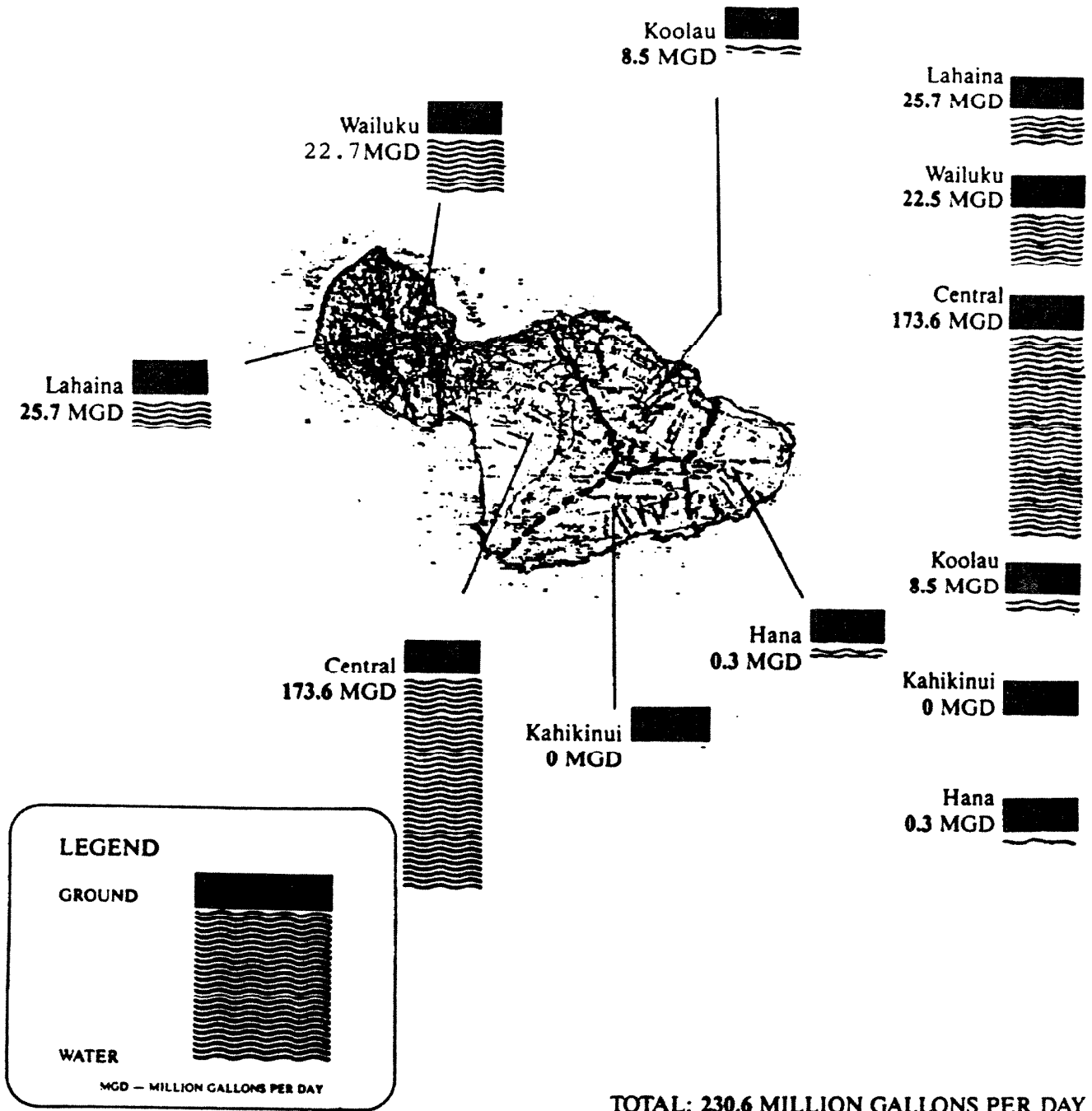
A small well is planned for the Hana Sector to supply small communities there.

Changes in water usage (Plate 10) are tabulated below:

CHANGES IN MAUI GROUNDWATER USE

Lahaina Sector	- 2.2 MGD
Wailuku Sector	+7.1 MGD
Central Sector	+2.0 MGD
Koolau Sector	+8.5 MGD
Kahikinui Sector	0.0 MGD
Hana Sector	+0.2 MGD
TOTAL:	+15.6 MGD

ISLAND OF MAUI YEAR 2010 GROUND WATER USE



Alternative development plans in the Central, Lahaina and Kahikinui sectors may be acceptable within the 20 year span of the plan since considerable saline water resources exist in these sectors. While currently not economical, these may prove to be acceptable if suitable technology becomes available. Technology in use elsewhere is capital and energy intensive and cannot compete with available sources. However, where other alternatives are too costly, desalinization using distillation, reverse osmosis and electrophoresis will be considered.

Another technique to increase total potable water resources involves the blending of saline water (250-800 ppm chloride) with very low salt groundwater. This mix, with levels of chlorides below 150 ppm, could be used to extend available water supplies at acceptable costs.

5.2.1 LAHAINA SECTOR

Water development plans in Lahaina include:

- Five wells by the Department of Water Supply (Appendix Figure 15)
- Three wells by Kapalua Resort (Appendix Figure 16)
- A well field of 3 MGD capacity (HFDC)
- Unspecified groundwater sources totaling 4 MGD by the Kaanapali Resort (Appendix figure 17).

Total withdrawals are expected to decrease by 2.2 MGD from the current 27.9 MGD to

approximately 25.7 MGD, due to reductions in use by Pioneer Mill.

Based on projections of domestic water use in the Lahaina Sector, the Department of Water Supply will develop approximately 4.0 MGD of new source capacity between 1987 and 2010 by drilling and installing five new wells tabulated below. The approximate sites for these wells are shown in Appendix Figure 15. HFDC will also be developing wells for its Lahaina housing project. When these wells are completed, HFDC will turn them over to the Department of Water.

PROPOSED DWS LAHAINA SOURCE DEVELOPMENT

Description	Est.	Year	Gal/
	Cost		Day
	(Millions)	Start	(Mils)
Honokahua "B"	\$ 2.100	1990	.8
Honokahua "C"*	8.765	1992	.8
Honokahua "D"	4.614	1994	.8
Honolua "A"	3.656	1998	.8
Honolua "B"	4.185	2002	.8

(*Includes the cost of transmission pipeline)

The Kapalua Resort now uses surface water for all applications. Plans call for converting their domestic system to groundwater use by putting in three wells designated Kapalua 1, 2 and 3. Each well will have a nominal pump capacity of 1.0 MGD. The location of these wells is shown on Appendix Figure 19. Based on projected domestic water use, average withdrawal for the Kapalua wells may be up to 2.185 MGD in 2010.

The HFDC is planning a 1,334 acre residential community in the Lahaina area. The preliminary estimates for the project indicate a demand of approximately 3 MGD to be met by sources provided by the HFDC. Well sites are being considered in USGS area "B". A well field with a total capacity of 4 MGD is proposed for the area between Kahana and Launiupoko streams with an estimated capacity of .3 MGD each.

5.2.2 WAILUKU SECTOR

The Department of Water Supply will be increasing withdrawals from the existing Wailuku well and tunnel sources from 15.1 MGD to 18.0 MGD. This represents 85 percent of the sustainable yield of the Iao Aquifer source, supplemented by an additional 2.0 MGD from high level water.

To meet a portion of the expected demand, additional wells, with a pumped capacity of 6 MGD, are planned for the Waihee Aquifer System (Appendix Figure 18). Although the aquifer's sustainable yield is uncertain (nominally stated to be 8 MGD), current plans call for an average pumping rate of 4 MGD.

An agricultural developer within the Waihee boundary plans a groundwater withdrawal of 0.2 MGD.

5.2.3 CENTRAL SECTOR

The Central Sector, with its high salt content, is largely used as a source for agricultural water and no domestic water development are planned. Both the Wailea and Makena resort area plan to install

several wells for golf course use. New withdrawals are expected to be an additional 2 MGD.

5.2.4 KOOLAU SECTOR

The Koolau Sector, with a potential potable sustainable yield of 186 MGD of groundwater, is the largest single source of future water for Maui Island. This sector has an additional non-potable potential of 16 MGD. Current potable withdrawals from this aquifer total about .1 MGD.

Since the Wailuku Sector does not have sufficient water to meet the next 20 years' development, plans call for development of the Koolau aquifer including a transmission line and a well field of about 10.0 MGD capacity (Appendix Figure 19). No sites have been identified yet. The Department of Water also plans to install a well with a .5 MGD capacity in Haiku (Appendix Figure 20).

5.2.5 KAHIKINUI SECTOR

No changes are planned for the Kahikinui Sector.

5.2.6 HANA SECTOR

The Department of Water Supply is considering the installation of a small well at or near Koali, Hana to replace an existing small surface water system. This well would have a .1 to .2 MGD capacity. The total groundwater aquifer capacity of Hana has been estimated at 133 MGD. Total installed capacity, today and projected for the next 20 years, is less than 1 MGD.

6.0 SUMMARY AND CONCLUSIONS

There does not appear to be any danger of over-withdrawal of any of the Island's aquifers if plans as discussed are followed.

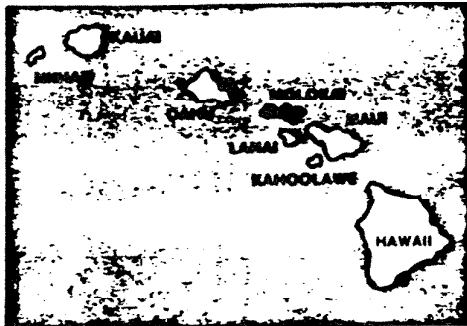
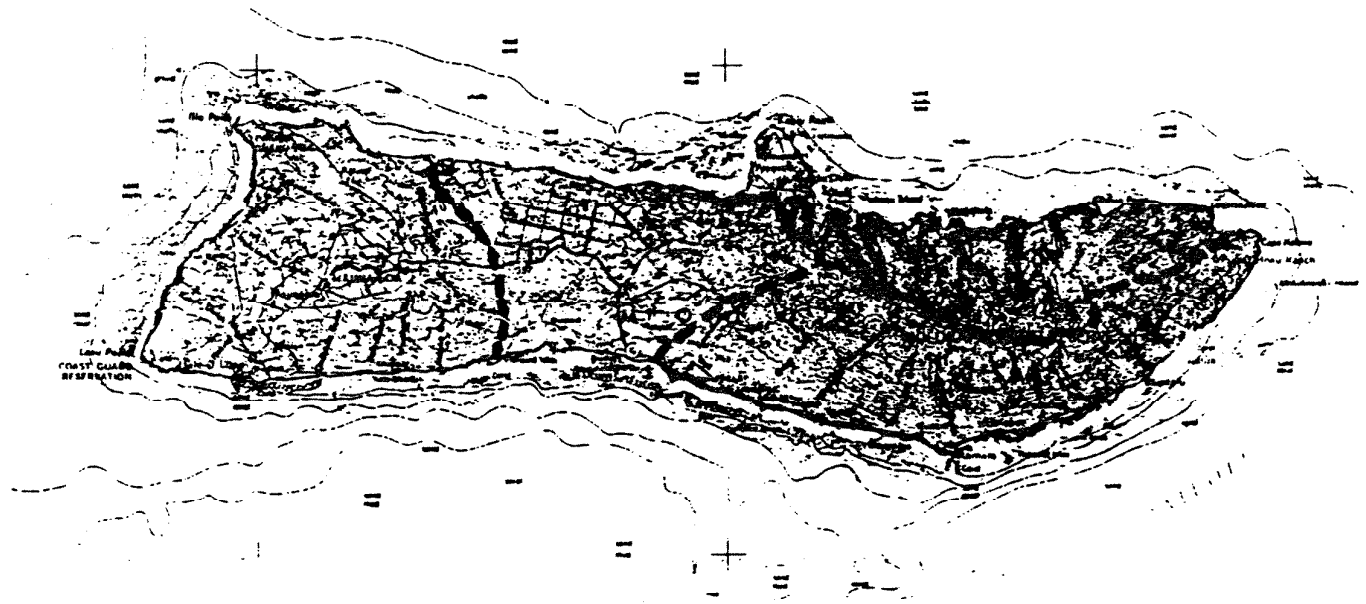
Proposals for water source development on Maui Island include a total new surface source withdrawal of about 26.3 MGD with most of that increase coming from the existing and developed surface water sources of Wailuku Agribusiness.

This summary plan and the technical references should be used as a guide for future water source planning and development.

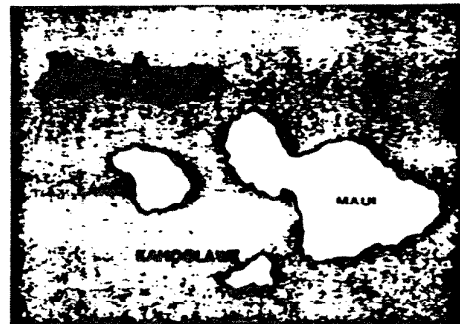
The Maui Water Use and Development Plan must be flexible to accommodate changing community needs, as updated every five to 10 years in the Community Plans. This Plan should be updated either concurrently or subsequently to reflect significant change in community plans and direction.

MOLOKAI

The Molokai section of the Executive Summary was amended in July 1990. Bracketed portions are deletions, while underlined portions are additions.



STATE OF HAWAII



MAUI COUNTY

ISLAND OF MOLOKAI

1.0 INTRODUCTION

Molokai has abundant undeveloped water resources on the east end of the island, and potential agricultural, housing and visitor industry development on the dry west end. Most of the population resides in or around the town of Kaunakakai, on the south central coast of the island. These three factors are among several considerations for the planning of Molokai water systems.

On Molokai, there are two state water systems, the Molokai Irrigation System and the Department of Hawaiian Home Lands (DHHL), four county systems at Ualapue, Kaunakakai, Kalae and Halawa, and four private systems, Kukui (Molokai) Inc., Molokai Ranch, Kualapuu and Kawela Plantation. The National Park Service also operates a deep well system in Waihanau Valley which provides approximately .1 MGD of potable water to Kalaupapa. These systems are generally isolated from each other with no provisions for interconnection.

Molokai's population is small - 6,600 people - and growing slowly. In the last decade, the population grew from 6,049 to the present figure, an annual rate of 1.1 percent per year. This slow population growth rate is reflective of the community's desires for controlled growth to the extent that it does not infringe upon the traditional social, economic and

environmental qualities of the island as stated in the Molokai Community Plan.

1.1 SURFACE WATER SYSTEMS

The majority of water used in the United States today comes from surface water systems - lakes, rivers, streams and other forms of water available at or near the surface of the land. Surface water represents slightly more than half the water presently used on Molokai. Surface water is in use in the central, northeast and southeast sectors, totaling about 5.05 MGD. The bulk of that use, 4.84 MGD, is in the Northeast Sector.

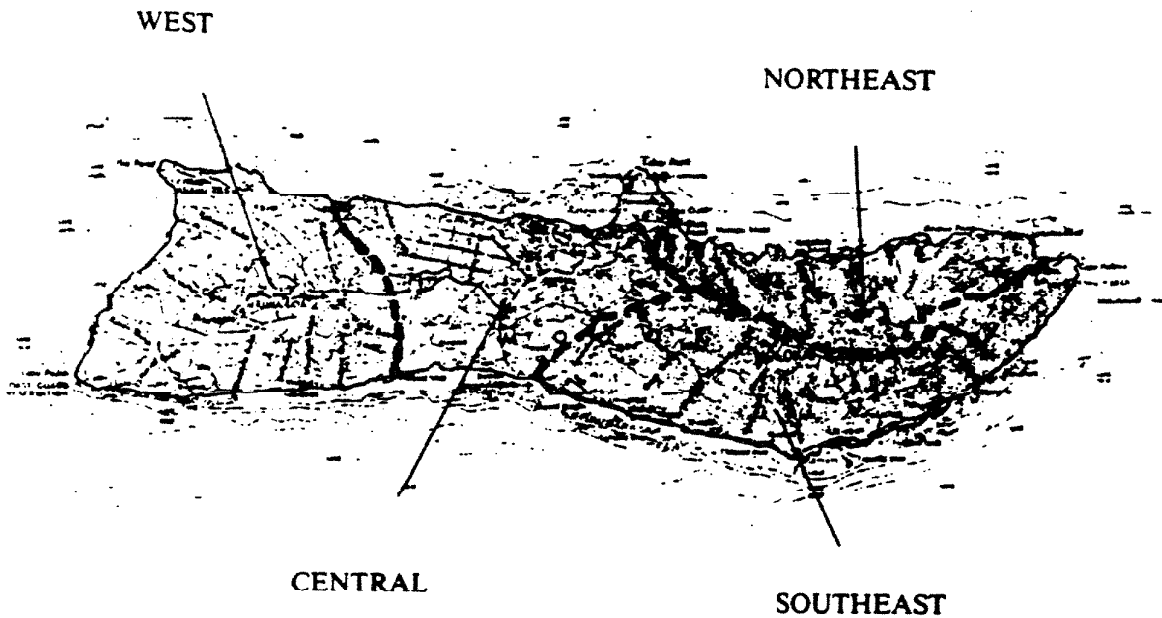
1.2 GROUNDWATER SYSTEMS

Groundwater comes from wells and tunnels deep below the surface. Groundwater sources do not show any increase in turbidity or bacterial counts when it rains. A total of 4.7 MGD of groundwater is presently used on Molokai and there is an estimated potential for as much as 83 MGD if all sources of groundwater are fully utilized.

2.0 WATER RESOURCES INVENTORY

Molokai is divided into four aquifer sectors made up of several aquifer systems. Each sector is believed to operate independently of the others. The sectors, as illustrated on Plate 11, are:

ISLAND OF MOLOKAI
AQUIFER SECTORS



Central	<u>0.0</u>	5.3	<u>*5.3</u>
Northeast	4.8	2.7	7.5
Southeast	<u>0.0</u>	1.0	1.0
West			
TOTAL	4.8	9.0	13.8

(1.25 MGD), Molokai Ranch (.85 MGD), Kukui Molokai, Inc. (1.70 MGD) and Alpha U.S.A. (0.00 MGD). These estimated withdrawals are not prescribed allocations.

The major water users who are currently relying on the Kualapuu Aquifer as a source have projected water needs which significantly exceed the aquifer's estimated capacity, and it is anticipated that other sources will have to be developed. These source options have not been specifically identified, but may include the development of other aquifers, surface water sources and/or desalinization facilities.

* The above 5.3 figure for water withdrawn from the Central Aquifer Sector by the year 2010 is based on the 5 to 6 MGD estimate of the sustainable yield for the Kualapuu Aquifer by the state geologist. The figure assumes the following approximate withdrawals by the six potential large-scale users of water on Moloka'i: DHHL (1.50 MGD), County Department of Water Supply

AQUIFER SECTOR	ESTIMATED SUSTAINABLE YIELD
Central Aquifer System	**11
Northeast Aquifer System	44
Southeast Aquifer System	24
West Aquifer System	*4
TOTAL:	83

- * 4 MGD all brackish
- ** 4 MGD estimated to be brackish

2.1 SURFACE WATER RESOURCES INVENTORY

The State Water Commission is responsible for providing an inventory of surface waters and recommendations for excedent levels (the amount of water which can be taken from the stream). When this data is available it will be incorporated in the next issue of the Water Use and Development Plan. The Maui County use of surface water for domestic purposes is quantified and included in the interim instream standards. For the purposes of this report, it is assumed that the current use is equal to the excedent levels. This is consistent with the interim instream flow standards used by the Water Commission. Discussion on this topic is deferred.

2.2 GROUNDWATER RESOURCES INVENTORY

According to data provided by the State's geologist, there is an estimated 83 MGD of potential capacity (Plate 12) in the four aquifer sectors. This estimated potential has not been validated by test wells and has

not been adjusted for recharge. The estimated available groundwater resources are:

Central Sector	11 MGD
Northeast Sector	44 MGD
Southeast Sector	24 MGD
West Sector	4 MGD
TOTAL:	*83 MGD

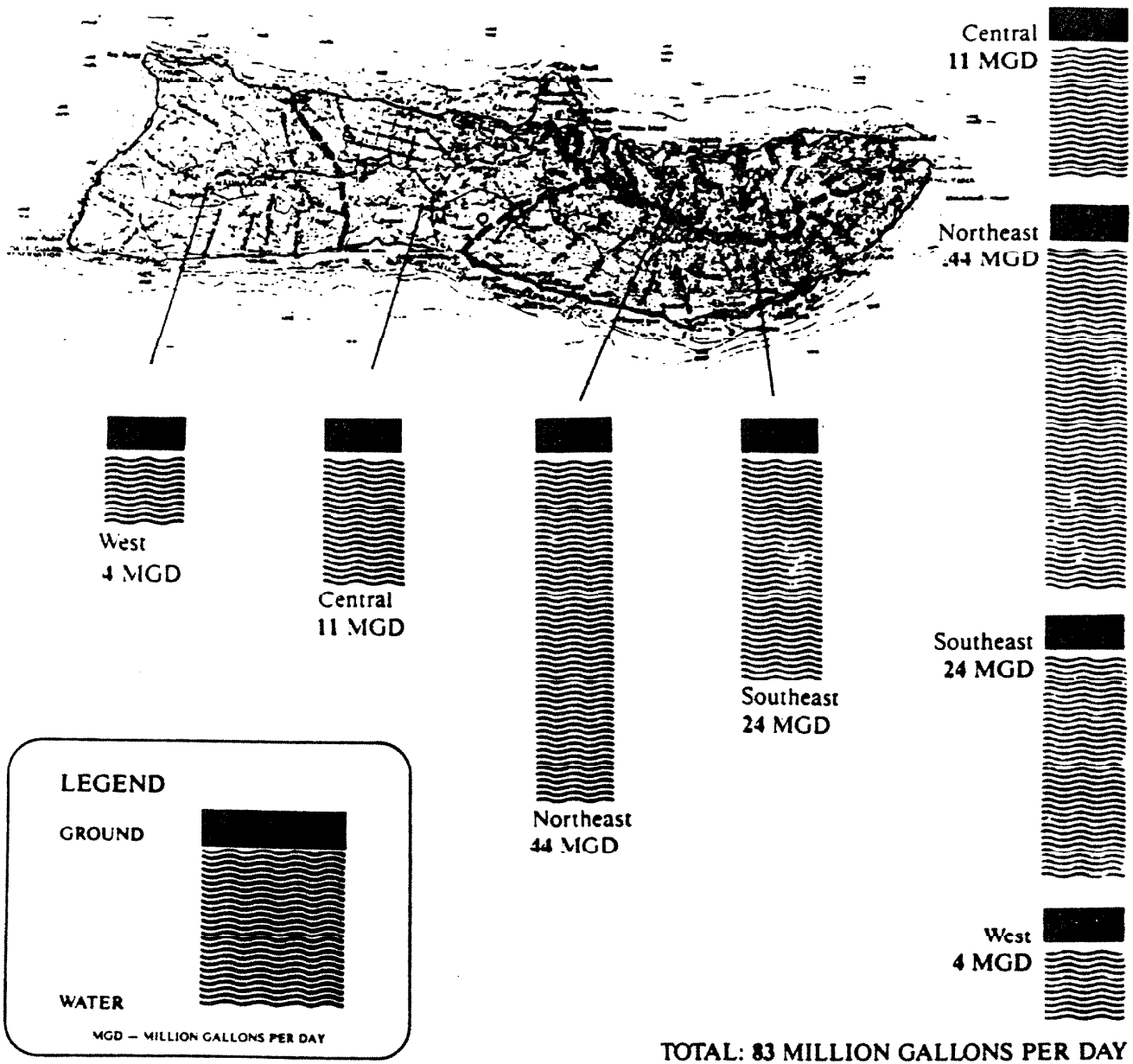
* Actual water available for development may differ significantly from the estimated numbers. Included in this total is approximately 8 MGD of non-potable (brackish) water, which includes 4 MGD estimated for the central sector and all 4 MGD estimated for the west sector.

3.0 WATER USE INVENTORY

For the purposes of this report, there are only two kinds of water - surface and ground. Surface water, as mentioned earlier, is any water which shows influence of weather or other events on the surface. Groundwater is everything else. Water is considered "used" in the sector where it originates, even though it may actually be used in another sector.

AQUIFER SECTOR	1988		TOTAL
	SURFACE	GROUND	
Central	0.1	1.1	1.2
Northeast	4.8	2.7	7.5
Southeast	0.1	0.9	1.0
West			
TOTAL	5.0	4.7	9.7

ISLAND OF MOLOKAI 1988 POTENTIAL GROUND WATER SUSTAINABLE YIELD



3.1 SURFACE WATER USE INVENTORY

The water used (withdrawn) in each sector (Plate 13) is summarized below:

Central Sector	0.1 MGD
Northeast Sector	4.84 MGD
Southeast Sector	0.11 MGD
West Sector	0.0 MGD
TOTAL:	5.05 MGD

3.1.1 CENTRAL SECTOR

The Central Sector includes the communities of Hoolehua, Maunawainui and Kualapuu. Both Maunawainui and Kualapuu use surface water to meet part of their needs for domestic service. Kualapuu is also supplied by Well #17, which is currently owned by Kukui (Molokai) Inc. The table below identifies the surface water users and usage in this sector:

USER	DAILY AVERAGE (MGD)
Kalae	0.03
Maunawainui	0.04
Kualapuu	0.03
TOTAL:	0.10

3.1.2 NORTHEAST SECTOR

USER	DAILY AVERAGE (MGD)
Kaunakakai	0.37
Maunaloa	0.04
Molokai Irrigation System	4.43
TOTAL:	4.84

3.1.3 SOUTHEAST SECTOR

USER	DAILY AVERAGE (MGD)
Maunaloa	0.08
Kualapuu	0.03
TOTAL:	0.11

3.1.4 WEST SECTOR

No surface water withdrawals are recorded for this sector.

3.2 GROUNDWATER USE INVENTORY

The water used (withdrawn) in each sector (Plate 14) is:

Central Sector	1.06 MGD
Northeast Sector	*2.70 MGD
Southeast Sector	0.92 MGD
West Sector	0.00 MGD
TOTAL:	4.68 MGD

* 2.70 is well water withdrawn from the MIS wells in Waikolu Valley. This potable ground water is mixed with the surface water from Waikolu Valley and used to service the agricultural demands of the MIS.

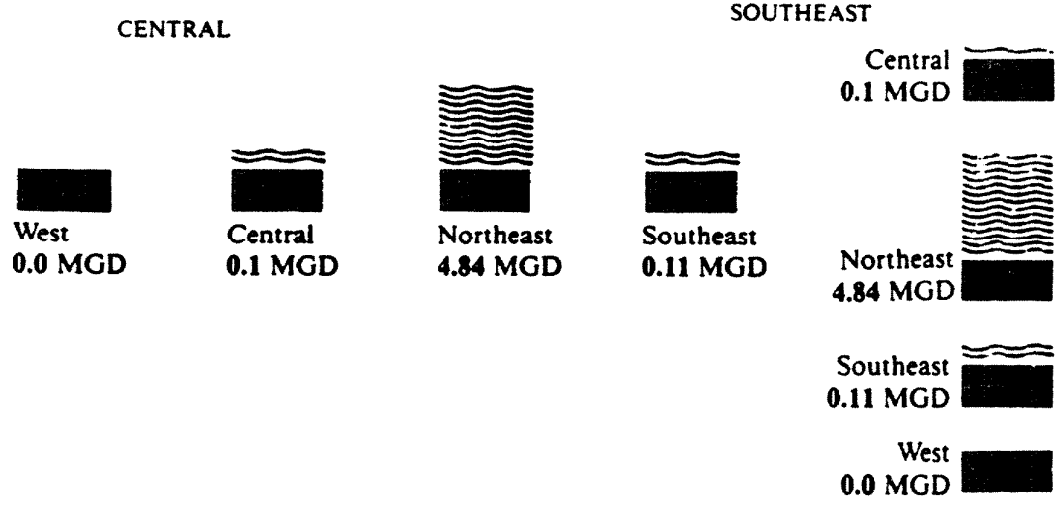
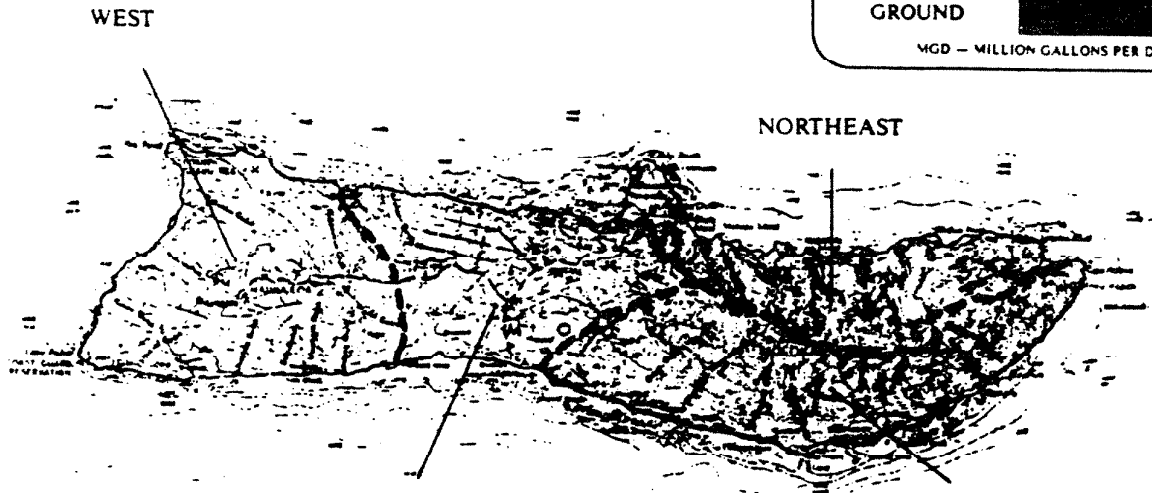
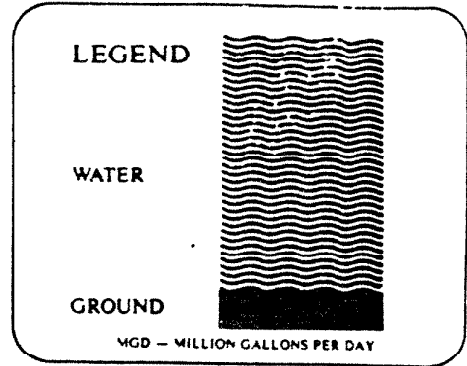
3.2.1 CENTRAL SECTOR

USER	DAILY AVERAGE (MGD)
Kualapuu	0.06
Kukui (Molokai), Inc.	0.60
DHHL	0.40
TOTAL:	1.06

3.2.2 NORTHEAST SECTOR

USER	DAILY AVERAGE (MGD)
Molokai Irrigation System	2.70
TOTAL:	2.70


ISLAND OF MOLOKAI 1988 SURFACE WATER USE INVENTORY




TOTAL: 5.05 MILLION GALLONS PER DAY

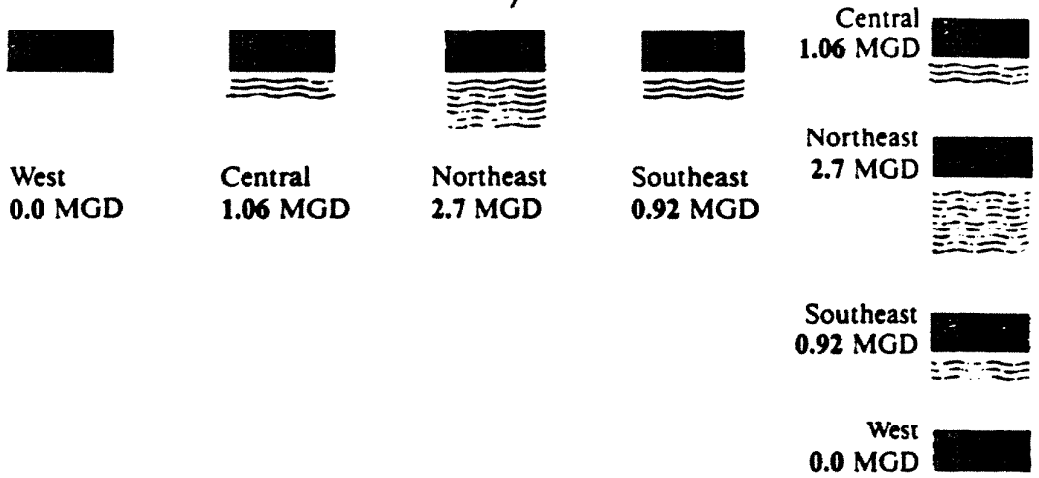
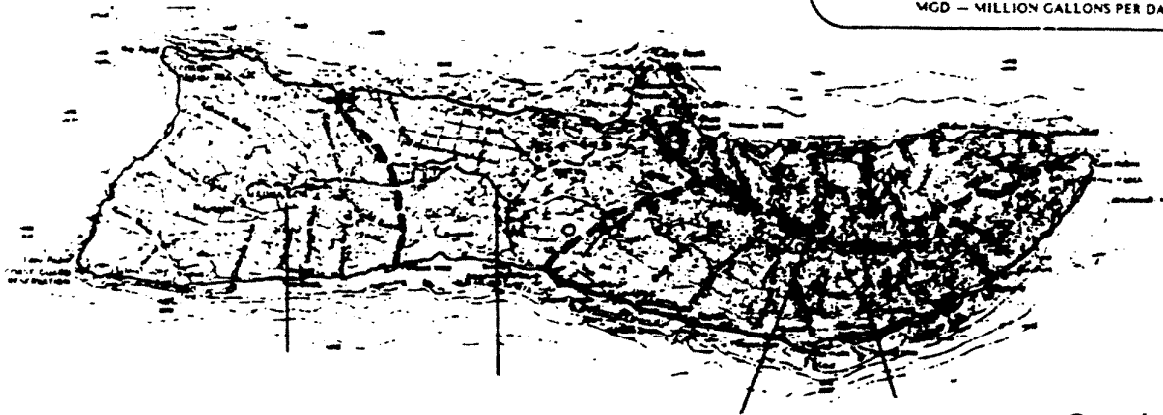
ISLAND OF MOLOKAI 1988 GROUND WATER USE INVENTORY

LEGEND

GROUND 

WATER 

MGD — MILLION GALLONS PER DAY



TOTAL: 4.68 MILLION GALLONS PER DAY

3.2.3 SOUTHEAST SECTOR

USER	DAILY AVERAGE (MGD)
Ualapue	0.18
Kawela	0.32
Kawela Plantation	0.16
Kamalo Ranch	0.26
TOTAL:	0.92

3.2.4 WEST SECTOR

No groundwater withdrawals are recorded for this sector.

4.0 COMMUNITY PLAN

Unlike Maui, the entire island of Molokai is represented by one Community Plan. The approved community plan for Molokai represents the community's best effort to guide the direction of growth up until the year 2000. The County's Department of Water Supply, the County's Planning Department and other members of the Water Code Task Force used the Molokai community plan as a guideline in developing projections for future use.

The community plans did not address the water questions directly and only include the 20 years from 1980 to 2000. The Water Use and Development Plan covers the 20 years from 1990 to 2010.

The Molokai community plan includes total land and potential development in excess of the year 2000. For the purpose of this report, it was assumed that population growth would continue at the rate suggested in the community plan. If Department of Water records suggest otherwise, water use growth rates were used to project potential long-term consumption.

The Molokai community plan projects a population of 10,600 in the year 2000. Based on the 1988 population of 6,600, this requires a population growth rate of 4 percent, compared to the growth rate in the past decade which average 1.1 percent per year. Water consumption has grown at a rate of 1.6 percent per year.

4.1 KALUAKOI

The Kaluakoi Resort area is comprised of approximately 6,700 acres. Approximately 5,000 acres is owned by Kukui (Molokai), Inc. (will require substantially increased water) if build-out occurs. Kukui projects the resort's use will increase from .6 MGD (two-thirds of which is currently required to irrigate its golf courses) to about (2.0) 3.0 MGD by the year 2010. Kukui is currently reevaluating options for the development and use of its land, but has not presented its new plan to support its projected water needs.

Water drawn from the Kualapuu Aquifer is presently transported from Kukui's Well #17 to the Kaluakoi resort via MIS pipeline. Kaluakoi is required by contract to be off the MIS system. In order to accomplish this, a major new pipeline extending from its Well #17 to the west-end is required. This pipeline, if designed to provide additional capacity for other users, can provide the basis for a conceptually proposed integrated Molokai water system, which is more fully described in Section 5.2.1. The projected water requirements presented above, are presented for planning purposes only and are not intended in anyway, to either modify or supersede the Molokai Community Plan.

4.2 DEPARTMENT OF WATER SUPPLY

The Department of Water Supply expects water use in the Kawela-Kaunakakai Water System to increase from the present 0.69 MGD to about 1.6 MGD by the year 2010. To meet [this] its projected demand, the Department [is planning to install] has drilled an [additional] new well in the Kualapuu aquifer, increasing DWS withdrawal capability from the present 0.0 to 1.25 MGD. Due to slow growth in other areas served by the DWS and the existing source (capacity) capacities for those areas, no additional sources are currently planned for the service areas of Kalae, Halawa, and Ualapue. DWS has tentative plans to drill another well in the Kualapuu Aquifer for back-up purposes.

4.3 MOLOKAI RANCH

Molokai Ranch has plans for several developments in the next 20 years. At Maunaloa, the site of a proposed county housing project, water consumption is expected to increase from the present .12 MGD to about .28 MGD in 2010. The water is proposed to come from the Kualapuu Aquifer.

Molokai Ranch also plans for development at Kualapuu (a 40-unit residential subdivision mauka of the Del Monte office.) Such (growth) development is expected to increase usage to (.18) .25 MGD by year 2010. The water [will also] is proposed to come from the Kualapuu Aquifer.

[Other development proposals by Molokai Ranch include 80 lots at Pun Kokea, Kipu, an industrial development at Maunawainui and more aggressive use of the ranch lands. The first two developments propose to obtain their water via purchases from the

DHHL, also using water from the Kualapuu Aquifer.] (In addition.) Molokai Ranch has current development proposals for the Kipu and Maunawainui areas, and it is proposed that small increase in water demand for these projects can be handled by the purchase of water from DHHL. However, DHHL has suggested that alternative water sources for these projects be developed because DHHL may not be able to service them in the future from its system.

In addition, the new owners of Molokai Ranch are re-evaluating options for development and use of their land, which consists of approximately 52,000 acres. [for other water-intensive applications.] [These new requirements are not yet quantified and will be incorporated in a later issue of this plan.] They are projecting an estimated need for approximately .75 MGD of additional potable water within the next 3 years, for the Ranch's current and proposed projects, and a need for as much as 5.0 MGD of non-brackish water by the year 2010 if plans are developed to the ultimate. The owners estimate that a portion of the 5.0 MGD may come from the expansion of its existing surface water system. However, no detailed plans have been made available by the new Ranch owners to support their projected future water needs. The projected water requirements presented above, are presented for planning purposes only and are not intended in anyway, to either modify or supersede the Molokai Community Plan.

[4.4] 4.5 DEPARTMENT OF HAWAIIAN HOME LANDS

The Department of Hawaiian Home Lands [plans] does not have any current plans to expand its water sources. [in the next 20 years.] The Department has approximately

25,398 acres of land on Molokai and currently provides water to Hoolehua, Kalae and Kalamaula. The Kalae area is serviced from the DHHL potable system. For the Hoolehua area, agricultural water is provided from the MIS system and potable water from the DHHL system. For the Kalamaula area, potable water is provided by the DHHL system, but there is no system to deliver agricultural water to the area.

The primary sources for the DHHL potable system are two deep wells, with a capacity of 1.7 MGD. It currently has a demand of between .3 and .4 MGD. The projected demand in year 2010 is a minimum of 1.5 MGD for domestic use. (Based on current projections, DHHL has not expressed any need for additional domestic source capacity. The expected usage will grow from the present .4 MGD to a minimum of 1.5 MGD.) This is within the present capacity of the DHHL domestic system. DHHL has indicated that if another source of water is not available to supply the irrigation needs for Kalamaula, its projected needs from the Kualapuu Aquifer will increase from a minimum of 1.5 MGD to a minimum of 3.0 MGD.

Agricultural usage for DHHL is projected to increase from the present 3.5 MGD to 7.29 MGD by the year 2010. The latter figure includes the minimum agricultural water estimate of 1.5 MGD for Kalamaula. Since [we do not have] there are no clear directions on the source of that water (surface or ground) [or any knowledge of the aquifer it will come from], the additional agricultural water has not been included in our projections. However, any rights of the Hawaiian Home Lands Commission to water, [pursuant] pursuant to the Hawaiian Home L[A]nds Commission

Act will be preserved.

Based on the federal origin of Hawaiian home lands program (Congressional Act of July 9, 1921, c 42, 42 Sta 108 as amended) and the State's fiduciary obligation to native Hawaiians under Section 4 of the Admissions Act (Congressional Act of March 18, 1959, Pub L. 86-3, 73 Stat 4), the DHHL has the right consistent with Section 221 as amended. This right to water, guaranteed under the State Constitution (Congressional Act of July 9, 1921, c42, 42 Sta 108 as amended), is acknowledged in Section 174C-101 of the State Water Code.

[4.5] 4.6 MOLOKAI IRRIGATION SYSTEM

The Molokai Irrigation System (MIS), built by the State and funded with State and Federal funds, was built exclusively for agriculture. The balance of the federal loan has been paid off by the state. The present system has an estimated yield from well and tunnel sources totaling 7.5 MGD. Operated by [DOWALD (Division of Water and Land Development, Department of Land and Natural Resources) the Department of Agriculture (DOA), there are plans to increase the capacity of the system. Additional wells to supplement the three existing Waikolu Valley wells are planned by DOA[DOWALD]. DOA[DOWALD] has yet to provide a schedule of source development projects or [and DOA,] its estimate of needed additional water. The MIS is subject to a preference to the Hawaiian Homes Commission and lessees of the Act pursuant to Section 168-4 HRS (See Appendix B). An additional .37 MGD will also be available for the MIS when the Department of Water Supply places the new Kualapuu-Kaunakakai well in operation.

[4.6] 4.5 ALPHA U.S.A.

[This company] Alpha U.S.A. has purchased [over 6,000 acres] approximately 6,300 acres on the west end of Molokai. Its property is adjacent to [Kaluakoi] the Kaluakoi resort and Molokai Ranch land. This land is currently zoned agricultural as is the surrounding Ranch land and 4,500 acres of the Kaluakoi resort, and has no water consumption. [Alpha U.S.A. has not provided definite plans for this area.] [Potential consumption could be as high as one to two million gallons per day.] [Water and other requirements will be included when available.] Alpha projects that its water needs will be approximately 2.0 MGD by the year 2010. Alpha U.S.A. is currently working on a master development plan for its property. However, it has presented no detailed plans to support its projected future water needs. The projected water requirements presented above, are presented for planning purposes only and are not intended in anyway to modify or supersede the Molokai Community Plan.

5.0 WATER DEVELOPMENT PLANS

There are six potential large-scale users of water on Molokai: DHHL, Molokai Irrigation System, Department of Water Supply, Molokai Ranch, Kukui (Molokai) Inc. and Alpha U.S.A.

Each of these users is at a different stage in their individual water development plans. In the cases of Kukui (Molokai) Inc, Alpha U.S.A. and Molokai Ranch, there are major uncertainties in their future requirements due to recent changes in ownership.

5.1 SURFACE WATER DEVELOPMENT PLANS

There are no plans for development of additional surface water resources on Molokai. Present plans are to change all surface domestic water systems to groundwater sources. This will result in a total decrease of surface water use for domestic applications from an average of 5.05 MGD to 4.8 MGD. Any surface water made available will probably be put to agricultural use. The table below and Plate 15 summarize the changes:

CHANGES IN MOLOKAI SURFACE WATER WITHDRAWALS	
Central Sector:	- 0.10 MGD
Northeast Sector:	- 0.41 MGD
Southeast Sector:	- 0.08 MGD
West Sector:	- 0.00 MGD
TOTAL:	-0.62 MGD

5.2 GROUNDWATER DEVELOPMENT PLANS

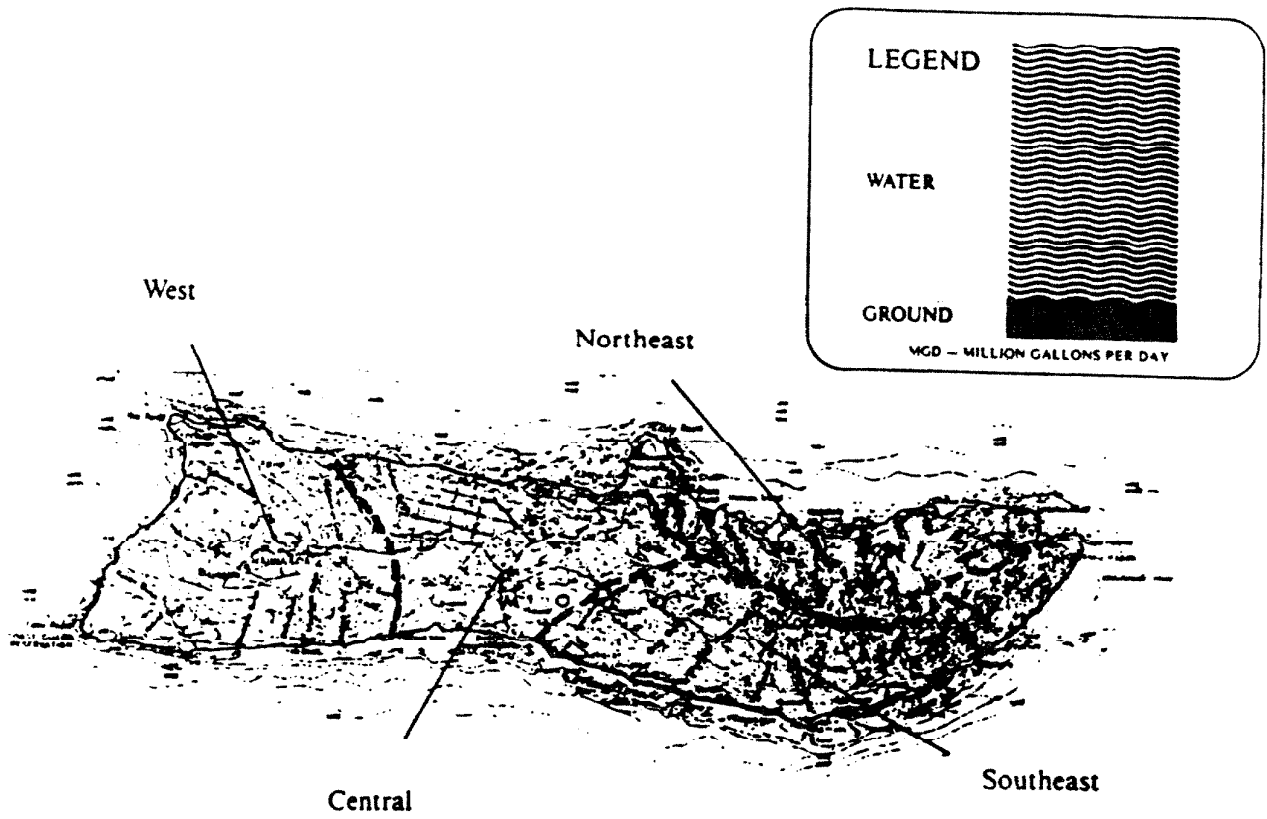
New groundwater sources are planned for the Northeast Sector aquifers. None are planned for the central, southeast or west sectors, although some increase in use of existing sources will take place in the Southeast. The proposed changes are summarized below and on Plate 16:

CHANGES IN MOLOKAI GROUNDWATER WITHDRAWALS	
Central Sector:	5.60 MGD
Northeast Sector:	0.00 MGD
Southeast Sector:	0.05 MGD
West Sector:	0.00 MGD
TOTAL:	5.65 MGD

5.2.1 CENTRAL SECTOR

The major changes in use in the Central

ISLAND OF MOLOKAI YEAR 2010 SURFACE WATER USE



TOTAL 4.8 MILLION GALLONS PER DAY

ISLAND OF MOLOKAI YEAR 2010 GROUND WATER USE



West
0.0 MGD

Central
5.31 MGD

Northeast
2.7 MGD

Southeast
0.97 MGD


Central
5.31 MGD

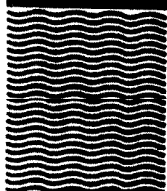
Northeast
2.7 MGD

Southeast
0.97 MGD

West
0.0 MGD

LEGEND

GROUND 

WATER 

MGD — MILLION GALLONS PER DAY

TOTAL: 8.98 MILLION GALLONS PER DAY

Sector are:

USER CHANGE IN USE

Department of
Hawaiian Home Lands 1.10 MGD
Dept. of Water Supply 1.25 MGD
Molokai Ranch 0.80 MGD
Kaluakoi Res. 2.40 MGD
TOTAL: 5.55 MGD

The total sustainable yield from the Kualapuu Aquifer is expected to range from 5 to 8 MGD. The total projected withdrawal from the Central Sector is projected at 5.31 MGD. Since Kukui (Molokai, Inc., Molokai Ranch and Alpha U.S.A. are working on development plans, extension of the water system outside the Kualapuu Aquifer is necessary. It appears likely that other aquifers in that sector will need to be tapped to meet estimated demand, unless either surface water development or, desalinization proves to be a viable alternative.

[The Department of Hawaiian Home Lands expects to increase its usage from the present .4 MGD to about 1.5 MGD by the year 2010. Since this is within the present capacity of its system, no new wells are planned to accommodate this increase of 1.1 MGD.]

[The Department of Water Supply presently uses about .37 MGD from the MIS to supply Kaunakakai. This water will be replaced in 1990 with water from a new well at Kualapuu. The Department projects water demand to increase to 1.6 MGD by the year 2010 for the Kawela-Kaunakakai system, up from the present .69 MGD. While the Department has systems at Kaias and Ualupue, no significant increase in these

areas is expected. One additional well will be developed to meet the increased demand in Kaunakakai and to provide adequate backup. This well is tentatively planned for the area behind Kaunakakai.]

[Molokai Ranch expects increases in demand in several of their private systems. The water source for the present Maunaloa system comes from six stream diversions and a tunnel, with a minimum flow of about .11 MGD. To meet the future requirements of Maunaloa, Molokai Ranch proposes to take approximately .95 MGD from the pipeline which will be installed by Kukui (Molokai), Inc. and DHHL to serve Kaluakoi. These uses, already partially supplied from Kaluakoi and DHHL are:

(SYSTEM	PRESENT USE	2010 USE
Maunaloa	.120 MGD	.280 MGD
Kualapuu	.120 MGD	.250 MGD
Kipu	.020 MGD	.094 MGD
Manawainui	.015 MGD	.310 MGD
TOTAL:		.934 MGD]

[The Kaluakoi Corporation was purchased by Kukui (Molokai), Inc. Current consumption at Kaluakoi averages .6 MGD, two-thirds of which is used for golf course irrigation. Projected demand for Kaluakoi

is 2.0 MGD in 2010.)

[Alpha U.S.A., a new corporation, purchased approximately 6,000 acres on the southwest part of the island. Currently, this land is not in use and there is no substantial water consumption. While there may eventually be a large demand for water from these lands, Alpha has not yet formulated any definite plans for either land or water system development.]

DHHL projects that the Kualapuu Aquifer will service its future water demands and has no plans to develop additional sources. Kukui (Molokai), Inc., Molokai Ranch and Alpha U.S.A. currently have no plans to develop additional potable sources. The County tentatively plans to develop an additional well in the Kualapuu Aquifer in the area behind Kaunakakai to meet the increased future demand in Kaunakakai and to provide adequate backup.

Due to the distance between the potential ground water sources and the probable users on the arid west end of Molokai, the Department of Water Supply initiated a study with Molokai Ranch and Kukui (Molokai), Inc. to identify potential cooperation in future water system developments. A preliminary study has identified one conceptual potential pipeline project, extending from central Molokai to the west end. This preliminary concept is called the Molokai Integrated System.

The only current developed source of potable water in central Molokai is the Kualapuu Aquifer, which lies under lands owned by Molokai Ranch and lands owned by DHHL. The current projected water needs by the major water users in central and west Molokai exceed the estimated

sustainable yield of the Kualapuu Aquifer. The sustainable yield is the estimated amount of water that can be safely withdrawn so that the integrity of the aquifer is not compromised.

Therefore, it is recommended that all the prospective major water users in central and west Molokai attempt to work cooperatively together by entering into a negotiations agreement. This would include the County of Maui, DHHL, Kukui (Molokai), Inc., Molokai Ranch, Alpha U.S.A., and a representative selected by the homestead community on Molokai.

The intended purposes of the agreement would include, but not be limited to, a) establishing procedures by which the parties may negotiate the details of the conceptually proposed pipeline (i.e. development strategies, maintenance, ownership, etc.), b) evaluating alternative water source development outside of the Kualapuu Aquifer, and c) reaching a mutual understanding among all the parties as to the priority rights to usage of the water from the Kualapuu Aquifer based on the interpretation of the various state and federal laws as applicable to Native Hawaiian and other water users.

The preliminary study for the conceptually proposed Molokai Integrated System also included a non-potable system, as well as, a potable system. The non-potable system, as tentatively proposed, would draw water from brackish wells drilled south of the airport. This brackish water would be transported through a dedicated pipeline to the West End to serve irrigation needs for that area. The non-potable, or brackish, system is important because the County's Department of Water Supply has emphasized its position of not wanting potable ground

water to be used for golf course irrigation.

5.2.2 NORTHEAST SECTOR

No projects are planned for the Northeast Sector.

5.2.3 SOUTHEAST SECTOR

No projects are planned for the Southeast Sector.

5.2.4 WEST SECTOR

No projects are planned for the West Sector.

6.0 SUMMARY AND CONCLUSIONS

The water systems on Molokai will be undergoing a major transition in the next 20 years. The majority of the water presently used for domestic systems comes from surface sources. By the year 2010, if the plans above are implemented, all domestic water systems will be supplied by groundwater. This implies major changes in the cost structure of all domestic water suppliers. Current supply costs from surface water are relatively low. Future costs for water from deep wells will be much higher for both private and municipal systems.

It is strongly suggested that the major landowners, water users, state and county agencies, and community interest groups coordinate their efforts to develop Molokai's water. There are many water system options at present, and development options as well. The development of meaningful approaches to the selection of

the most appropriate option will depend on the efforts of all elements of the Molokai community.

It is also evident that the projected demand from the Kualapuu Aquifer exceeds that aquifer's sustainable yield, if the geologists' estimates of 5 to 8 MGD are used. Prudent and careful development will be required to ensure that the aquifer's limits are not exceeded. Planning for the future must include contingency plans to develop other sources of water. There is no margin between the estimates of sustainable yield and the projected water demands on the Kualapuu Aquifer.

The long-term estimated sustainable yield for the Island of Molokai is approximately 83 MGD (including about 8 MGD of brackish aquifer). This represents many potential years of water source development for agricultural and domestic purposes.

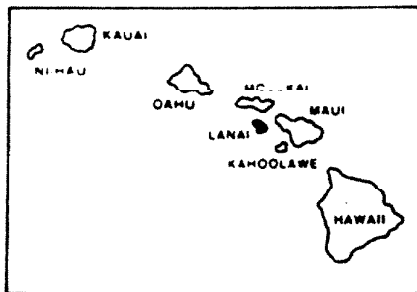
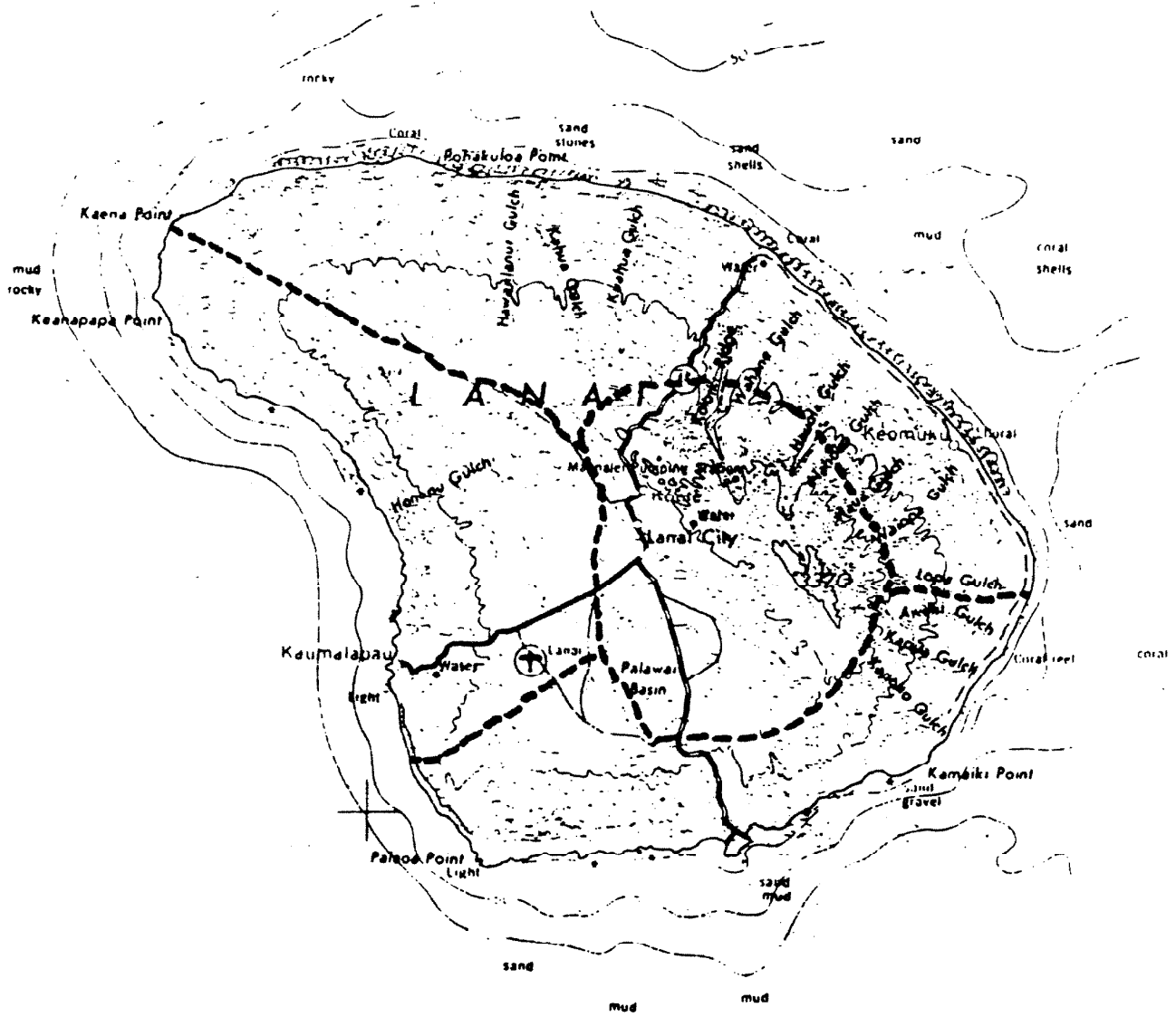
FUTURE ISSUES AND OPPORTUNITIES

The island of Molokai has a rich heritage of native Hawaiian Culture, many square miles of open spaces suitable for many recreational and agricultural pursuits, and large potential water resources. The desire of the people of Molokai to maintain their way of life is paramount to the appropriate application of the goals community plan. The meaningful cooperation of all the parties, major land owners, water users, community interest groups and State and County agencies is required for the people of Molokai to preserve their way of life. The issues relating to water are an important part of the total picture. The resources are there. Are they to be

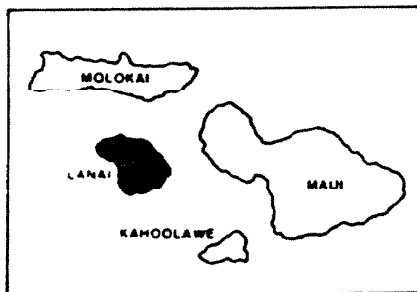
developed, and how? This Water Use and Development Plan has left many of these questions unanswered, because the community has to define the answers first, before an attempt can be made to implement their desires.

As a final note, it is recommended that forest planting on Maunaloa's Mountains for the purpose of water resource management pursuant to the Molokai Community Plan be initiated.

LANAI



STATE OF HAWAII



MAUI COUNTY

ISLAND OF LANAI

1.0 INTRODUCTION

The Island of Lanai has a land area of 90,000 acres (141 square miles), spread somewhat irregularly around the peak of a single volcano. Most of its 2,200 people live in Lanai City on the central plateau just below Lanaihale, the volcanic peak. Centrally located, the community services the pineapple fields that extend over the central plateau.

The remainder of the population is in small communities along the shore. The largest of these surrounds the Kaumalapau barge harbor which handles outgoing pineapple and incoming goods. Along Manele and Hulopoe bays are a small boat harbor and park. Along the eastern windward shore are a few kuleanas and land holdings which make up the two percent of the island not owned by Castle and Cooke, Inc.

Castle and Cooke, Inc. owns and operates the pineapple plantation, one of the world's largest, and is the only major employer on the island. Labor requirements have decreased as the industry has become more mechanized and the population has declined as younger people leave for employment opportunities elsewhere.

1.1 SURFACE WATER SYSTEMS

There are no surface water systems in use on Lanai.

1.2 GROUNDWATER SYSTEMS

Castle and Cooke, Inc. is the only water supplier on the island. It supplies domestic water through the Maunalei system as well as agricultural water for the plantation. As the water purveyor and a registered public utility, Castle and Cooke, Inc. must meet the requirements of the Safe Drinking Water Act. The Maui County Department of Water Supply, though nominally responsible for public water systems, does not have any operations or responsibilities on the Island of Lanai.

2.0 WATER RESOURCES SUMMARY

The island is divided into four aquifer sectors. The Central Sector covers the circular region around Lanaihale. Mahana Sector includes the semi-circular region on the north half of the island. Kaa Sector is the southwest part of the island and Kamao Sector, the southeast (Plate 17). Each sector is divided into several systems. The sectors and their associated systems are:

ISLAND OF LANAI AQUIFER SECTORS



AQUIFER SECTOR	AQUIFER SYSTEM	CLASSIFICATION #
Central	Windward	50101
	Leeward	50102
Mahana	Hauola	50201
	Maunalei	50202
	Paoma	50203
Kaa	Honopu	50301
	Kaunalapau	50302
Kamao	Kealia	50401
	Manele	50402

Central Sector. This aquifer has an estimated sustainable yield of between 6 and 6.2 MGD, according to data provided by two independent studies. Aquifers in the other sectors are brackish (non-potable). The estimated sustainable yields for all the sector are identified below and on Plate 18.

Central	6.0 Million Gallons/Day
Mahana	N/A Million Gallons/Day
Kaa	N/A Million Gallons/Day
Kamao	N/A Million Gallons/Day

TOTAL: 6.0+ Million Gallons/Day

2.1 SURFACE WATER RESOURCES INVENTORY

The State Water Commission is responsible for providing an inventory of the surface waters and recommendations for exceedent levels (the amount of water which can be taken from the stream). The State has yet to provide the County of Maui with the numbers required for long-term planning in this area. The data will be incorporated in the next issue of this plan.

The Maui County use of surface water for domestic purposes is quantified and included in the interim in-stream standards. For the purpose of this report, it is assumed that the current use is equal to exceedent levels. This is consistent with the interim in-stream flow standards used by the Water Commission. Discussion of this topic is deferred.

2.2 GROUNDWATER RESOURCES INVENTORY

The principal potable water on the island comes from a high level aquifer in the

These numbers represent the potential groundwater source unadjusted for recharge. The Central Sector adjustment may need to be made to determine the practical sustainable yield.

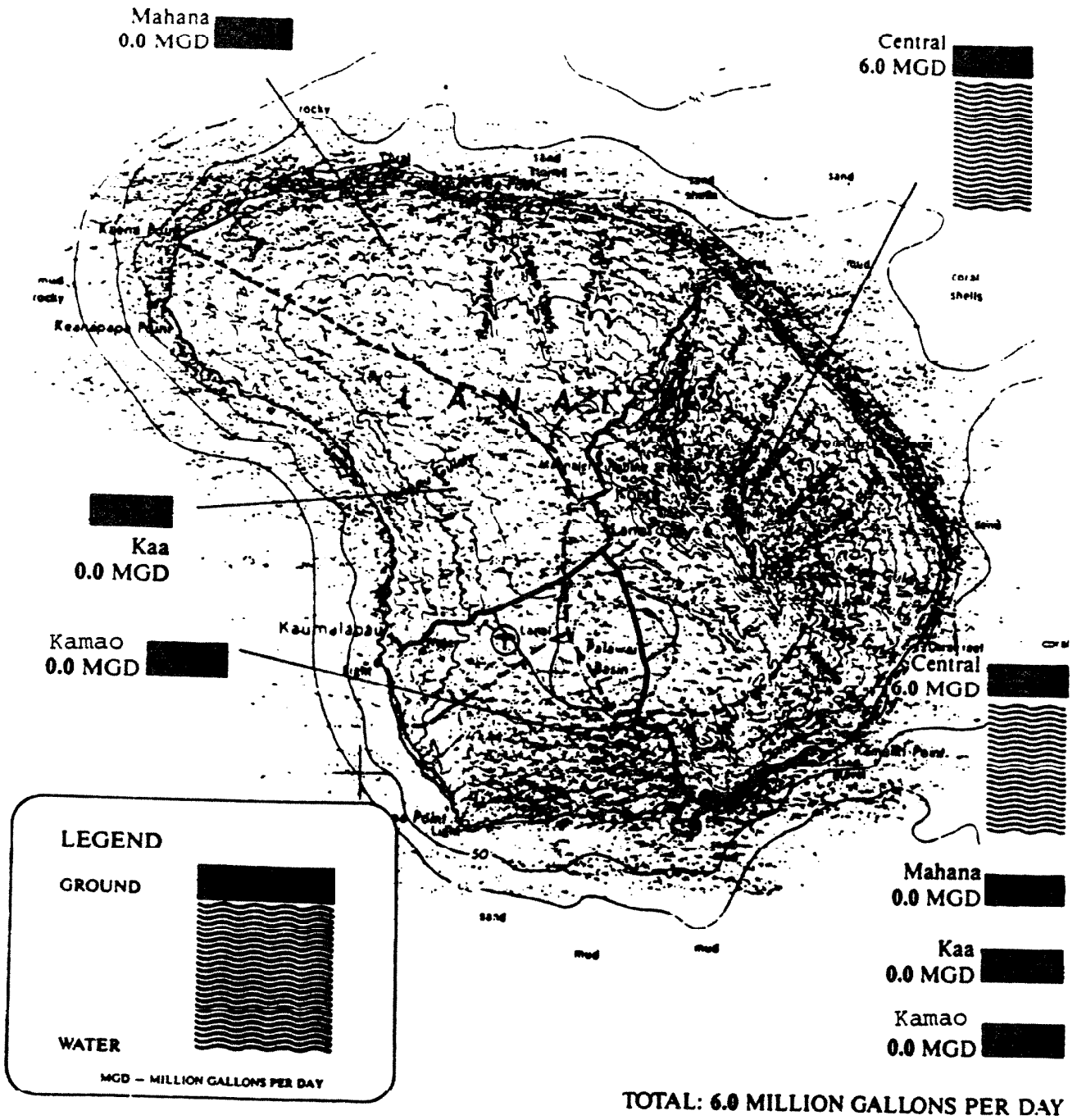
3.0 WATER USE INVENTORY

For the purposes of this report, there are only two kinds of water - surface and groundwater. Surface water, as mentioned earlier, is any water which shows influence of weather or other events on the surface. Groundwater is everything else. Water is considered "used" in the sector where it originates although the water may be actually applied somewhere else. All sources identified in Lanai are presently classified as groundwater.

3.1 SURFACE WATER USE INVENTORY

There are no surface water sources in use on the Island of Lanai.

ISLAND OF LANAI 1987 POTENTIAL GROUND WATER SUSTAINABLE YIELD



3.2 GROUNDWATER USE INVENTORY

The domestic water for Lanai is supplied from the Central high level aquifer from Upper and Lower Tunnels, Shafts #2 and #3. Well #6, also in this aquifer, has been dug and is ready for production. Current domestic and commercial usage is .38 MGD.

Water for pineapple is also supplied from the same Central high level aquifer. Wells #1 through #5 and Shaft #3 are in production and used for irrigation. The current average use is 2.4 MGD.

Total current use is 2.78 MGD, all from the high-level source.

4.0 COMMUNITY PLANS

The two attributes valued most highly by the Lanai residents were:

- 1) the environment (pleasing climate, attractive landscaping, good drinking water and absence of air and water pollution)
- 2) and its social qualities (stable, small town atmosphere, low crime rate, lack of pressure and a healthy environment for children).

The two major problems areas were:

- 1) the island's dependence on one crop (pineapple) with the resulting decline in jobs, the leaving of their children and the high cost of living in a shrinking economy, and

- 2) the serious constraints in basic services of health, education and cultural programs.

Based on these concerns, the community plan emphasizes:

- a. development of tourism as a secondary economic activity,
- b. encouragement of more diversified agriculture,
- c. concentration of any population growth in Lanai City, and
- d. discouragement of special permits in State Agriculture and Rural Districts.

Project districts were to be established in Koale and at Manele Bay.

Based on these original plans, the projected population was expected to reach 4,500 in the year 2000. When the plan was developed in 1980, population had dropped to 2,119. Current population (1988) is 2,200.

The Lanai Company, a subsidiary of Castle and Cooke Ltd., has started construction of resort facilities in the two project districts, Koale and Manele Bay. The projected population growth is similar to that projected in the community plan, with population reaching a level of 4,500 in the year 2005 and 4,800 in year 2010. Most of this population growth will come from new workers at the resort, the return of out-migrant children to Lanai and a reduction in the out-migration rate.

5.0 WATER DEVELOPMENT PLANS

To meet the demands for water resulting from the development of the two resorts, the Lanai Company has projected water usage from the Center high level source as:

Domestic	1.0 MGD
Pineapple	1.8 MGD
Commercial	0.25 MGD
Landscaping:	
Koele Hotel	0.18 MGD
Koele Golf Course	0.25 MGD
Hulopoe	0.0 MGD
Manele Golf Course	0.00 MGD
Manele Bay	0.23 MGD
TOTAL:	3.86 MGD

To meet this increased demand, Wells #6 and #7 have been drilled and are ready to go into production. Wells #8 and #9 are being drilled.

Additional, non-potable sources will be used for landscape watering as below:

Manele Golf Course	0.8 MGD
Community Gardens & Other	0.4 MGD
TOTAL:	1.20 MGD

Well #10 is under construction in Manele as an exploratory well to supply landscape watering in this area.

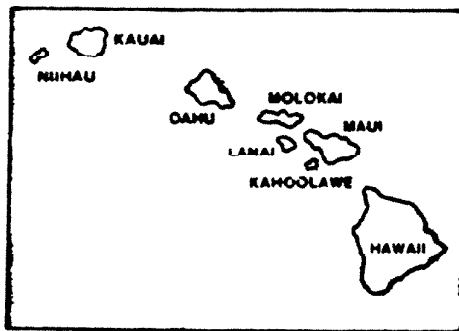
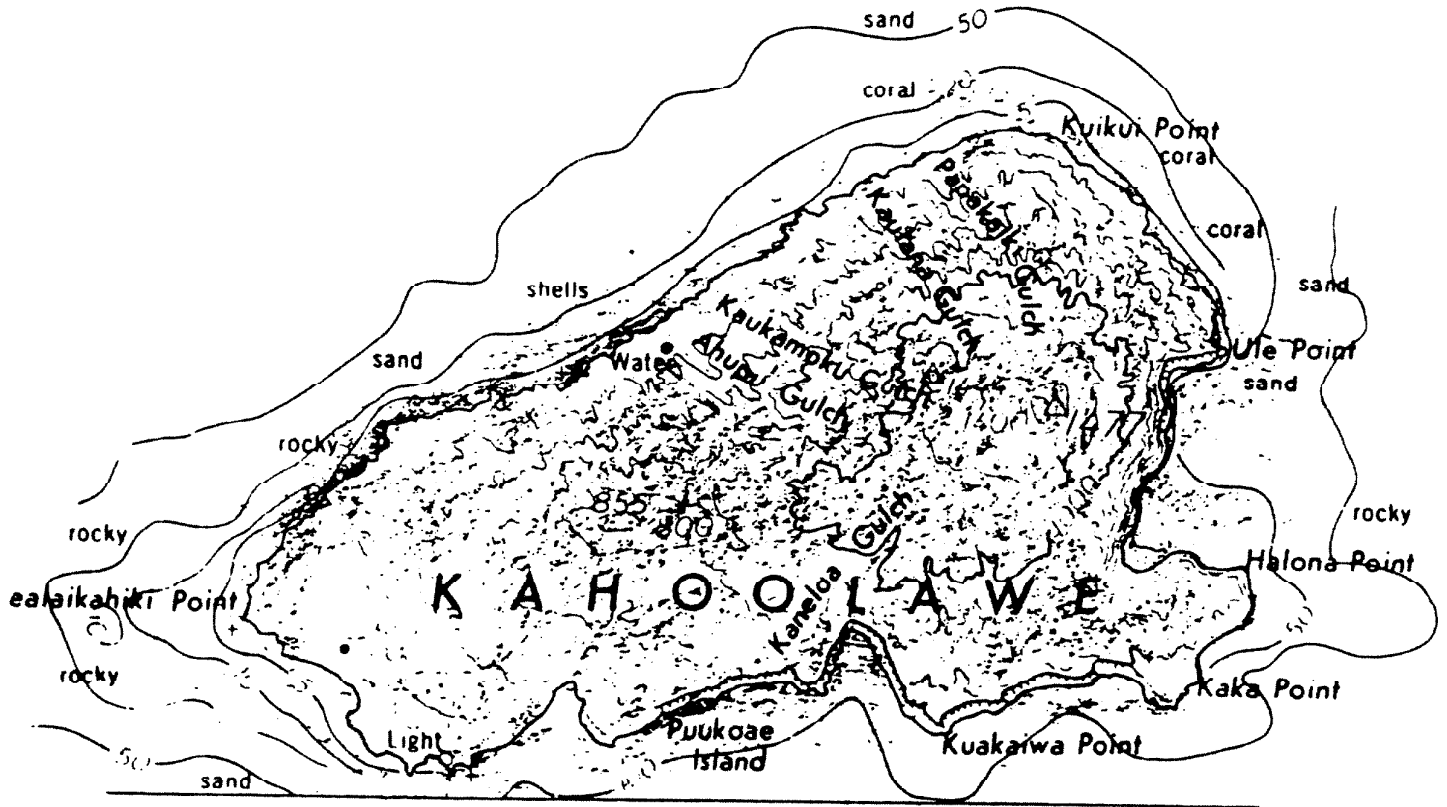
6.0 SUMMARY AND CONCLUSIONS

The plans for development are consistent with the community plan. There appears to be sufficient water to meet the development needs, if the geologist estimates are correct. There are two cautions:

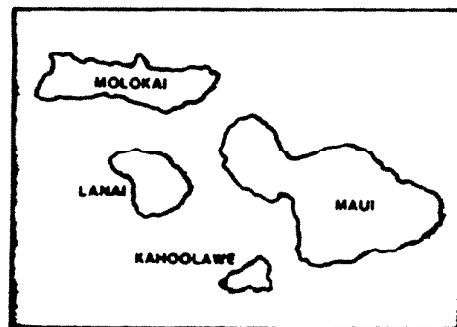
- Geologists numbers are estimates. The actual water available that can be economically developed may differ.
- There is only one potable water aquifer for the island. Extreme caution is suggested to prevent damage to the aquifer or contamination by agricultural chemicals.

Since the projected use totals 64 percent of the total estimated sustainable yield, incremental development of the projects and substitution of non-potable groundwater for potable groundwater is suggested whenever possible.

KAHO'OLAWE



STATE OF HAWAII



MAUI COUNTY

ISLAND OF KAHO'OLAWE

1.0 INTRODUCTION

Kaho'olawe, located approximately seven miles southwest of Maui's Makena, has an area of 28,000 acres (45 square miles) and rises 1,500 feet at its highest point, Moa'ula. The island, which once had an ancient native Hawaiian settlement, was more recently a ranch. Currently uninhabited except for a Navy contingent, the island is used as a target for naval aircraft and ships. It has a very sparse groundcover and recurring erosion.

The entire island is in a State Conservation District, is listed as an Archeological District on the National Register of Historic Places and is a Special Management Area under the Hawai'i Coastal Zone Act. Now under the jurisdiction of the U.S. Navy, joint use and management of the island's resources is provided through a Consent Decree with the Protect Kaho'olawe 'Ohana and a Memorandum of Understanding with the State of Hawai'i.

2.0 WATER RESOURCES SUMMARY

There are no developed water sources on Kaho'olawe. However, there is potential for further exploration. Geologists divide the island into these aquifer sectors:

AQUIFER SECTOR	AQUIFER SYSTEM	CLASSIFI- CATION #
-------------------	-------------------	-----------------------

NOT YET AVAILABLE

2.1 SURFACE WATER RESOURCE INVENTORY

The annual runoff on Kaho'olawe is estimated at 58,300 acre-feet. This corresponds to about 24 inches of rain a year. Historically, surface water catchment served as the primary source of water. Due to the deforestation of the island and extreme sediment loading, surface catchment is not currently feasible.

2.2 GROUNDWATER RESOURCE INVENTORY

There are two types of groundwater on Kaho'olawe - the newly discovered dike impounded source and a historically developed basal source. The actual yield and the quality of the groundwater is not known and needs further investigation.

The basal lens has been used in historic times. It was tapped by wells and became brackish in the early 20th century. Because of the present degraded state of the Kaho'olawe surface environment, surface recharge of the aquifer is very low. Sustainable yield is also probably very low.

The volume of the dike water is estimated between 65,865 and 263,463 acre-feet, or 21 to 86 billion gallons. It may be high in dissolved solids and must be investigated to determine quality, quantity and potential use.

3.0 WATER USE INVENTORY

Nearly all water presently used is imported. Present annual consumption is 344,720 gallons. This water is used by the military (316,000 gallons per year) and by Protect Kaho'olawe 'Ohana (27,920 gallons per year).

4.0 COMMUNITY PLANS

The Community Plan for Kaho'olawe has four general principles:

- a) Preservation of archeological sites
- b) Erosion control and reforestation
- c) Eradication of goats
- d) Return of the island to Maui County control

To fulfill these general principles, there are proposals for clearing areas of unexploded ordinance, building trails to provide access, replanting and

reforestation, and construction of several permanent base camps. The following annual water consumption is anticipated to meet these needs in the next several years:

	Gallons
Base Camp Development	90,000
Hiking Trails/Cultural Use	1,000
Fire Suppression	54,000
Educational/Scientific	1,500
Revegetation	350,000
Military Use	316,800
TOTAL:	813,300

Demand is expected to increase by 25 percent to about one million gallons per year by the end of the 20 year period.

5.0 WATER DEVELOPMENT PLANS

There are four sources of water that can be developed to satisfy the water needs of Kaho'olawe. Each of the four - surface/rain catchment, groundwater, importation and desalinization - can be developed to meet various requirements.

5.1 GROUNDWATER DEVELOPMENT

The program's first stage is the design and implementation of a drilling program to determine the water available from the diked water and the basal aquifer. Estimated cost is \$1,223,800.

5.2 SURFACE/RAIN WATER

The renovation of existing catchments and storage structures at Kuhe'e'ia and Ahupu is suggested. Collection of approximately 120,000 gallons per year is projected. The O'hana has built two demonstration rain catchment/storage facilities with approximately 3,000 gallons capacity. Extensive construction of similar additional facilities is also planned.

5.3 DESALINIZATION

Desalinization of approximately 70,000 gallons per year at the four proposed base camps is also proposed. Estimated unit cost is \$21,500 per camp. Annual operation and maintenance cost is estimated at \$70 per 1,000 gallons.

5.4 IMPORTATION

Water importation is recommended to meet the ongoing water demand for military use. Annual cost to the Navy is approximately \$88,000 or \$280 per 1,000 gallons.

6.0 SUMMARY

The needs of Kaho'olawe can be met with a relatively low level of funding by making use of existing water resources and careful use of pre-existing structures. The island can also provide valuable information on the re-generation of a previously overdrawn and damaged aquifer.

APPENDIX

UPPER KOLA IMPROVEMENTS 35" TRANSMISSION PIPELINE

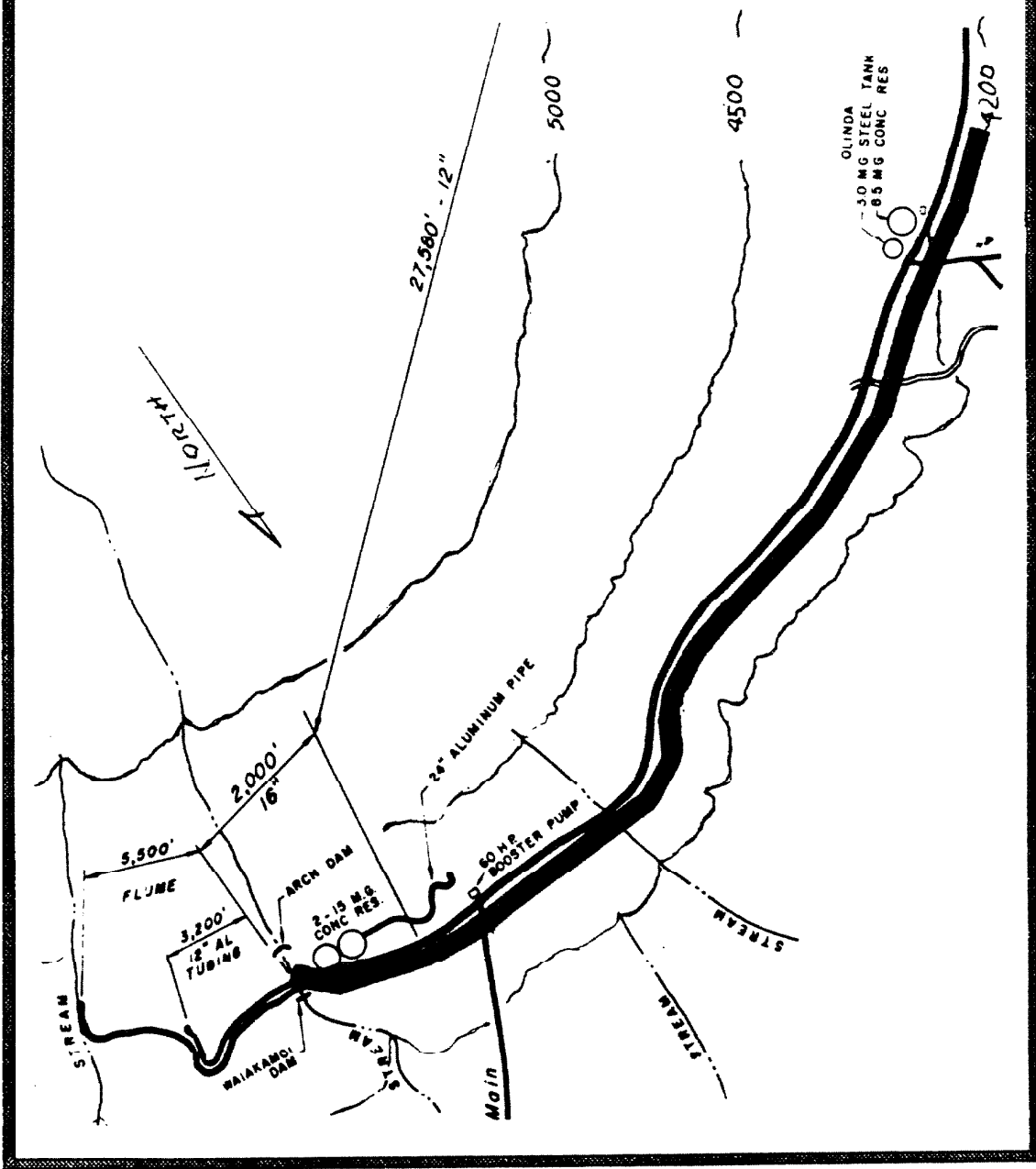


FIGURE 1

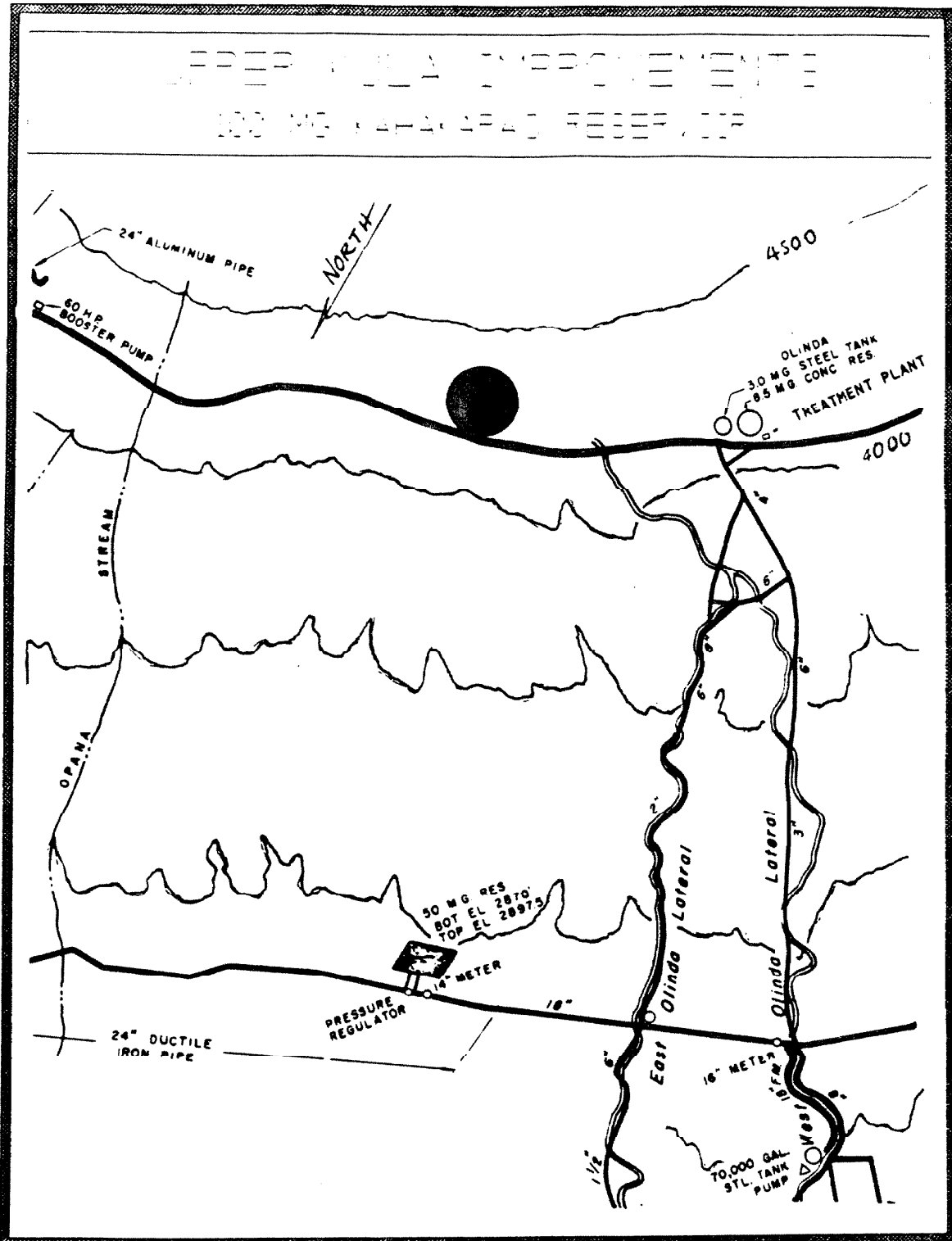


FIGURE 2

UPPER KULA IMPROVEMENTS INTAKES WEST OF WAIAKAMOI

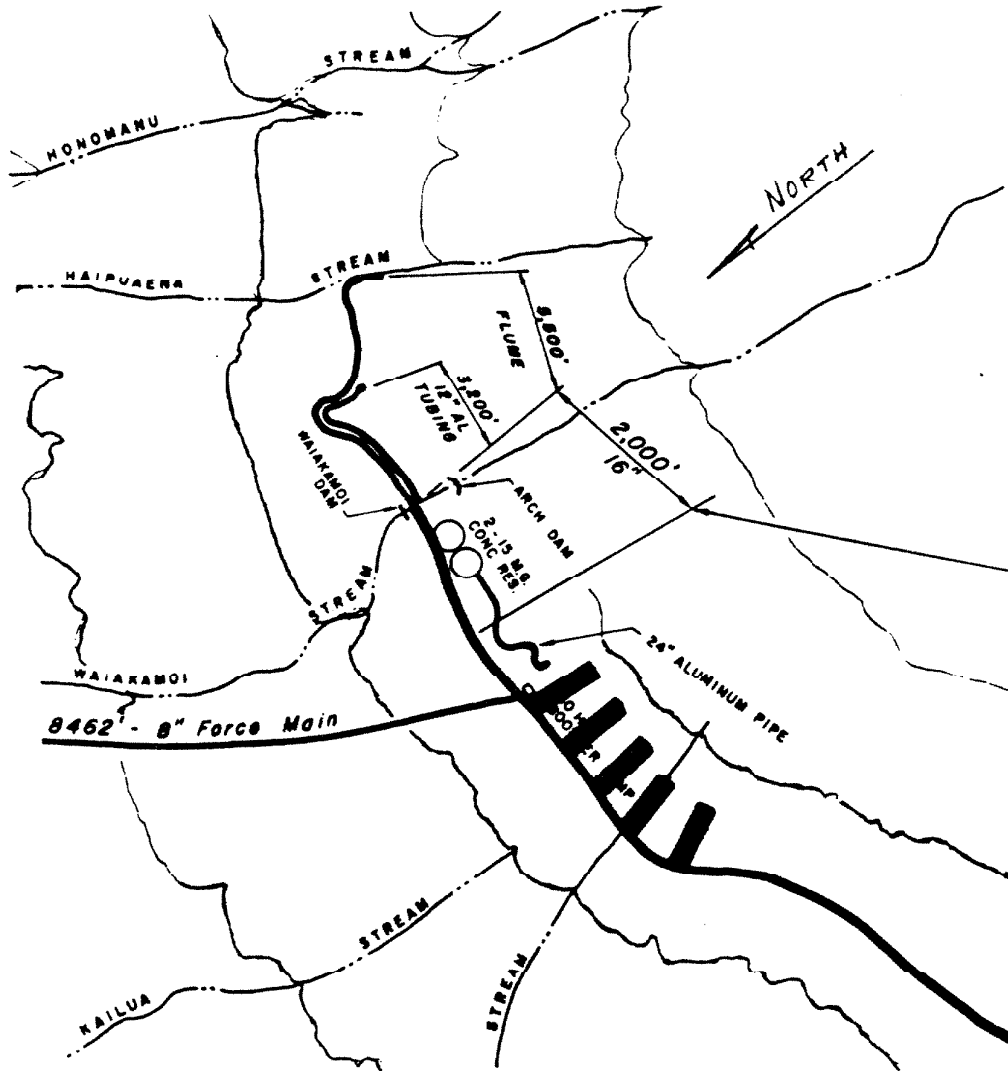


FIGURE 3

UPPER KULA IMPROVEMENTS

FIX WAIAKAMOI INTAKES & PIPELINE

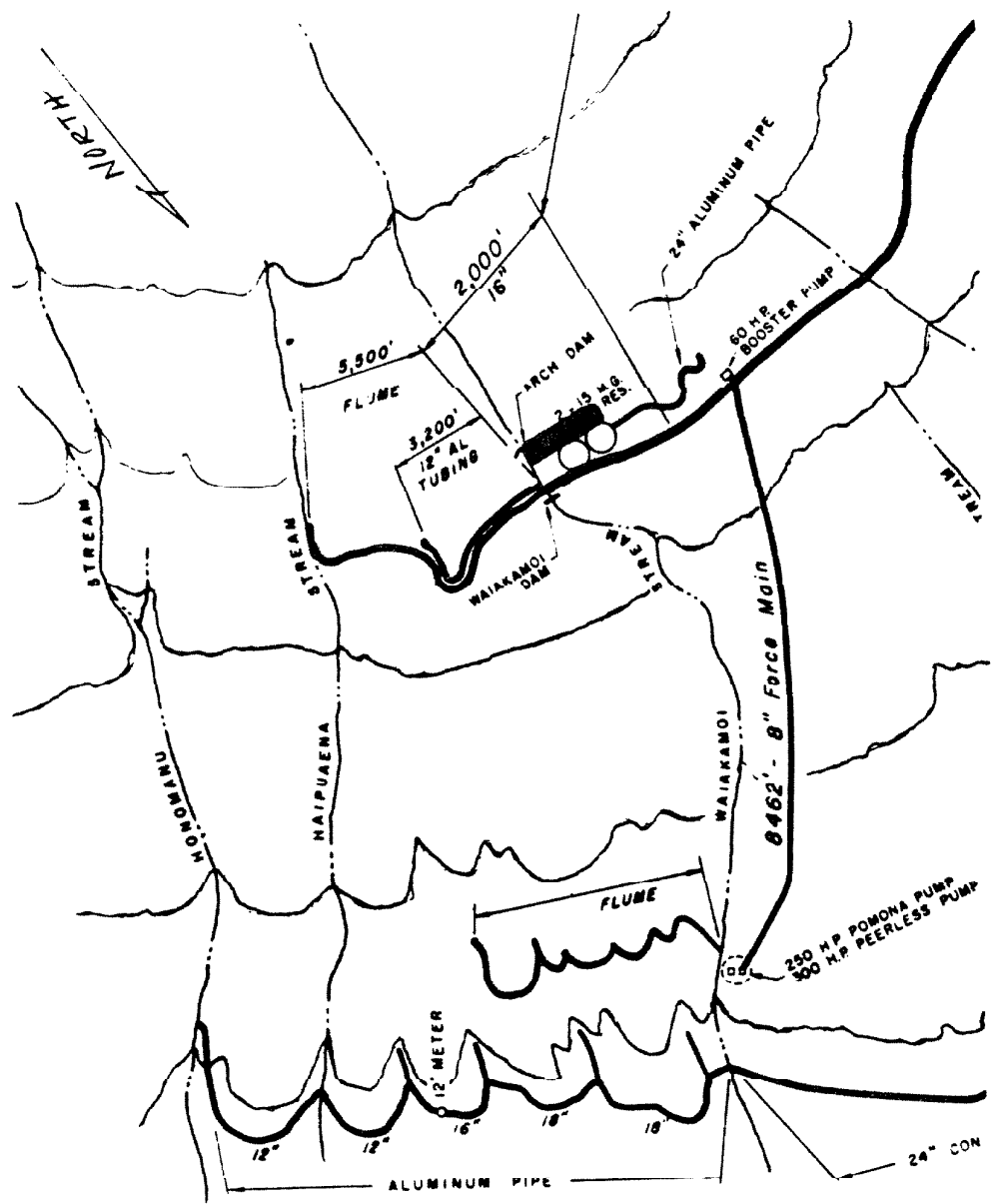


FIGURE 4

UPPER KULA IMPROVEMENTS
EXPAND OLINDA PLANT TO 2.5 MGD

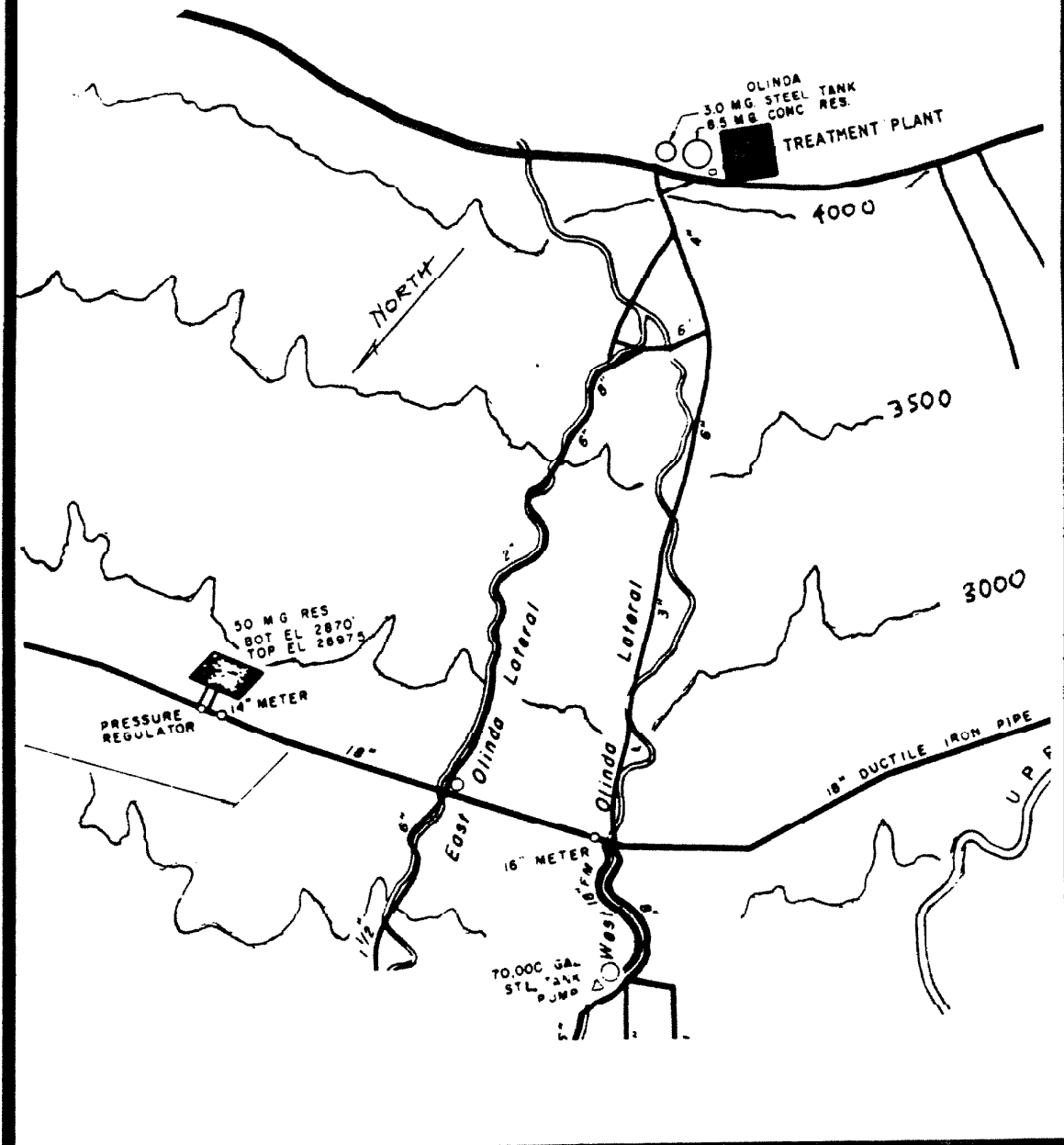


FIGURE 5

UPPER KULA IMPROVEMENTS 50 MG MAHANALUA RESERVOIR

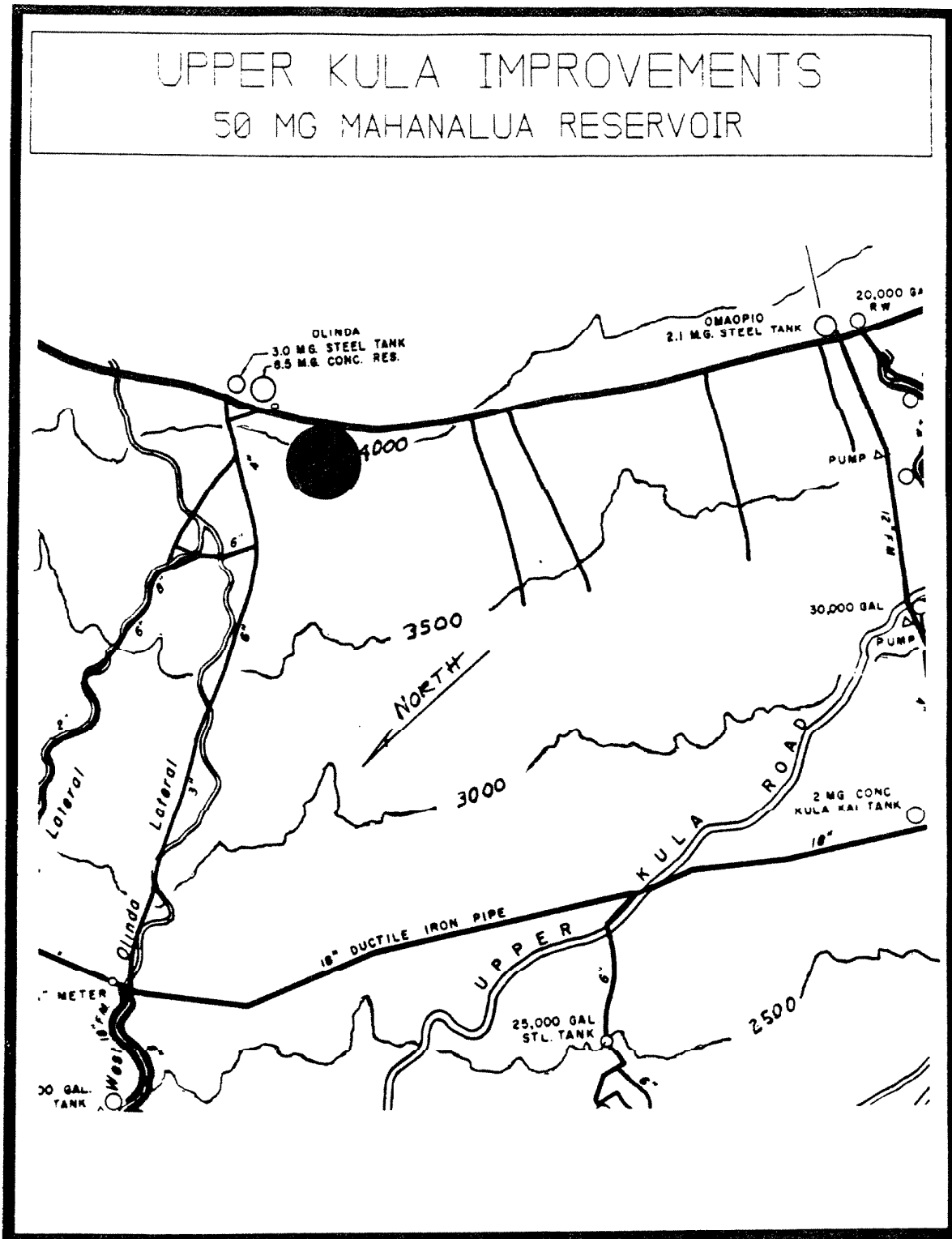


FIGURE 6

UPPER KULA IMPROVEMENTS

75 MG WAIHOU RESERVOIR

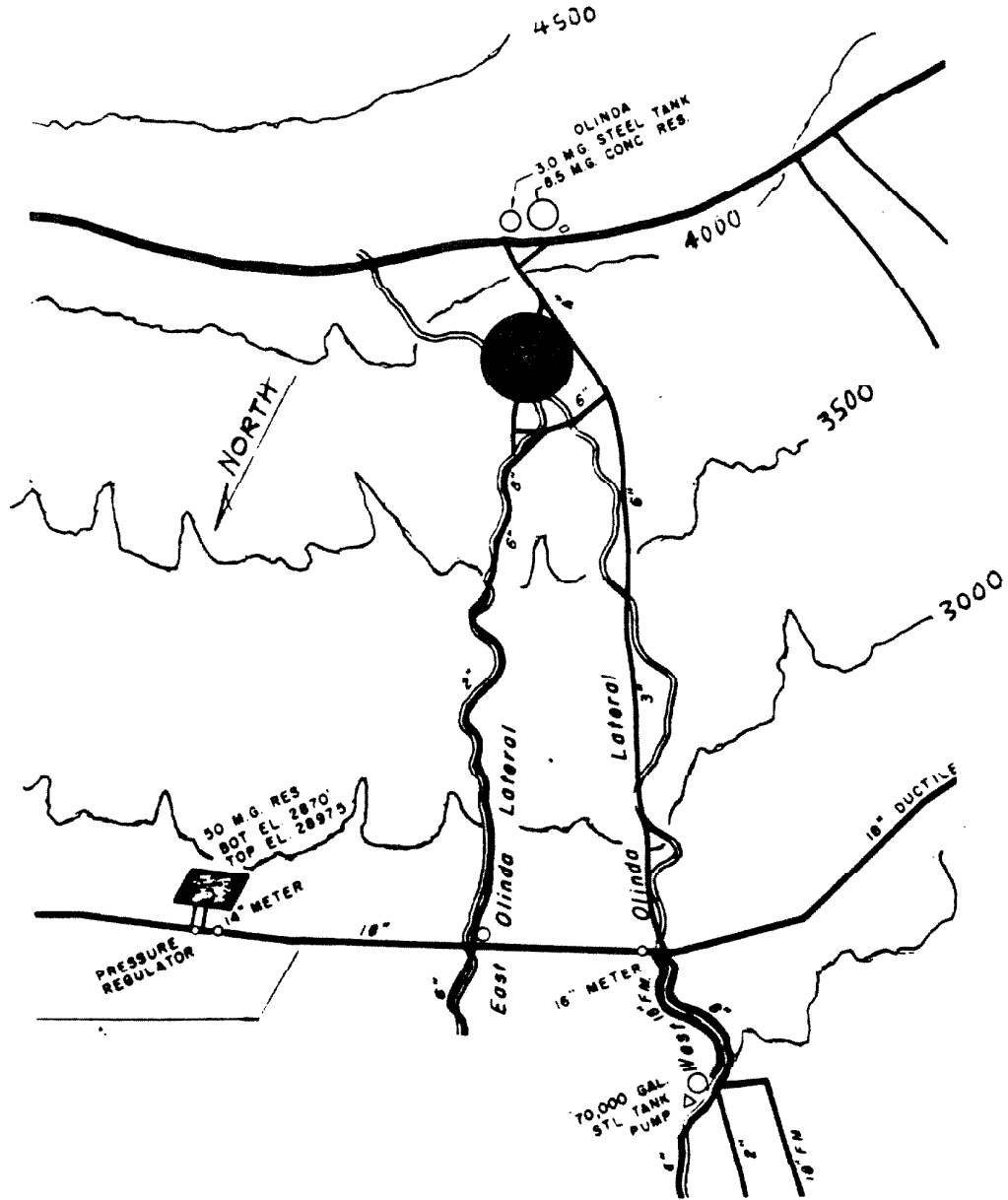


FIGURE 7

LOWER KULA IMPROVEMENTS

RAISE PIIHOLO RESERVOIR WALLS

MODIFY PIPING AND CONTROLS

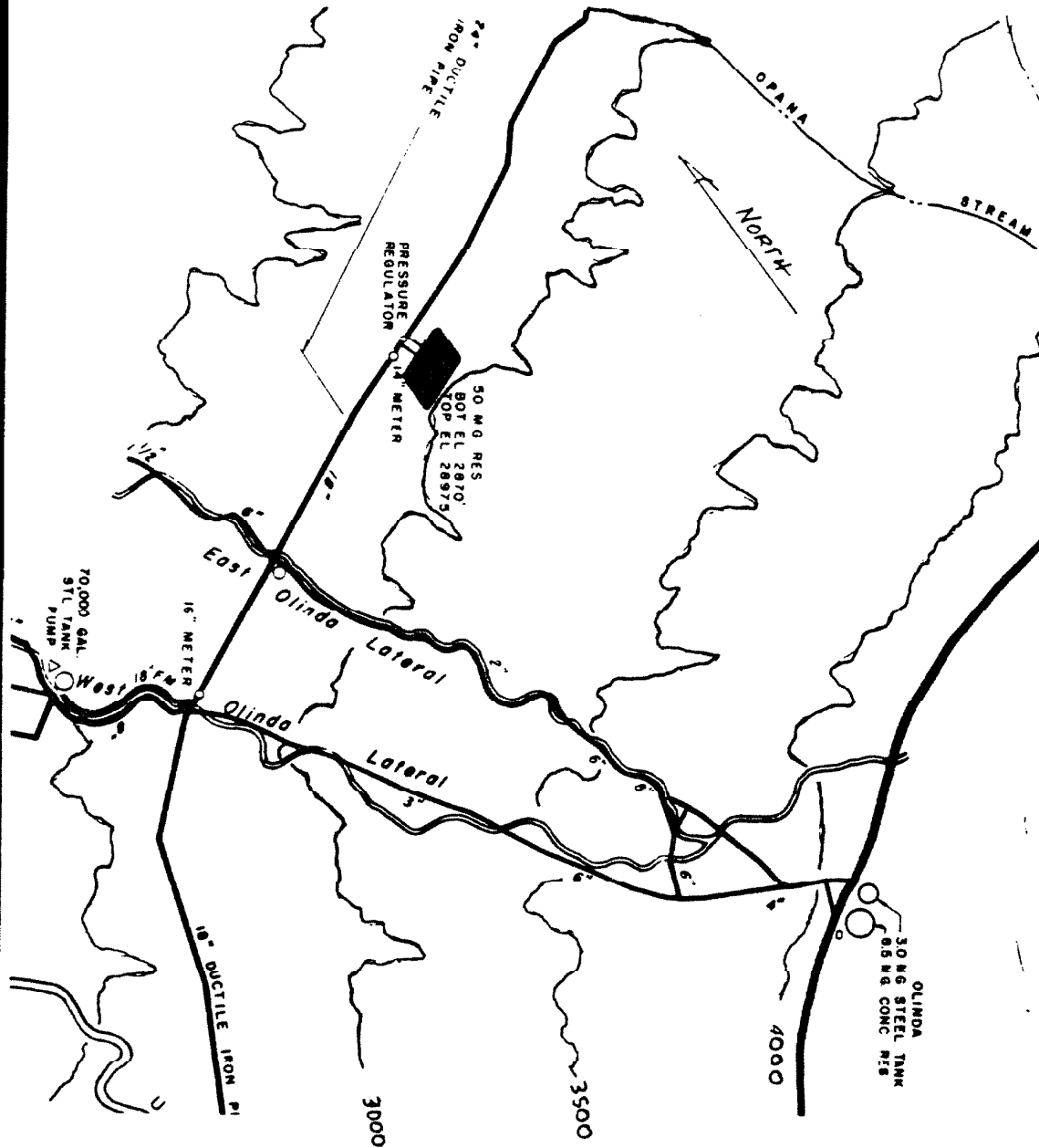


FIGURE 8

LOWER KULA IMPROVEMENTS RELOCATE EAST WAIAKAMOI INTAKE

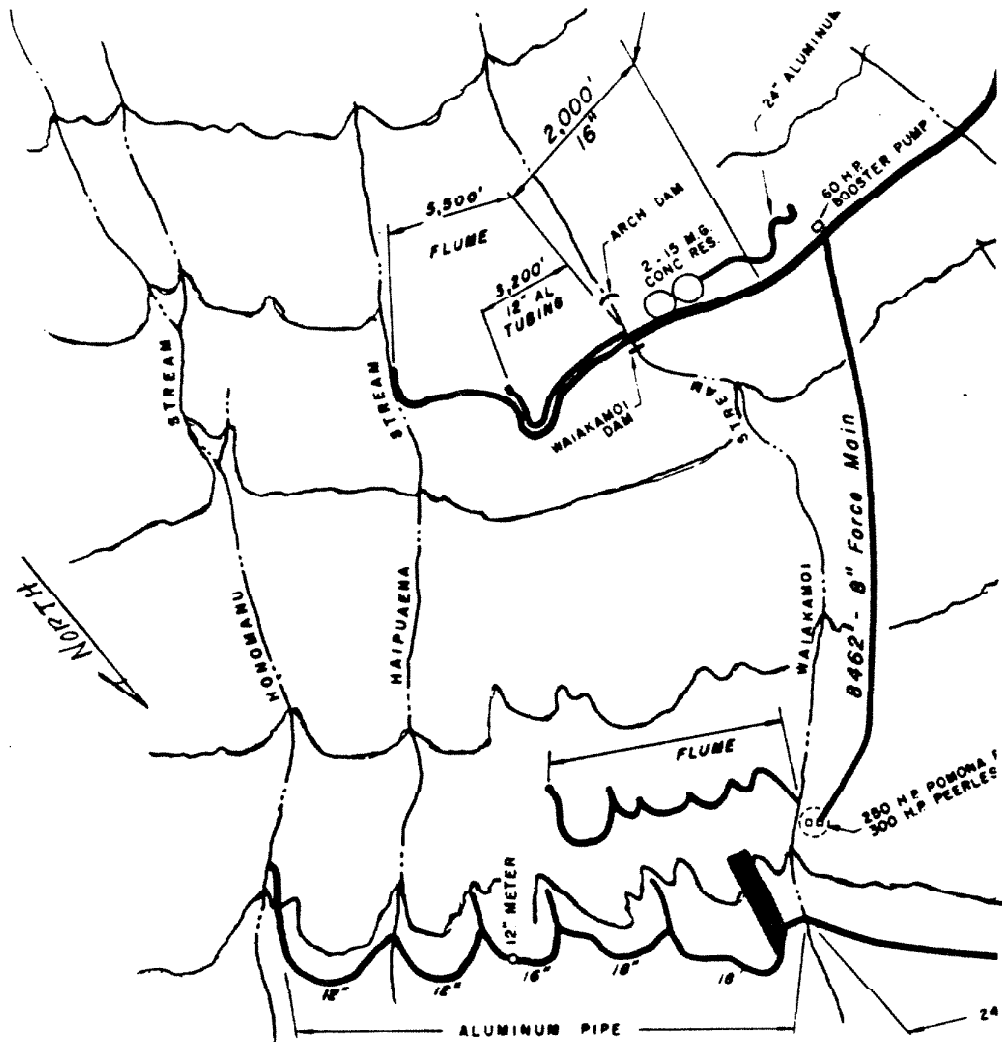


FIGURE 9

LOWER KULA IMPROVEMENTS NEW INTAKE, KAILUA STREAM

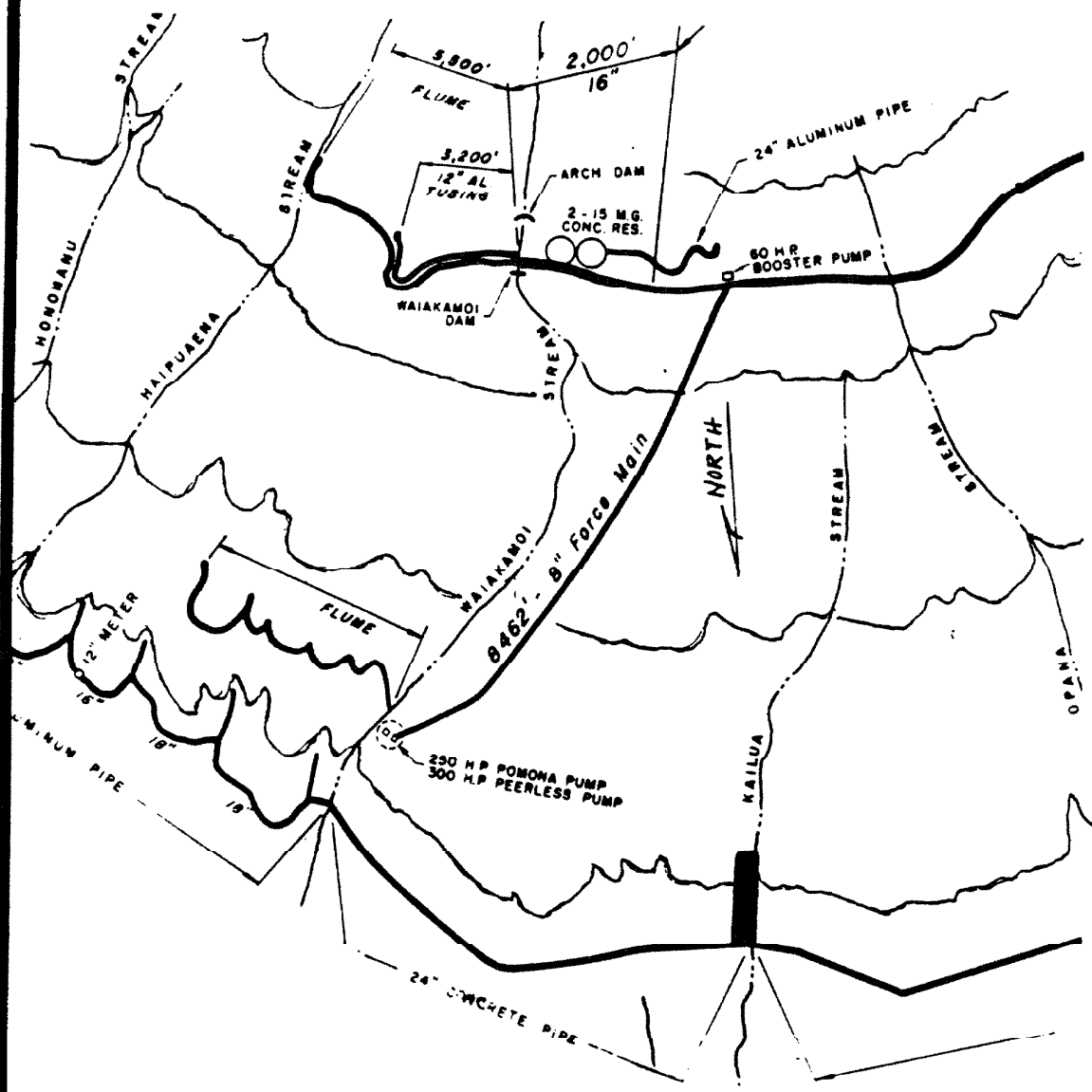


FIGURE 10

LOWER KULA IMPROVEMENTS
 NEW INTAKES, 10TH BRANCH, KAILUA STREAM

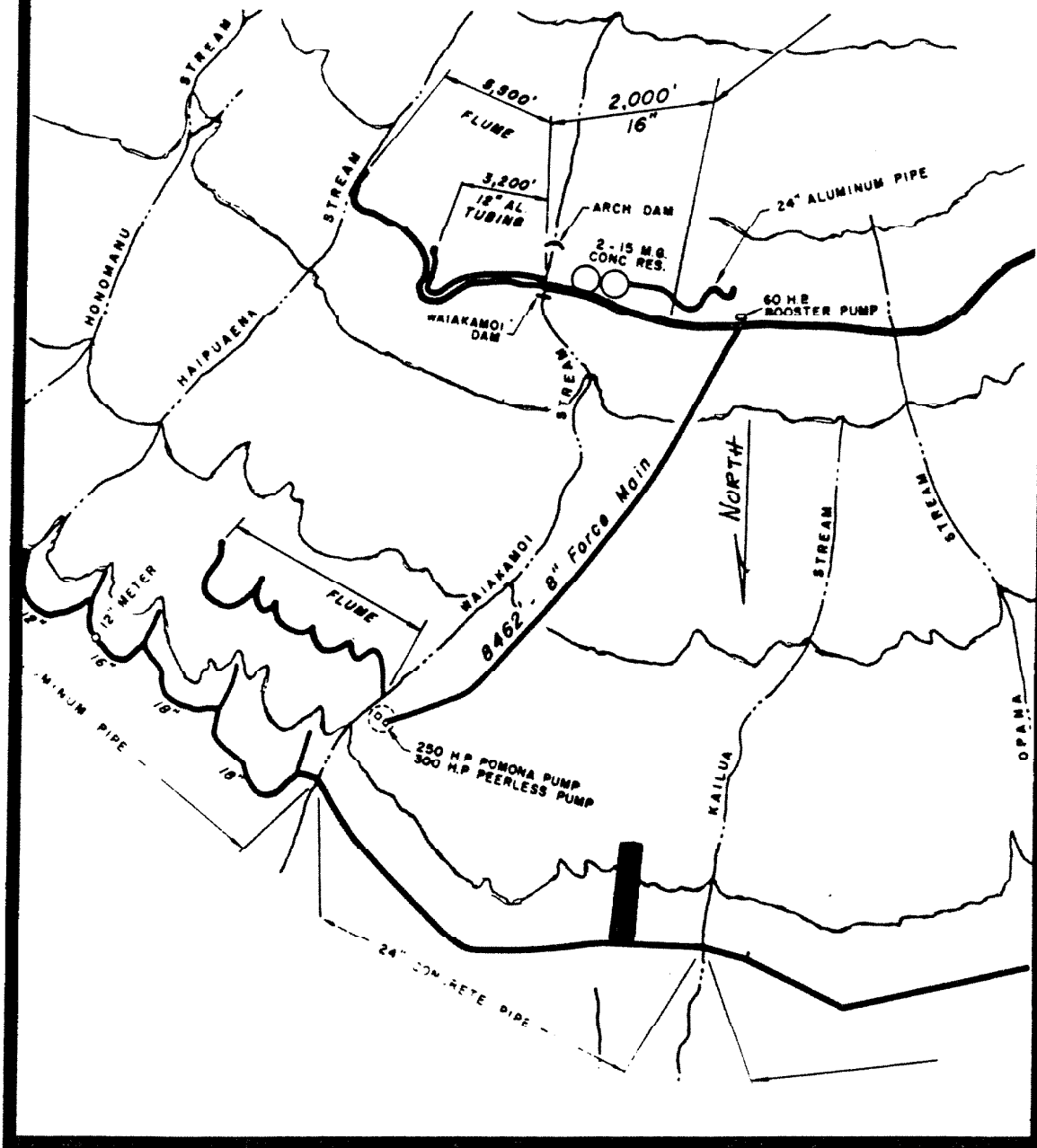


FIGURE 11

LOWER KULA IMPROVEMENTS 25 MGD LOWER KULA TREATMENT PLANT

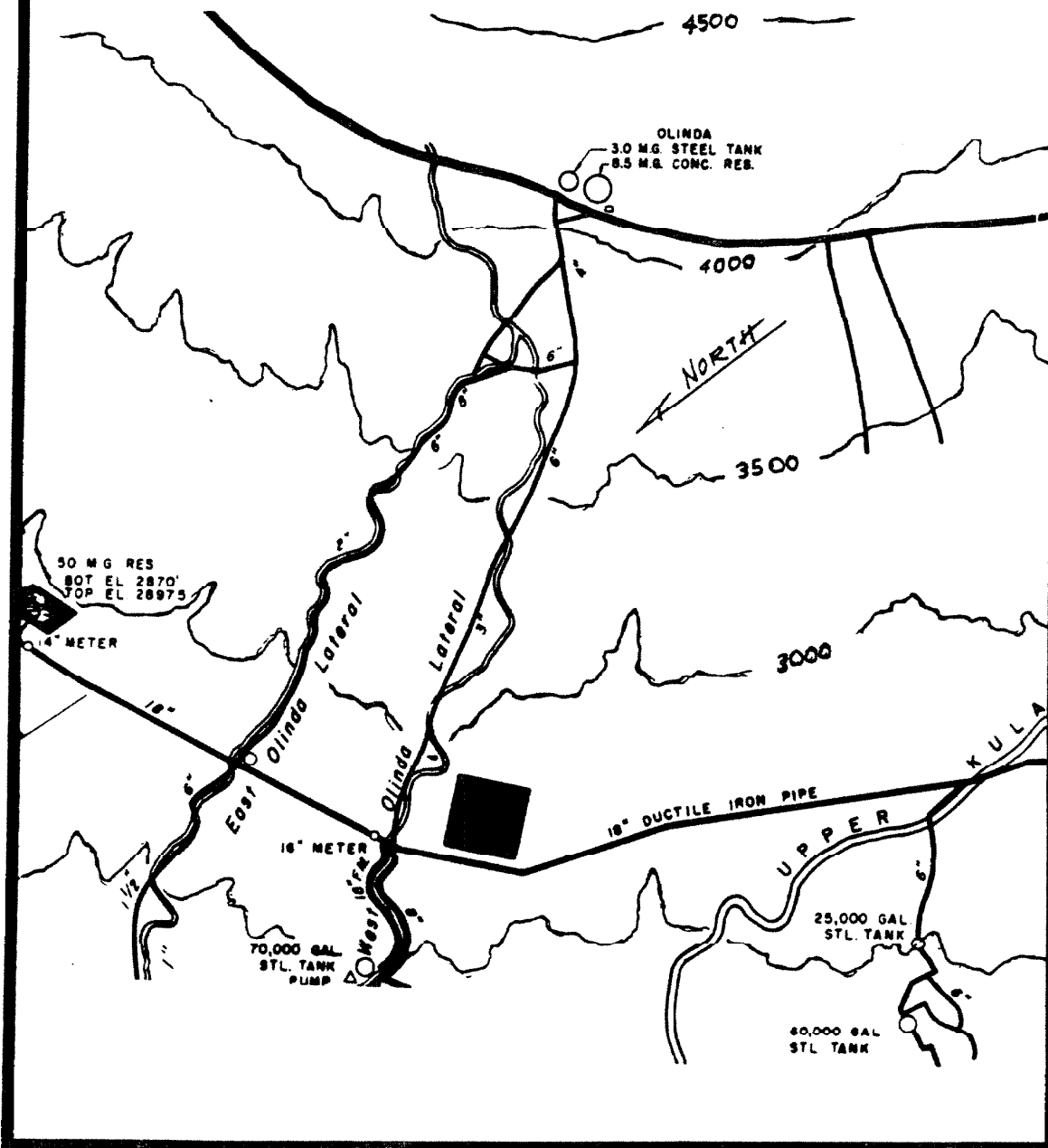


FIGURE 12

LOWER KULA IMPROVEMENTS
 INSTALL CHK VALVES, W & MIDDLE PUOHO.

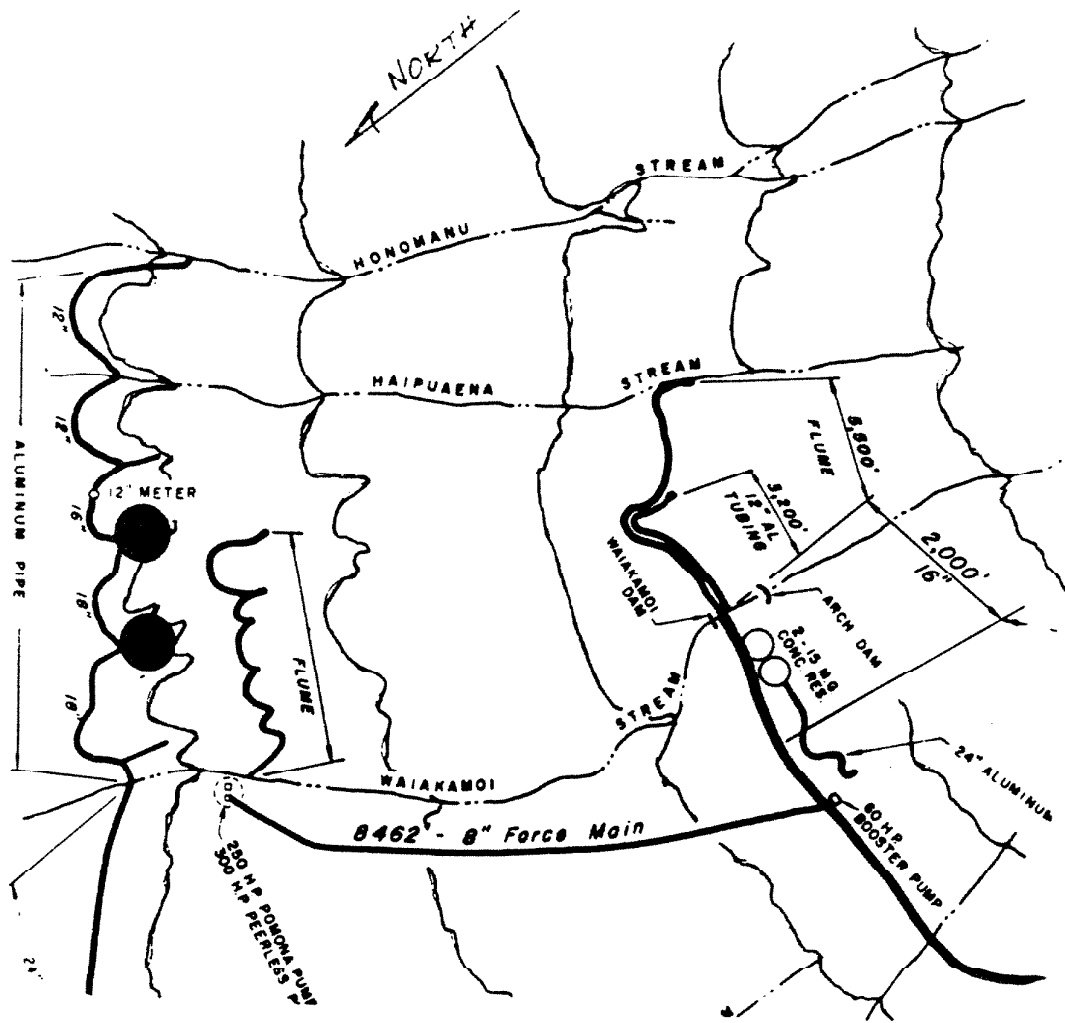


FIGURE 13

LOWER KULA IMPROVEMENTS

BUILD 300 MG KAILUA RESERVOIR

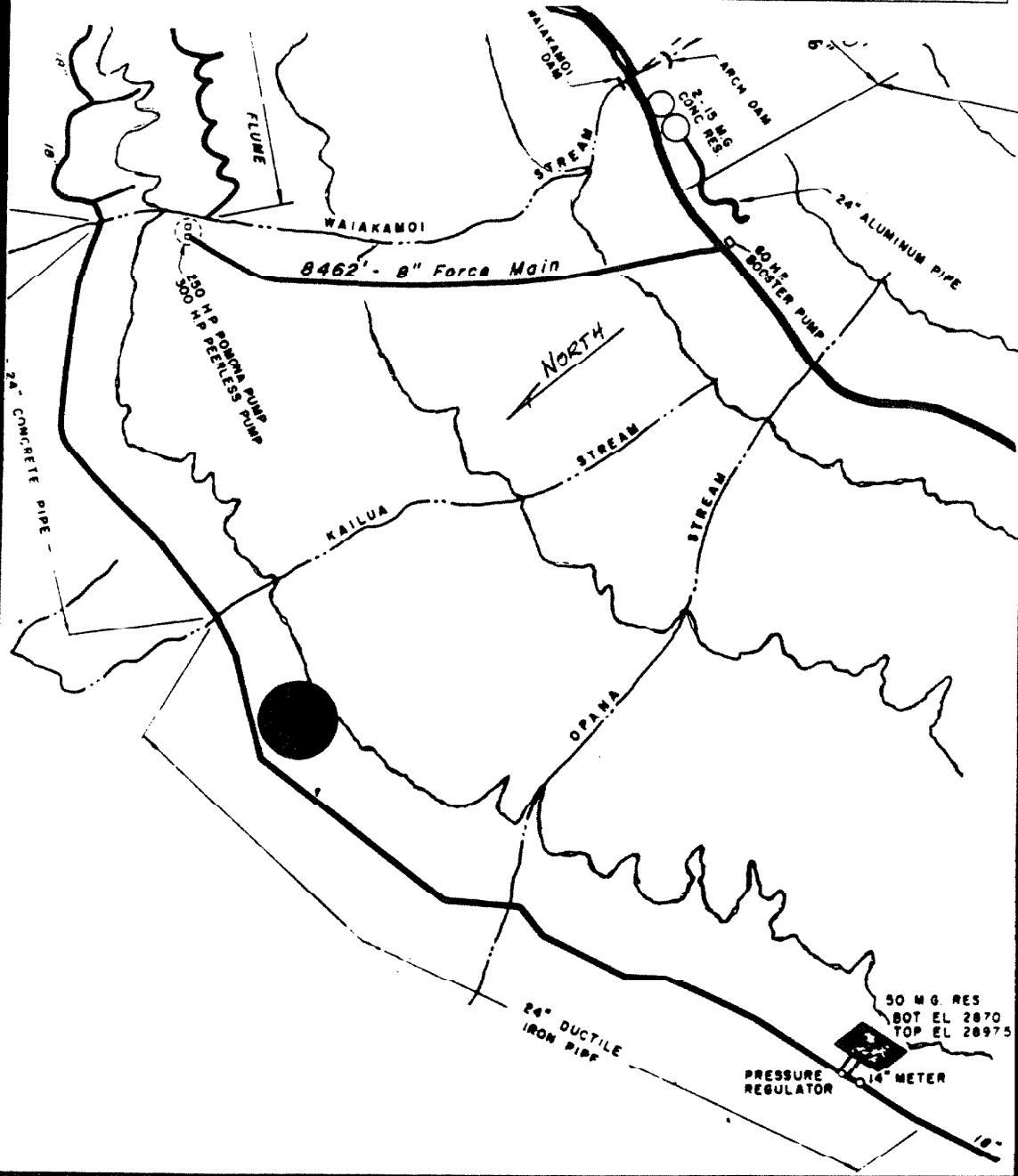


FIGURE 14

LAHAINA SECTOR

D.W.S. PROPOSED WELLS

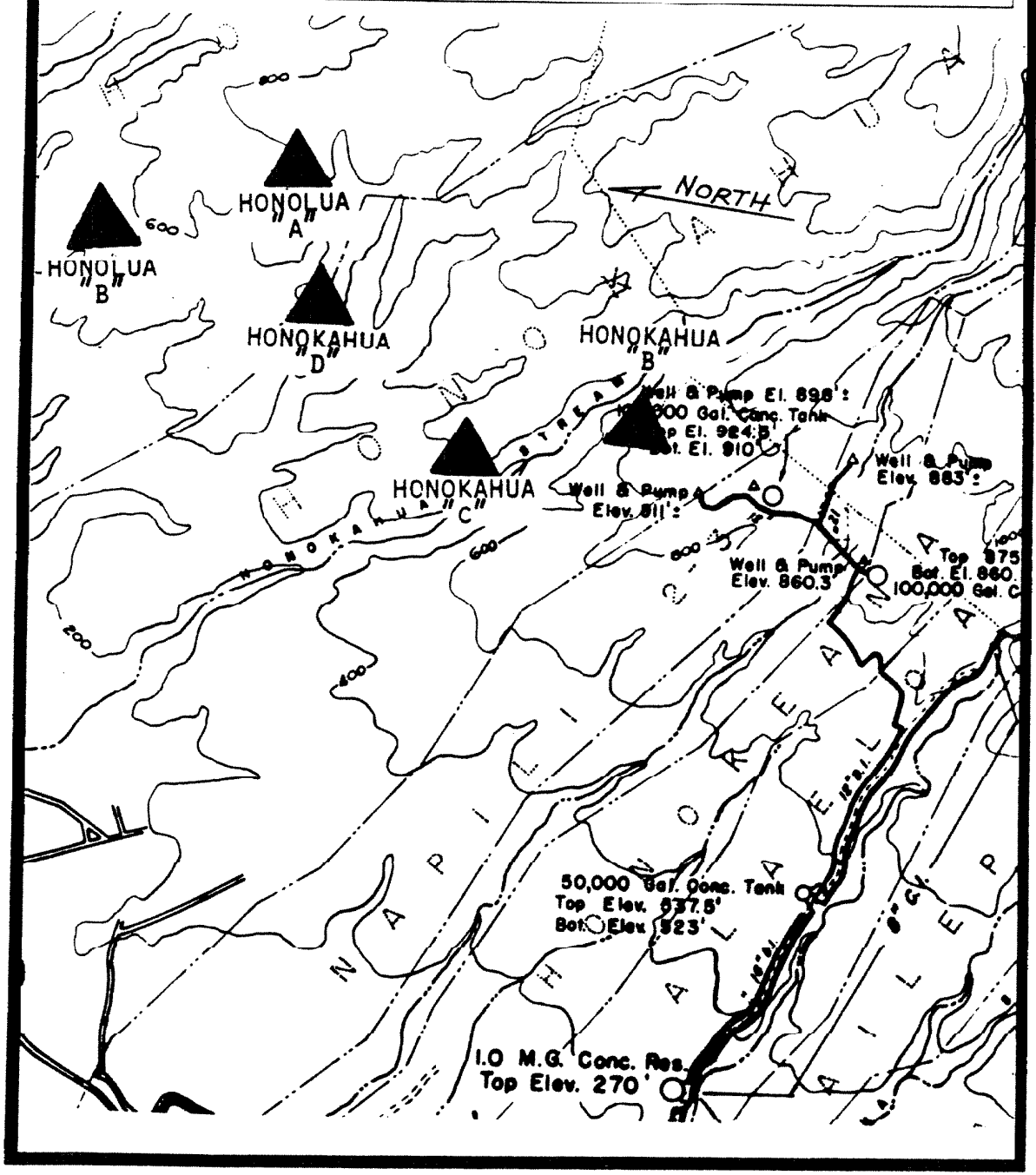


FIGURE 15

LAHAINA SECTOR
KAPALUA RESORTS PROPOSED WELLS

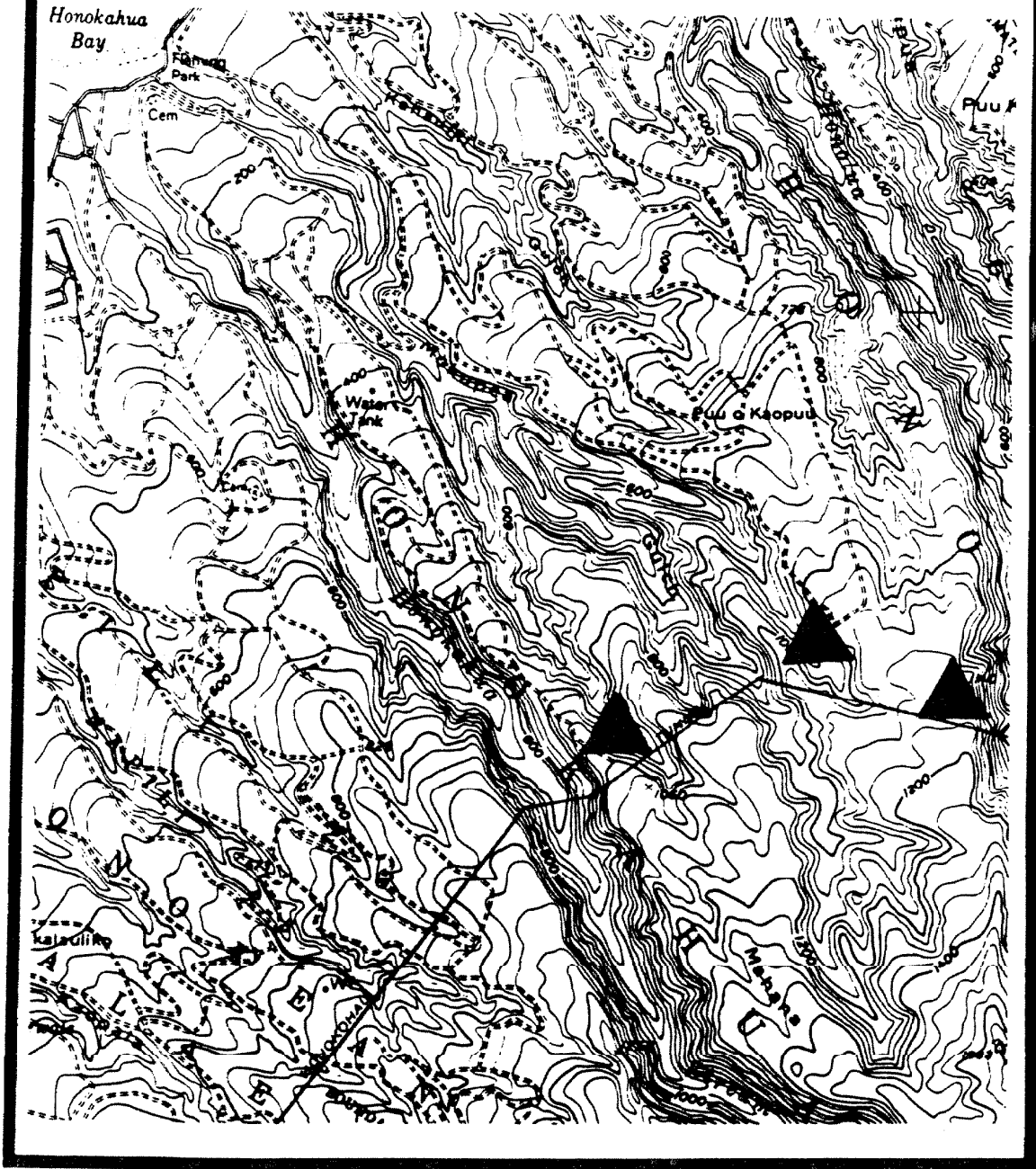


FIGURE 16

LAHAINA SECTOR

KAANAPALI RESORTS PROPOSED SOURCE AREA

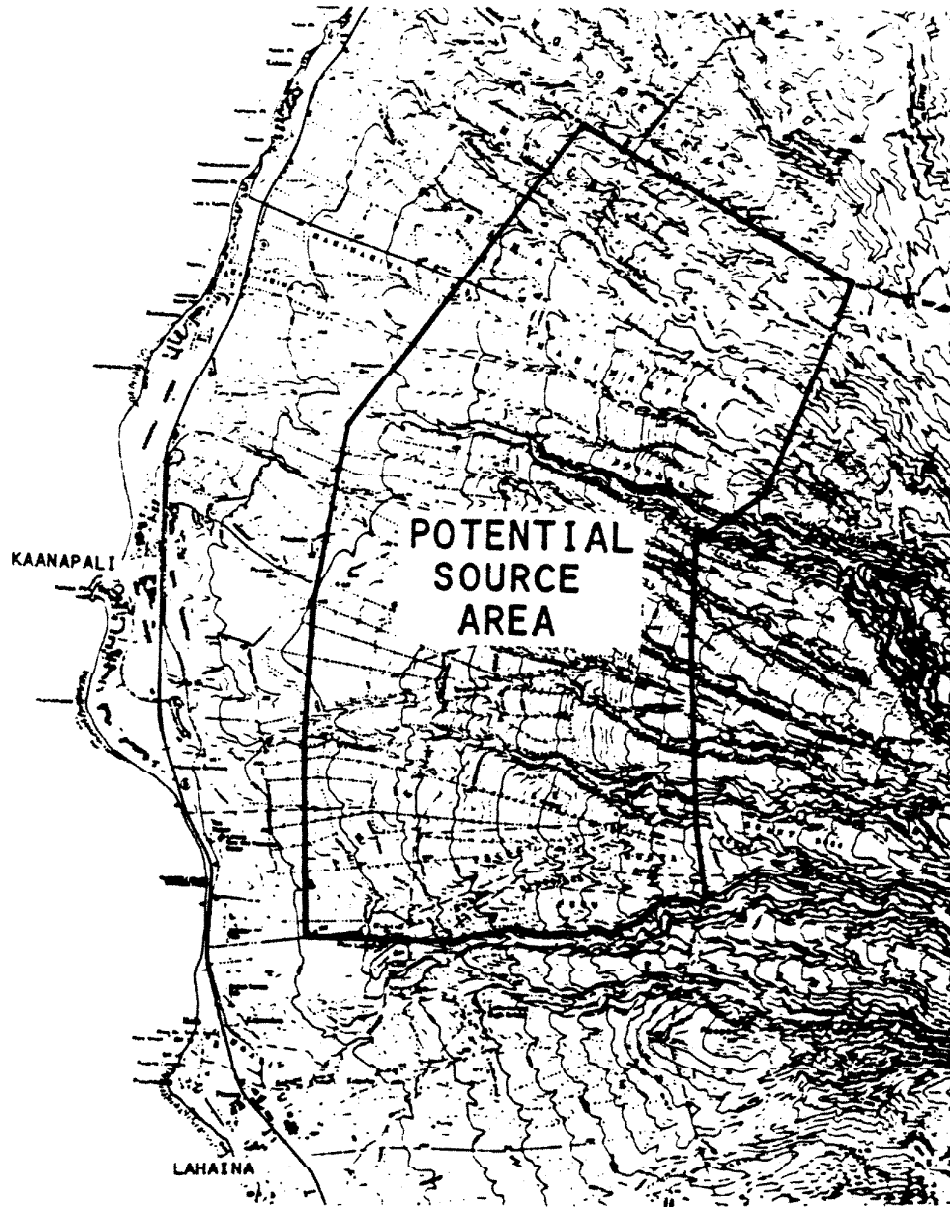


FIGURE 17

WAILUKU SECTOR DWS PROPOSED WAIHEE WELLS

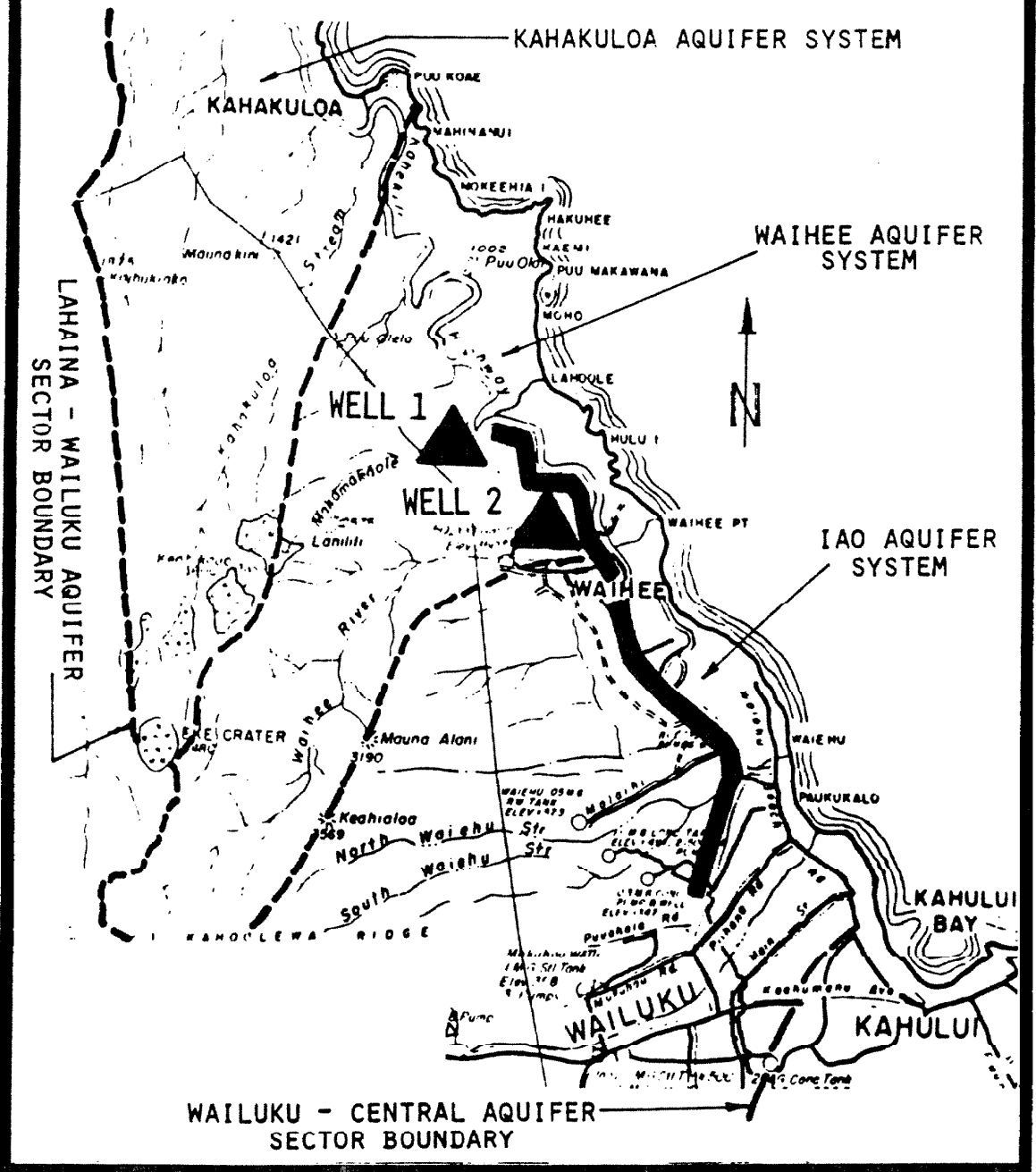


FIGURE 18

KOOLAU SECTOR EAST MAUI SOURCES DEVELOPMENT PROPOSAL

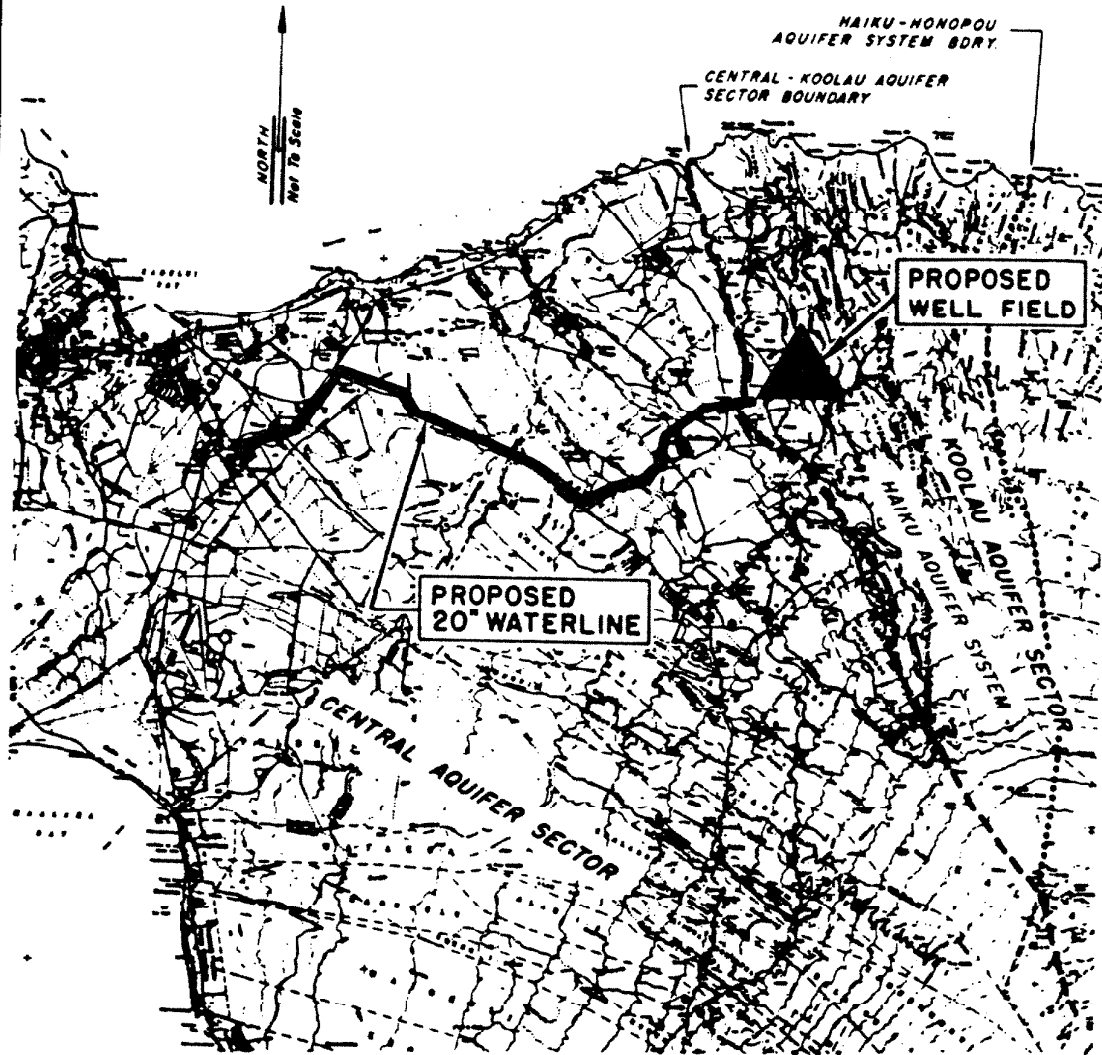


FIGURE 19

KOOLAU SECTOR
DWS PROPOSED HAIKU WELL

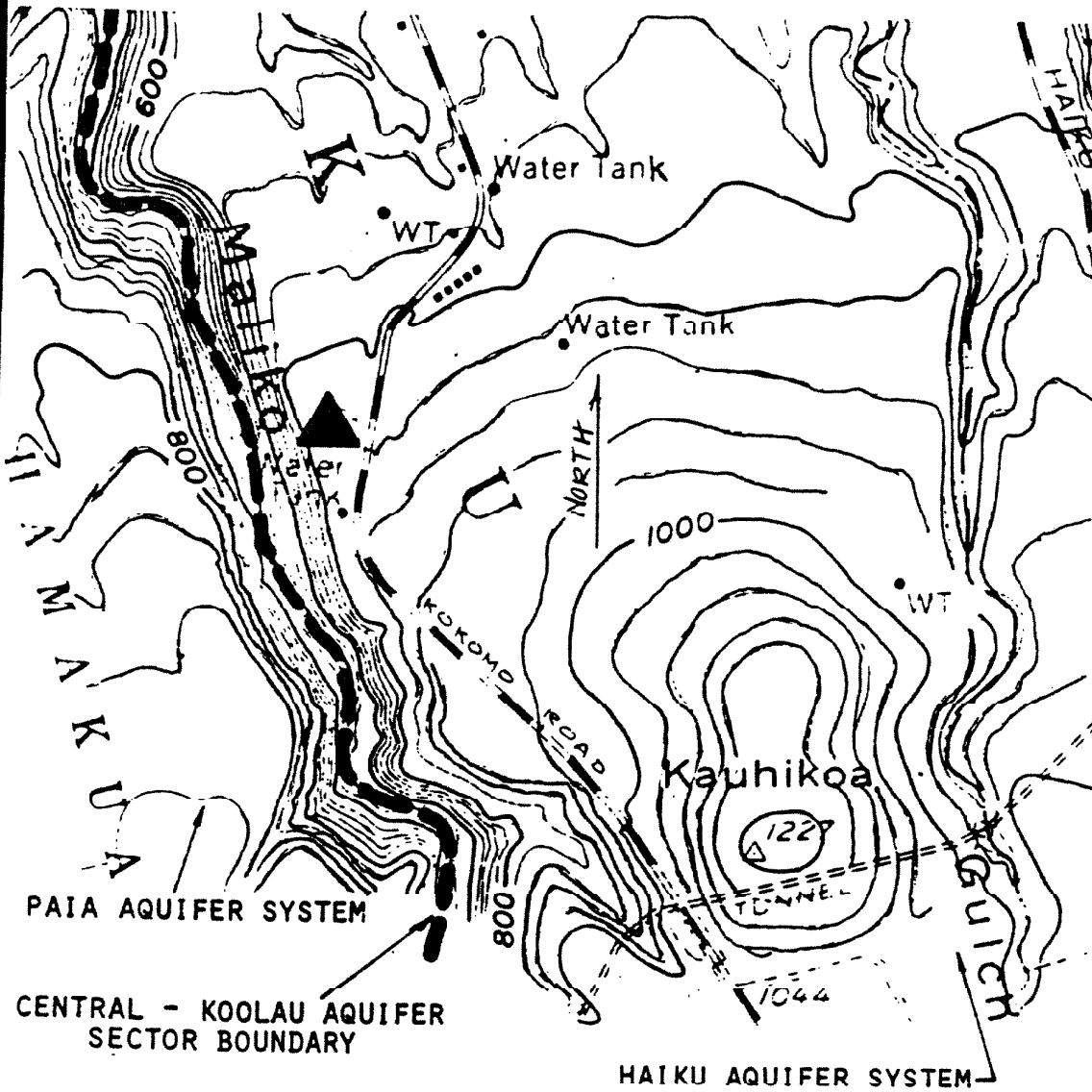


FIGURE 20

ORDINANCE NO. 1948

BILL NO. 84 (1990)

A BILL FOR AN ORDINANCE AMENDING
CHAPTER 2.88A OF THE MAUI COUNTY CODE PERTAINING
TO THE WATER USE AND DEVELOPMENT PLAN

BE IT ORDAINED BY THE PEOPLE OF THE COUNTY OF MAUI:

SECTION 1. Chapter 2.88 of the Maui County Code is repealed in its entirety.

SECTION 2. Title 2 of the Maui County Code is amended by adding thereto a new chapter to be designated and to read as follows:

"Chapter 2.88A

ADOPTION OF THE WATER USE AND DEVELOPMENT PLAN

Sections:

- 2.88A.010 Definitions.
- 2.88A.020 Purpose.
- 2.88A.030 Adoption of the plan.
- 2.88A.040 Application of the plan.
- 2.88A.050 Amendment.
- 2.88A.080 Severability.

2.88A.010 Definitions. "Board" means the board of water supply of the county of Maui.

"Commission" means the commission for water resource management of the state of Hawaii.

"Council" means the council of the county of Maui.

"County" means the county of Maui, a political subdivision of the state of Hawaii.

"Director" means the director of water supply of the county of Maui.

"Plan" means the water use and development plan for the county of Maui, comprised of the technical report and executive summary.

"State water code" means chapter 174C, Hawaii revised statutes.

2.88A.020 Purpose. The purpose of the plan is to meet the mandate of the state water code relative to statewide water resources planning; more specifically, to aid the commission and the county of Maui in the conservation, development, and use of the water resources of the county.

2.88A.030 Adoption of the plan. The council hereby adopts the plan, and any future revision, amendment or modification of the same, pursuant to section 2.88A.050 of this chapter, shall be deemed part of the plan without further adoption or amendment to this ordinance and will be incorporated into this chapter by reference.

2.88A.040 Application of the plan. The plan shall serve as a guideline to the council, the board and all other agencies or departments of the county (a) in approving or recommending to other agencies the use or commitment of the water resources in the county and (b) in using public funds to develop water resources to meet existing or projected future demands on the public water system as set forth in the plan.

2.88A.050 Amendment. A. If a proposed community plan amendment will impact the plan, the director shall initiate any necessary plan amendments.

B. An amendment to the plan proposed by the council, the director, or any agency shall be referred to the board for its review and recommendation. The board shall hold appropriate public hearings on the proposed revisions or amendments and shall transmit them, with its findings and recommendations to the council. Within forty-five days of receipt of a proposed amendment, the council shall approve the amendment by ordinance. If the council fails to act within forty-five days, the amendment shall be deemed disapproved.


C. The mayor shall appoint a nine-member task force to be chaired by the director to assist the board with the review and amendment of the plan whenever the planning director recommends revisions to the general plan pursuant to section 8-8.3.3 of the revised charter of the county of Maui. The task force shall recommend to the board amendments to the plan so as to be consistent with any community plan amendment.

2.88A.060 Severability. The invalidity of any word, section, clause, paragraph, sentence, part or provision of this chapter shall not affect the

validity of any other part of this chapter which can be given effect without such invalid part or parts."

SECTION 2. This ordinance shall take effect upon its approval.

APPROVED AS TO FORM AND LEGALITY:



HOWARD M. FUKUSHIMA
Deputy Corporation Counsel
County of Maui
use/ords/epg

WE HEREBY CERTIFY that the foregoing BILL NO. 84 (1990)

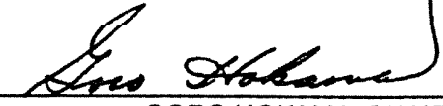
1. Passed FINAL READING at the meeting of the Council of the County of Maui, State of Hawaii, held on the 5th day of October, 1990, by the following votes:

Linda CROCKETT LINGLE	Goro HOKAMA Chairman	Patrick S. KAWANO	Howard S. KIHUNE Vice-Chairman	Alice L. LEE	Ricardo MEDINA	Wayne K. NISHIKI	Velma M. SANTOS	Joe S. TANAKA
No	Aye	Aye	Excused	Aye	Aye	Excused	Aye	Aye

2. Was transmitted to the Mayor of the County of Maui, State of Hawaii, on the 5th day of October, 1990.

DATED AT WAILUKU, MAUI, HAWAII, this 5th day of October, 1990.

RECEIVED
OCT 5 11 3:02
COUNTY CLERK

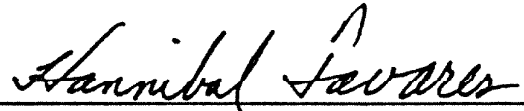


GORO HOKAMA, CHAIRMAN
Council of the County of Maui



DARYL T. YAMAMOTO, COUNTY CLERK,
County of Maui

THE FOREGOING BILL IS HEREBY APPROVED THIS 19th DAY OF OCTOBER, 1990.



HANNIBAL TAVARES, MAYOR,
County of Maui

I HEREBY CERTIFY that upon approval of the foregoing BILL by the Mayor of the County of Maui, the said BILL was designated as ORDINANCE NO. 1948 of the County of Maui, State of Hawaii.

Passed First Reading on September 21, 1990.
Effective date of Ordinance October 19, 1990.



DARYL T. YAMAMOTO, COUNTY CLERK,
County of Maui

I HEREBY CERTIFY that the foregoing is a true and correct copy of Ordinance No. 1948, the original of which is on file in the Office of the County Clerk, County of Maui, State of Hawaii.

Dated at Wailuku, Hawaii, on

RECEIVED

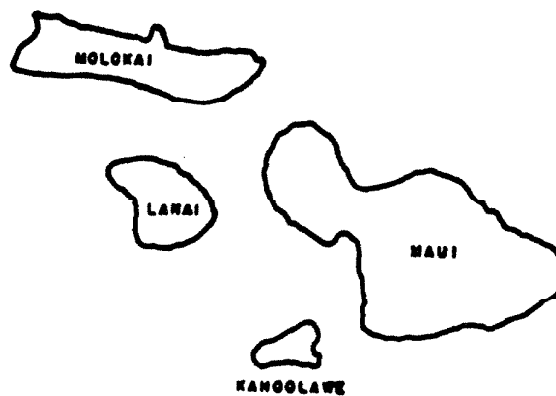
MAR 21 1990

TECHNICAL REPORT

WATER USE AND

DEVELOPMENT PLAN

COUNTY OF MAUI



T A B L E O F C O N T E N T S

INTRODUCTION

WATER USE & DEVELOPMENT PLANS

ISLAND OF MAUI
ISLAND OF MOLOKAI
ISLAND OF LANAI
ISLAND OF KAHOO LAWE

APPENDIX

A - DEFINITIONS
B - COMMUNITY PLANS
C - AQUIFERS
D - AQUIFER WITHDRAWALS

INTRODUCTION

Hawaii Water Plan and Water Use and Development Plan

The State Water Code enacted by the 1987 State Legislature requires the Water Resource and Management Commission to formulate the Hawaii Water Plan. The Hawaii Water Plan will consist of four elements:

1. Water Resource Protection
2. Water Use & Development
3. State Water Project
4. Water Quality

The Water Use and Development Plan as provided in Sections 13-170-30 and 31 of the Hawaii Administrative Rules, Department of Land and Natural Resources adopted in May, 1988, reads as follows:

"A water use and development plan shall be prepared by each separate county and adopted by ordinance setting forth the allocation of water to land use in that county."

"Each county water use and development plan shall include but not be limited to:

- (1) Status of county water and related land development including an inventory of existing water uses for domestic, municipal, and industrial users, agriculture, aquaculture, hydropower development, drainage, reuse, reclamation, recharge, and resulting problems and constraints;

- (2) Future land uses and related water needs; and,
- (3) Regional plans for water developments including recommended and alternative plans, costs, adequacy of plans, and relationship to the water resource protection plan and water quality plan."

The nine recently adopted Community Plans covering all of Maui County were used as the foundation documents to determine land and water uses.

Community Plans of the County of Maui

The County of Maui includes the islands of Maui, Lanai, Molokai, and Kahoolawe. For planning purposes, the entire County was further divided into nine community planning regions. The locations of the regional plans are shown on Page viii. As of December, 1987, the Maui County Council has adopted by ordinance all nine regional community plans as a current and comprehensive guide for future growth and development.

County of Maui
Nine Community Plans
and Date of Adoption

Island of Maui

Wailuku-Kahului Community Plan - December, 1987
Kihei-Makena Community Plan - July, 1985
Lahaina Community Plan - December, 1983
Paia-Haiku Community Plan - April, 1983
Makawao-Pukalani-Kula Community Plan - October, 1987
Hana Community Plan - July, 1982

Island of Molokai

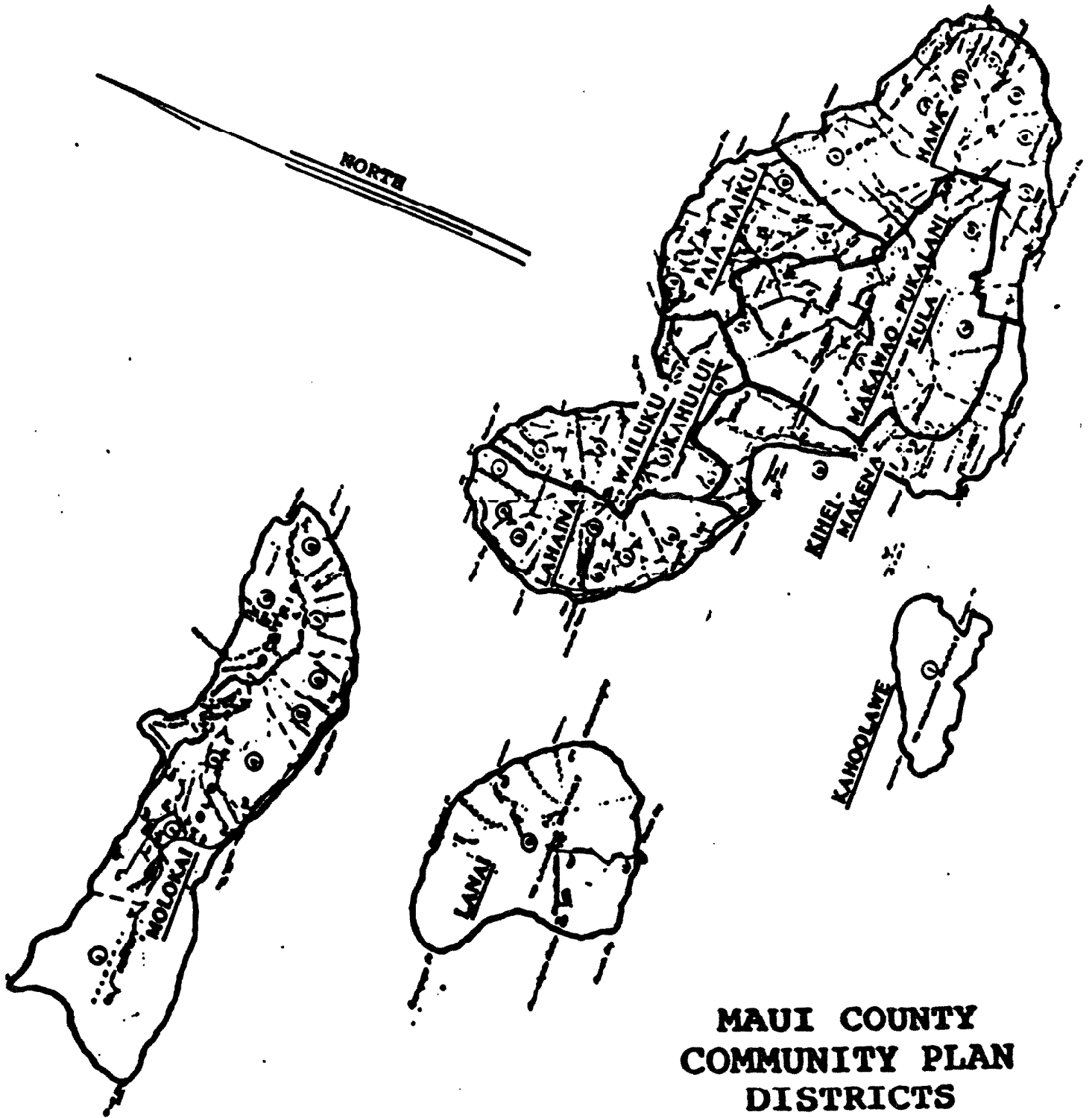
Molokai Community Plan - January, 1984

Island of Lanai

Lanai Community Plan - April, 1983

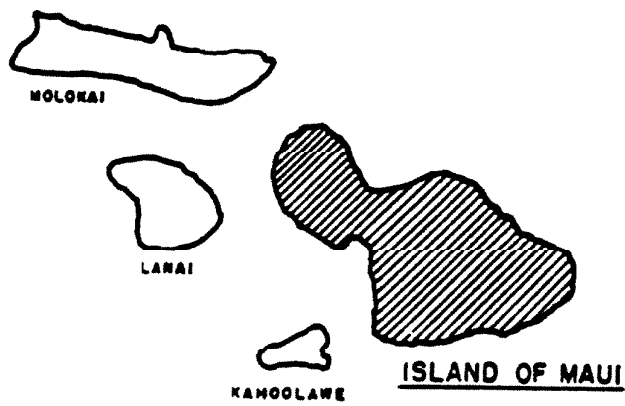
Island of Kahoolawe

Kahoolawe Community Plan - June, 1982



**MAUI COUNTY
COMMUNITY PLAN
DISTRICTS**

COUNTY OF MAUI
WATER USE AND
DEVELOPMENT PLAN
ISLAND OF MAUI



LOCATION MAP

**TABLE OF CONTENTS
ISLAND OF MAUI**

	Page
WATER USE & DEVELOPMENT PLAN - Introduction	1
MUNICIPAL & MAJOR PRIVATE DOMESTIC WATER SYSTEMS	
General	2-3
<u>CENTRAL MAUI WATER SYSTEM</u>	
Existing Uses & Sources	4-9
Future Demands	10
Development Plans	11-14
<u>MAKAWAO WATER SYSTEM</u>	
Existing Uses & Sources	15-21
Future Demands	22-23
Development Plans	24-26
<u>KULA WATER SYSTEM</u>	
Existing Uses & Sources	27-30
Future Demands & Summary	31-33
Development Plans	34-50
<u>HANA WATER SYSTEM</u>	
Existing Uses & Sources	51-56
Future Demands	57
Development Plans	58-60
<u>LAHAINA (MUNICIPAL) WATER SYSTEM</u>	
Existing Uses & Sources	61-64
Future Demands	65
Development Plans	66-69
<u>KAANAPALI (PRIVATE) WATER SYSTEM</u>	
Existing Uses & Sources	70-71
Future Demands	72
Development Plans	73-76
<u>KAPALUA (PRIVATE) WATER SYSTEM</u>	
Existing Uses & Sources	77-78
Future Demands	77
Development Plans	79-81
<u>OTHER PRIVATE DOMESTIC WATER SYSTEMS</u>	
Wainee, Olowalu and Lahainaluna High School Water Systems	82-83
<u>MISCELLANEOUS WATER SYSTEMS</u>	84

PRIVATE AGRICULTURAL WATER SYSTEMS

Summary of Withdrawals for Agricultural Water Use 85-86

INVENTORY OF EXISTING SOURCES - SUMMARY

Existing Agricultural Crop System Sources
 HC&S Co. - A&B Inc. 87-90
 Wailuku Agribusiness 91-92
 Maui Pineapple Company, Ltd. 91
 Pioneer Mill Co., Ltd. 93-94
Existing Agricultural Non Crop System Sources
 Grazing Areas 95-96
 Landscaping Plants, and Parks 97-98

FUTURE DEMANDS 99

DEVELOPMENT PLANS 99A

INDUSTRIAL & MISCELLANEOUS SYSTEMS 100-104

Existing Uses and Sources 100-104
Future Demands 103

WITHDRAWAL BY AQUIFER SECTOR-AQUIFER SYSTEMS

Introduction 105-106

Total Withdrawal for Island of Maui - 107-108
 Withdrawal for Municipal use 109-110

Withdrawal for Agricultural Use 111-112

Withdrawal for Miscellaneous Use 113

Groundwater Withdrawal by Aquifer Sector-System 114-120

FUTURE STUDY AREAS 121

REFERENCES

E X H I B I T S

<u>Exhibit</u>		<u>Page</u>
A	Municipal & Major Private Domestic Water System Service Area and Community Plan Regions	3
B	Central Maui Water System Service Area	7
C	Central Maui System Existing Sources	8
D	Central Maui Water System Schematic for 1987	9
E	Central Maui System Waihee-Kahakuloa Well #1 & #2	13
F	Central Maui System East Maui Sources	14
G	Makawao Water System Service Area	17
H	Kailiili Water Source	19
I	Makawao Water System Schematic for 1987	21
J	Makawao Water System Schematic for 2010	23
K	Makawao Water System Haiku Deep Well	26
L	Kula Water System Service Area	29
M	Kula Water System Schematic for 1987	30
N	Kula Water System Schematic for 2010	32
O-AB	Kula Water System	
O	36" Transmission Pipeline	37
P	Intakes W. of Waiakamoi	38
Q	Fix Waiakamoi Intakes and Pipe	39
R	100 M.G. Kahakapao Reservoir	40
S	Expand Olinda Treatment Plant	41

<u>Exhibits</u>	<u>Page</u>	
T	50 M.G. Mahanalua Reservoir	42
U	75 M.G. Waihou Reservoir	43
V	Check Valves, W & M Puoho	44
W	Relocate E. Waiakamoi Intake	45
X	Intakes, 10th Branch Kailua	46
Y	New Intake, Kailua Stream	47
Z	Raise Piiholo Reservoir	48
AA	Walls - Modify Piping and Controls	
AA	300 M.G. Kailua Reservoir	49
AB	2.5 M.G.D. Lower Kula Treatment Plant	50
AC	Hana Municipal and Private Water System. Existing Sources - General	53
AD	Keanae Water System Existing Sources	54
AE	Nahiku Water System Existing Sources	55
AF	Hana Municipal System Existing Sources	56
AF-1	Hana Municipal System Hamoia Well	60
AG	Lahaina Municipal and Private Water Systems Existing Area	62
AH	Lahaina Municipal System Existing Sources	64
AI	Lahaina Municipal System Planned Water Sources	69
AJ	Kaanapali and Kapalua Water Systems Existing Sources	71
AK	Kaanapali Water Corporation Potential Source Area	76
AL	Honokohau Ditch Existing Intakes and Distributions	78
AM	Kapalua Water Company Domestic Development Plan	81
AN	Olowalu Water System Existing Domestic System	83

<u>Exhibit</u>		<u>Page</u>
AO	Hawaiian Commercial & Sugar Company Irrigation System and State Water License	88
AP	Hawaiian Commercial & Sugar Company Irrigation Well	89
AQ	Wailuku Agribusiness Co., Inc. Irrigation System	91
AR	Pioneer Mill Company Irrigation System	94
AS	Makawao-Kula-Kahikinui Grazing Area and Sources	96
AT	Golf Courses - Central Maui Existing Sources	98
AU	Industrial and Miscellaneous Use Existing Lahaina Sources	101
AV	Industrial and Miscellaneous Use Existing Middle Maui Sources	104
AW	Aquifer Classification Island of Maui	106

WATER USE & DEVELOPMENT PLAN FOR THE ISLAND OF MAUI

This report includes the following:

1. Municipal and Major Private Domestic Water Systems
 - A. A brief description of the present water usage and sources of the supply.
 - B. Future water demand projections.
 - C. Development plans.
2. Agricultural Water Systems
 - A. Inventories of present water usage and sources of the supply.
 - B. Future water demand projections.
 - C. Development plans.
3. Industrial and Miscellaneous Water Systems
4. Aquifer Description
5. Summary of Water Withdrawals from Ground and Surface Sources
6. References

MUNICIPAL AND MAJOR PRIVATE DOMESTIC WATER SYSTEMS

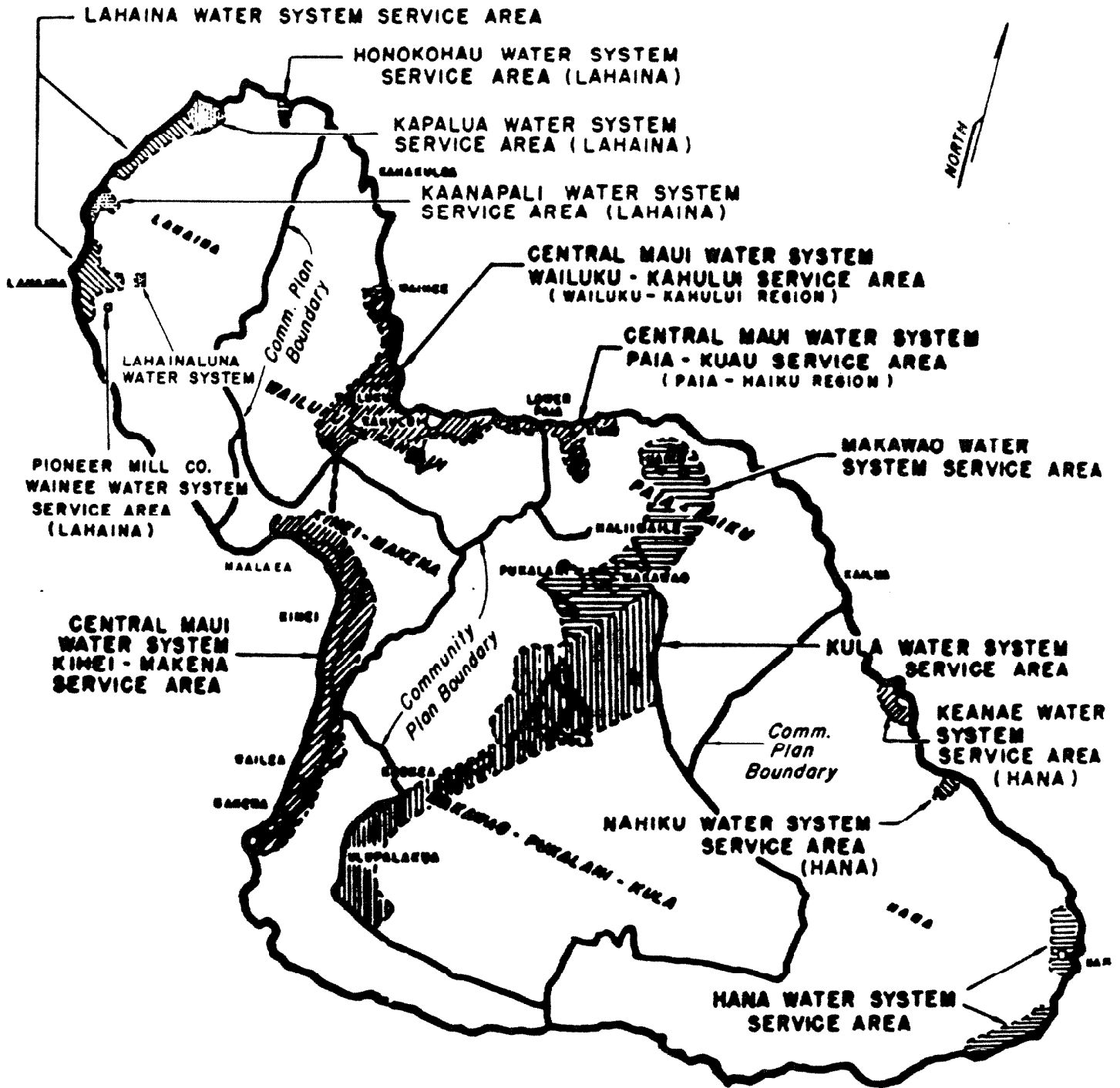
General

The County of Maui operates five separate water systems on the island of Maui. They are:

Central Maui Water System
Makawao Water System
Kula Water System
Hana Water System
*Lahaina Water System

Exhibit A shows the approximate service areas served by these municipal water systems.

* Kaanapali, Kapalua, Pioneer Mill Domestic Private Water System, and State's Lahainaluna School System are included as part of the Lahaina Water System.



**MUNICIPAL & MAJOR PRIVATE DOMESTIC
WATER SYSTEM SERVICE AREA AND
COMMUNITY PLAN REGIONS
ISLAND OF MAUI**

CENTRAL MAUI WATER SYSTEM

General

The Central Maui Water System serves the urban, rural, and a portion of agricultural areas within Wailuku-Kahului, Kihei-Makena Community Plan Regions*, and a portion of the Paia-Kuau section of the Paia-Haiku Community Plan*. A brief description of the service areas, sources, and the amount of water withdrawn from the existing Central Maui sources (by community plan regions) are covered below.

Wailuku-Kahului Community Plan Region

The water service areas for this region include Waihee to the north, Waikapu to the west, Spreckelsville to the east, and Puunene to the south (see Exhibit B).

The Department of Water Supply reports the amount of water withdrawn from the Central Maui sources (including losses**) for the fiscal year ended June 30, 1987 was 2,797 million gallons (MG) or 7.66 million gallons per day (MGD). The withdrawal breakdown is:

	<u>Yearly</u>	<u>Daily</u>
Wailuku Heights/Waikapu	94 MG	0.26 MGD
Waihee	71 MG	0.19 MGD
Wailuku	993 MG	2.72 MGD
Kahului-Spreckelsville	<u>1,639 MG</u>	<u>4.49 MGD</u>
Total water withdrawn from Central Maui sources	2,797 MG	7.66 MGD

* See Appendix B for information on community plan regions.

** This is the water system losses and includes water used or lost for fire fighting, broken mains, washing streets, and losses from metering adjustments, etc.

Kihei-Makena Community Plan Region

The water service areas for this region (see Exhibit B) are located along the coastal areas from Maalaea to the north, and Makena to the south.

The Department of Water Supply reports the amount of water withdrawn from the Central Maui sources (including water system losses) for the 1987 fiscal year was 2,583 MG or 7.08 MGD.

Paia-Haiku Community Plan Region

The Central Maui System serves only the urban areas of Paia and Kuau (see Exhibit B). The Department of Water Supply reports the amount of water withdrawn from the Central Maui sources for the 1987 fiscal year was 135 MG or 0.37 MGD.

Central Maui Sources - Description, Withdrawal and Capacities

Presently the municipal Central Maui ground water sources are located on the windward slope of the West Maui Mountain, and in the Wailuku Aquifer Sector*. The sources are located at Iao, Mokuahu, Waiehu, and Waihee (see Exhibit C).

* See Appendix C for information on Wailuku Aquifer Sector.

The withdrawals are summarized below. Exhibit D shows the schematics of the water system.

Central Maui Water Withdrawal by Regions for the Year 1987

<u>Community Plan Regions</u>	<u>Total</u>	<u>Average Day</u>
Wailuku-Kahului	2,797 MG	7.66 MGD
Kihei-Makena	2,583 MG	7.08 MGD
Paia-Haiku (small portion)	<u>135</u> MG	<u>0.37</u> MGD
Total	5,515 MG	15.11 MGD

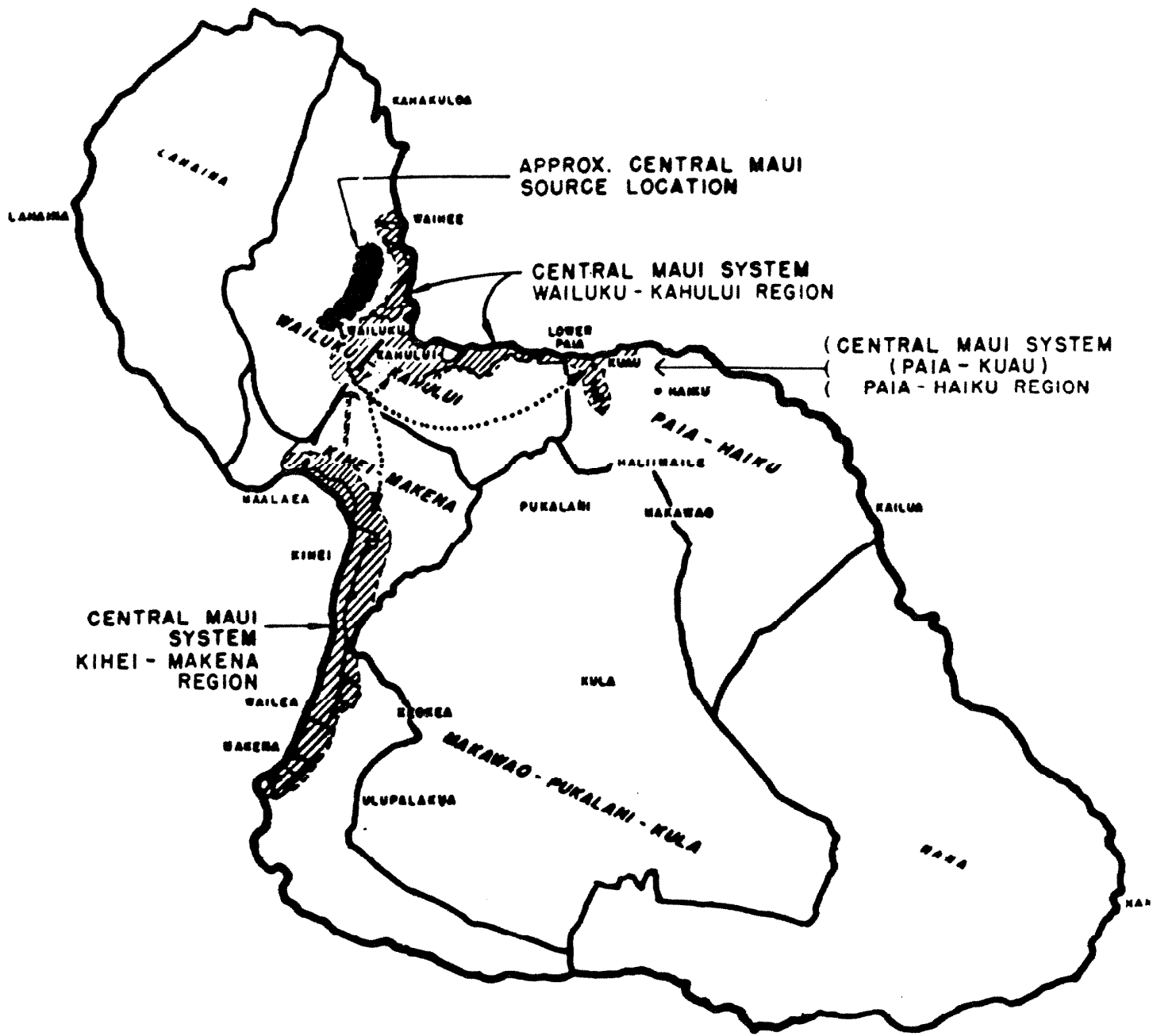
The withdrawal from the ground water sources is also shown below.

Municipal Waters Withdrawn from the Central Maui Groundwater Sources for the Fiscal Year 1987*

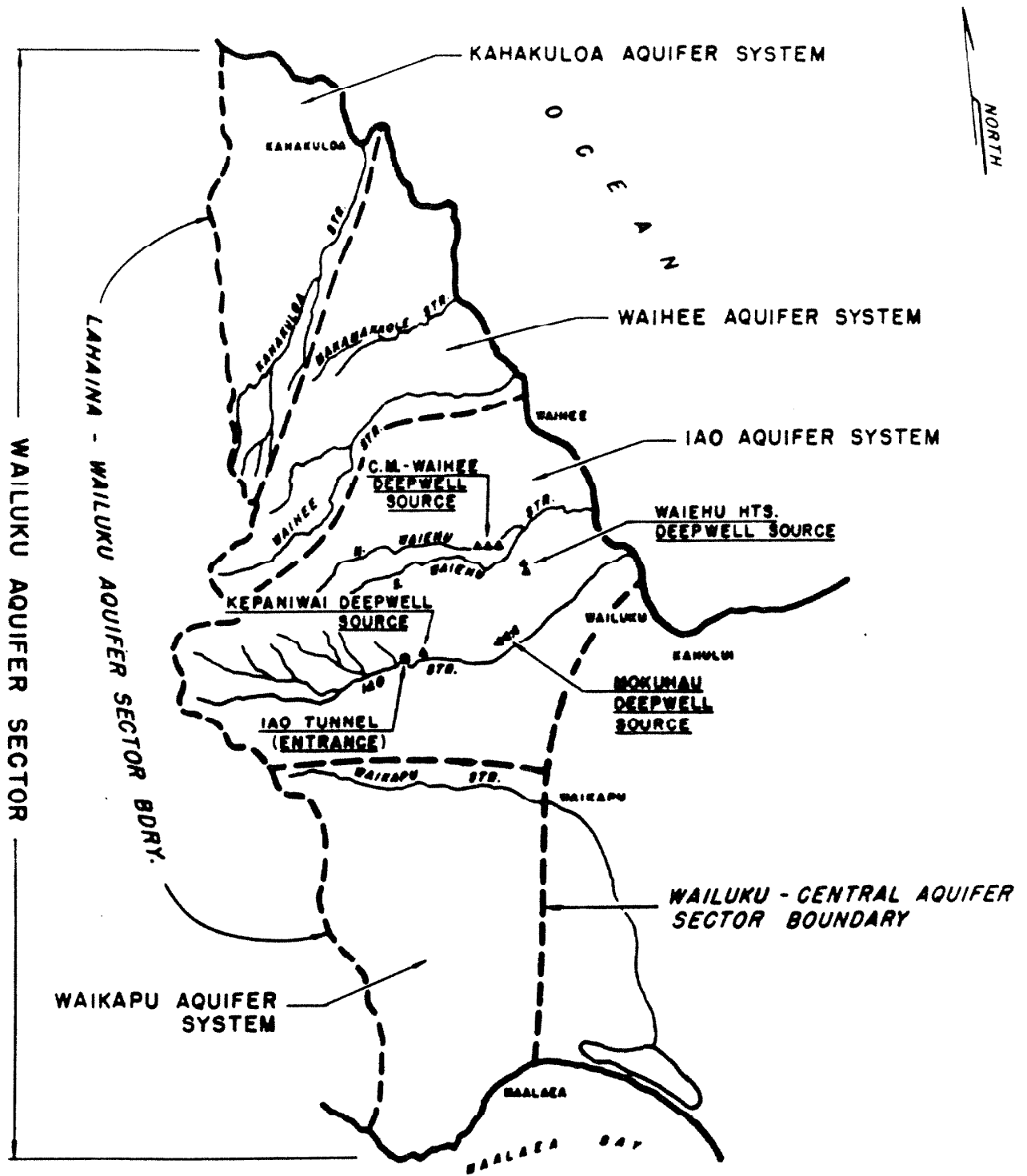
Iao Tunnel (elevation 787 ft.)	487.4 MG
Kepaniwai Well (elevation 713 ft.)	2.3 MG
1 1.0 MGD Pump	
Mokuhau Wells (elevation 353 ft.)	2,116.9 MG
2 4 MGD Pumps	
1 6 MGD Pump	
Waiehu Wells (elevation 337 ft.)	116.6 MG
2 1.8 MGD Pumps	
Waihee Wells (elevation 498 ft.)	2,791.8 MG
2 4.2 MGD Pumps	
1 5.0 MGD Pump	
Total	5,515.0 MG
	or
	15.1 MGD

See Exhibit C for location of sources.

* From Department of Water Supply, County of Maui. Ground elevations noted are approximate.



MAP SHOWING
 CENTRAL MAUI WATER SYSTEM
 SERVICE AREA (EXIST.)
 (MUNICIPAL)



See Appendix C For
Aquifer Information

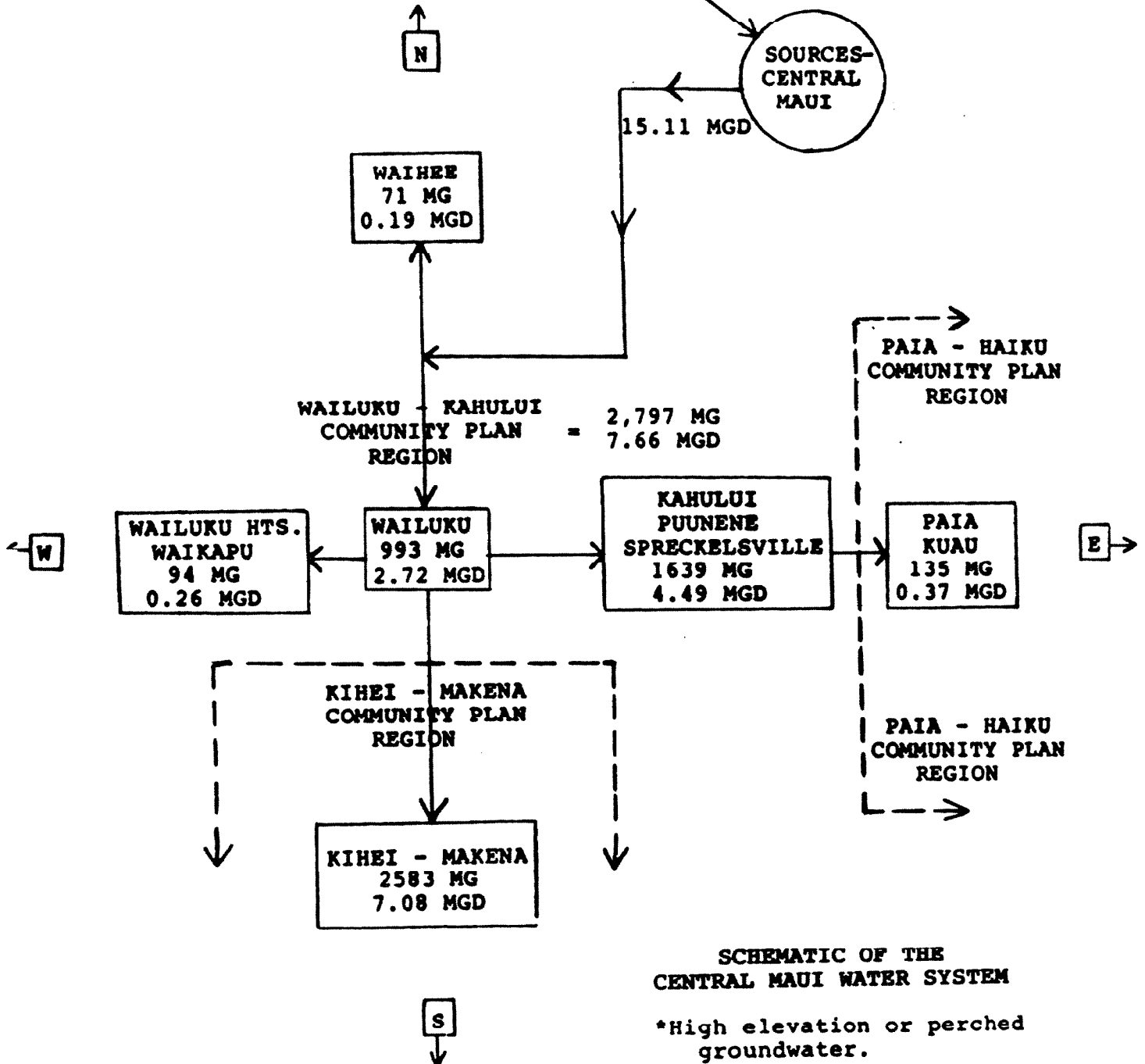
MAP SHOWING MUNICIPAL SOURCES CENTRAL MAUI SYSTEM

CENTRAL MAUI WATER SYSTEM - MUNICIPAL

EXISTING 1987

Central Maui Sources		Am't Withdrawn in 1987
Iao Tunnel (*)	(*)	487.366 MG
Kepaniwai Well (1)*	(1)*	2.323 MG
Mokuhau Wells	(3)	2116.942 MG
Waiehu Wells	(2)	116.586 MG
Waihee Wells	(3)	2791.800 MG
Total		5515.017 MG

15.11 MGD



SCHEMATIC OF THE CENTRAL MAUI WATER SYSTEM

*High elevation or perched groundwater.

CENTRAL MAUI SYSTEM - FUTURE WATER DEMAND PROJECTIONS(MUNICIPAL)

For the future, the Department of Water Supply projects the average day demands for the following community plan regions:

Wailuku-Kahului Region

<u>Year</u>	<u>Projected Average Day Demands *</u>
1987	7.6 MGD - actual
1990	7.8 MGD
2000	10.2 MGD
2010	12.2 MGD

Kihei-Makena Region

<u>Year</u>	<u>Projected Average Day Demands *</u>
1987	7.1 MGD - actual
1990	8.6 MGD
2000	14.4 MGD
2010	17.8 MGD

Paia-Haiku Region

<u>Year</u>	<u>Projected Average Day Demands *</u>
1987	0.4 MGD - actual
1990	0.4 MGD
2000	0.4 MGD
2010	0.5 MGD

Wailuku-Kahului, Kihei-Makena
Paia-Haiku Regions

<u>Year</u>	<u>Projected Average Day Demands *</u>
1987	15.1 MGD - actual
1990	16.8 MGD
2000	25.0 MGD
2010	30.5 MGD

*From "Central Maui Water Study" by N. Saito, Engineering Consultants. Includes water system losses.

WATER DEVELOPMENT PLANS

Municipal System - Central Maui

In February, 1988, the Department of Water Supply completed the County-Wide Source Study for the Municipal Water System. Based on the conclusions by the Norman Saito Report for Central Maui, and the recommendations of the Department of Water Supply's study, the total water production requirements for Central Maui increased from about 15.1 million gallons per day in 1987 to about 30.5 million gallons per day in the year 2010.

The Department of Water Supply proposes to meet the 15.4 million gallon per day increase as follows:

<u>Aquifer Sector-System</u>	<u>Range of Withdrawal Rate - MGD</u>	<u>Estimated Cost</u>	<u>Remarks</u>
1. Wailuku-Iao	3 - 3		
2. Wailuku-Waihee	4 - 6	\$13,400,000	Two Wells & transmission line.
3. Central-Paia	0 - 6		
4. Koolau-Haiku	<u>8.4 - 3.4</u>		
Total Required		15.4	

To meet part of that increase in demand, the Department of Water Supply proposes to spend about \$13,400,000 developing two wells and an associated transmission line in the Waihee Aquifer System* (see Exhibit E). These two wells would have a projected total pump capacity of 4 million gallons per day. Initial studies of the aquifer suggest a total sustainable yield of 10 million gallons per day. The approach to developing the aquifer would be to initially produce at 4 million gallons per day. After yields stabilized at that level, production would be incrementally increased to an average of 6 million gallons per day, if water quality remained acceptable. These well projects are scheduled for the 1990-1996 period.

The Iao Aquifer System, which presently supplies the Central Maui Water system has a sustainable yield of 20 million gallons per day. An additional 3 million gallons can be safely withdrawn.

Initial studies of the Waihee Aquifer System suggest a sustainable yield of 10 million gallons per day. For planning purposes, a range of 4 to 6 million gallons per day is used. These well projects are scheduled for the 1990-1996 period.

The Paia Aquifer System may have 2-3 million gallons. For planning purpose, this area would be initially bypassed.

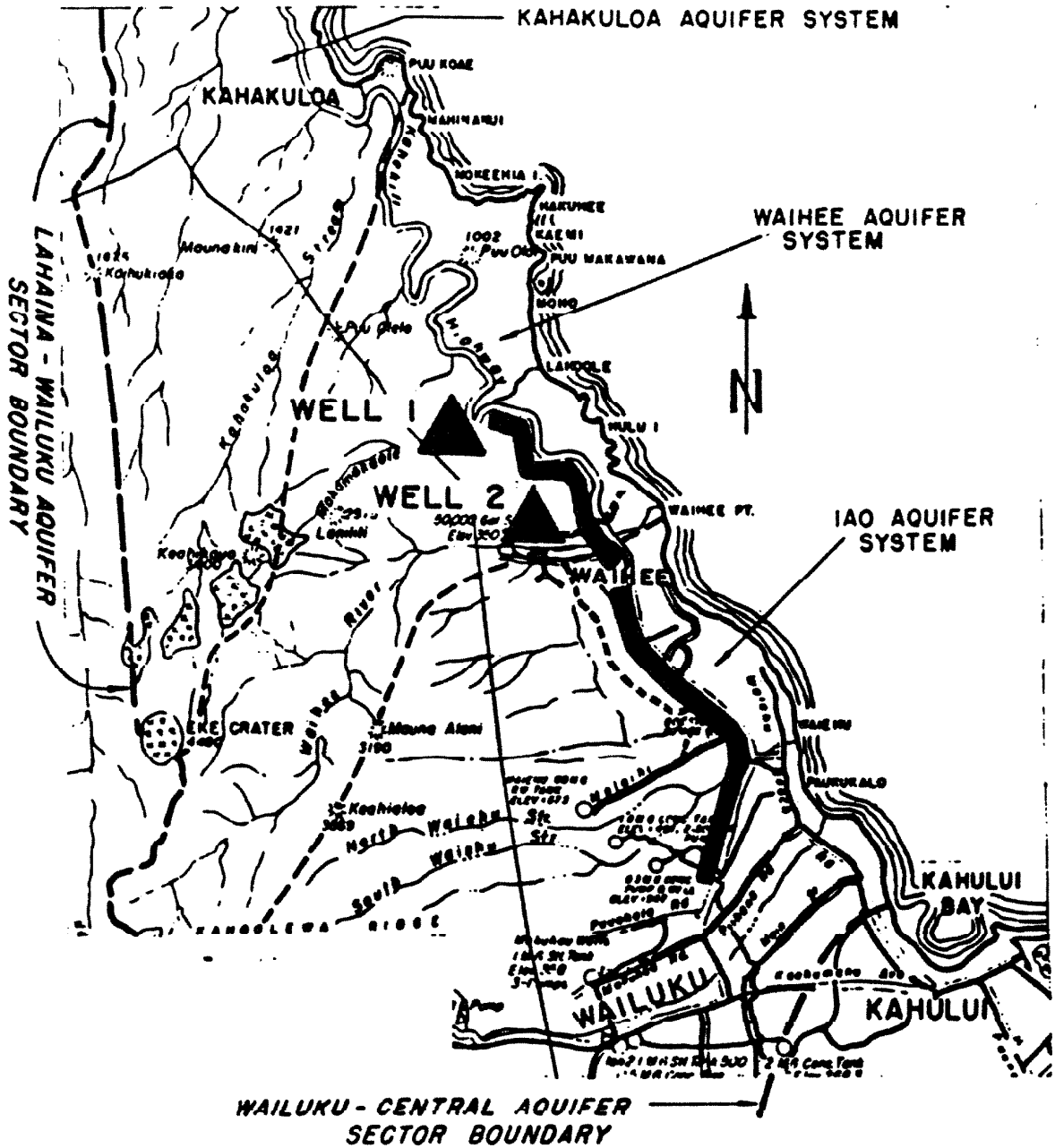
The remaining requirement for the 3.4 to 8.4 million gallons per day increase would be to establish a well field in the Haiku Aquifer System. The sustainable yield is estimated to be 15 million gallons per day; the capacity per well within this area is projected to be 0.5 to 1.0 million gallons per day.

Source development has been discussed for the Kahakuloa Aquifer System*. An additional 8 million gallons per day of sustainable yield is projected from that area. Due to the difficult terrain and the distances involved, the economics of developing the Kahakuloa source are debatable. The estimated cost for these two wells and the associated pipeline is under study. The cost projections for the Kahakuloa Aquifer will contain major uncertainties until the sustainable yield of the aquifer has been more firmly quantified. Until the study is complete, costs are not available.

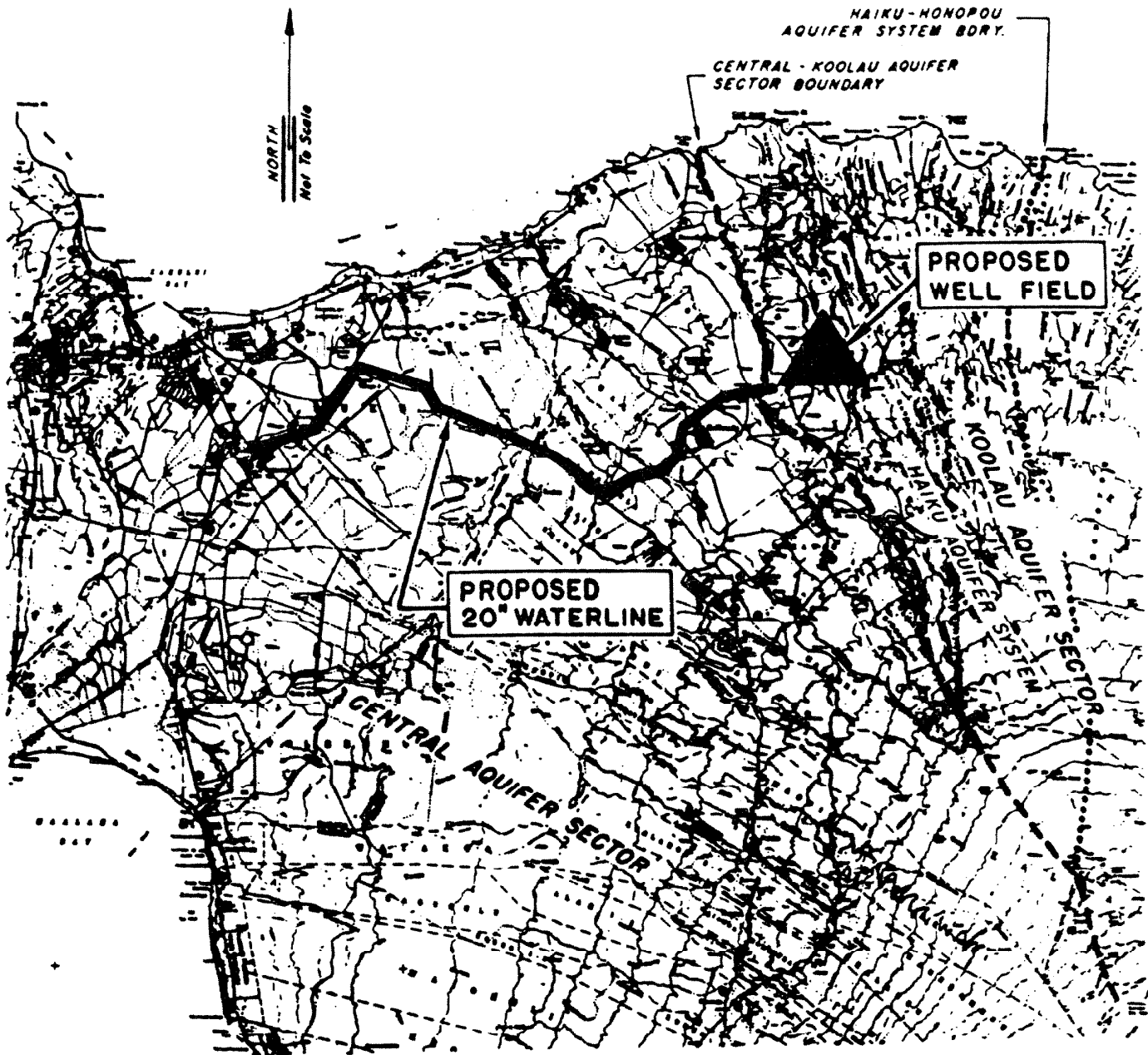
*See Appendix C for detailed aquifer information.

CENTRAL MAUI SYSTEM

WAIHEE-KAHAKULOA WELL #1 & #2



SEE APPENDIX C FOR AQUIFER INFORMATION.



SEE APPENDIX C FOR AQUIFER INFORMATION.

CENTRAL MAUI MUNICIPAL WATER SYSTEM EAST MAUI SOURCES

MAKAWAO WATER SYSTEM

General

The Makawao Water System serves the urban, rural, and portions of the agricultural areas in the Paia-Haiku Community Plan Regions *(except for the Paia-Kuau area) and the Makawao, Pukalani, and Haliimaile communities in the Makawao-Pukalani-Kula Community Plan Regions *(see Exhibit G). The Makawao System also supplements the Kula Water System during dry weather periods. The source of supply for this system is surface run off water collected from east Maui streams. A brief description of the service area, sources and the amount of water withdrawn from the Makawao water system sources by regions are covered in the following.

Makawao-Pukalani-Kula Community Plan Region

The service areas for this region include the Makawao, Pukalani, and Haliimaile communities (see Exhibit G).

The Department of Water Supply reports the amount of water drawn from the Makawao Water Sources for this region for the fiscal year ended June 30, 1987 was 509 million gallons or 1.39 million gallons per day. During dry periods, for the fiscal year, 96 million gallons or approximately 0.26 million gallons per day of water was pumped to the Kula System.

*See Appendix B for information on Community Plan.

A separate irrigation system from Hawaiian Commercial & Sugar Company's Hamakua ditch (see Exhibit G) supplies a portion of the water needs for the County Kula Agricultural Park. Forty-nine MG of water was pumped to the agricultural park.

The total amount of water withdrawn from the Makawao System for the Makawao-Pukalani-Kula Region was 654 MG or 1.79 MGD.

Paia-Haiku Community Plan Region

The service areas for this region include the Kokomo-Kaupakalua, Haiku-Pauwela, Kuiaha communities (see Exhibit G).

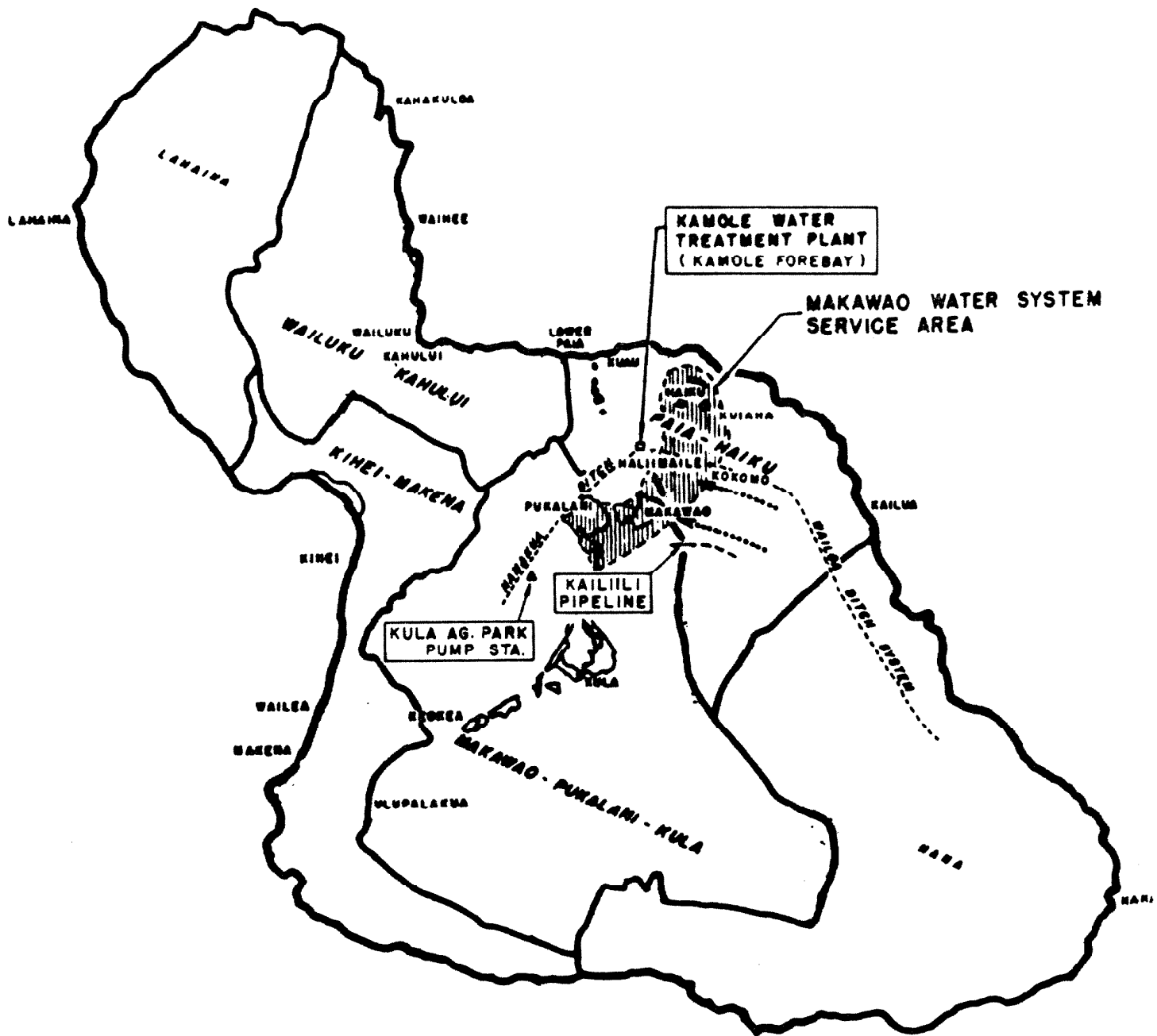
The Department reports the amount of water withdrawn from the Makawao Water System Sources for the fiscal year ended June 30, 1987 was 211 million gallons or 0.58 million gallons per day.

Makawao Water System Sources (Description and Withdrawal)

The Makawao Water System consists of three separate source systems: the Kamole Forebay, Kailiili, and Kula Agricultural Park Pump (Hamakua Ditch intake). Sources are surface runoff water collected from the windward slopes of Haleakala and are within the Koolau Aquifer Sector.*

The main source is the intake at the Kamole Forebay from the Wailoa ditch system at approximately 1100 feet (elevation) level (see Exhibit G). A water treatment plant with a capacity of 8 MGD is located at this site. (The forebay is the end of the Wailoa Ditch and the beginning of the Hamakua Ditch.) This Wailoa irrigation ditch

*See Appendix C for Aquifer information.



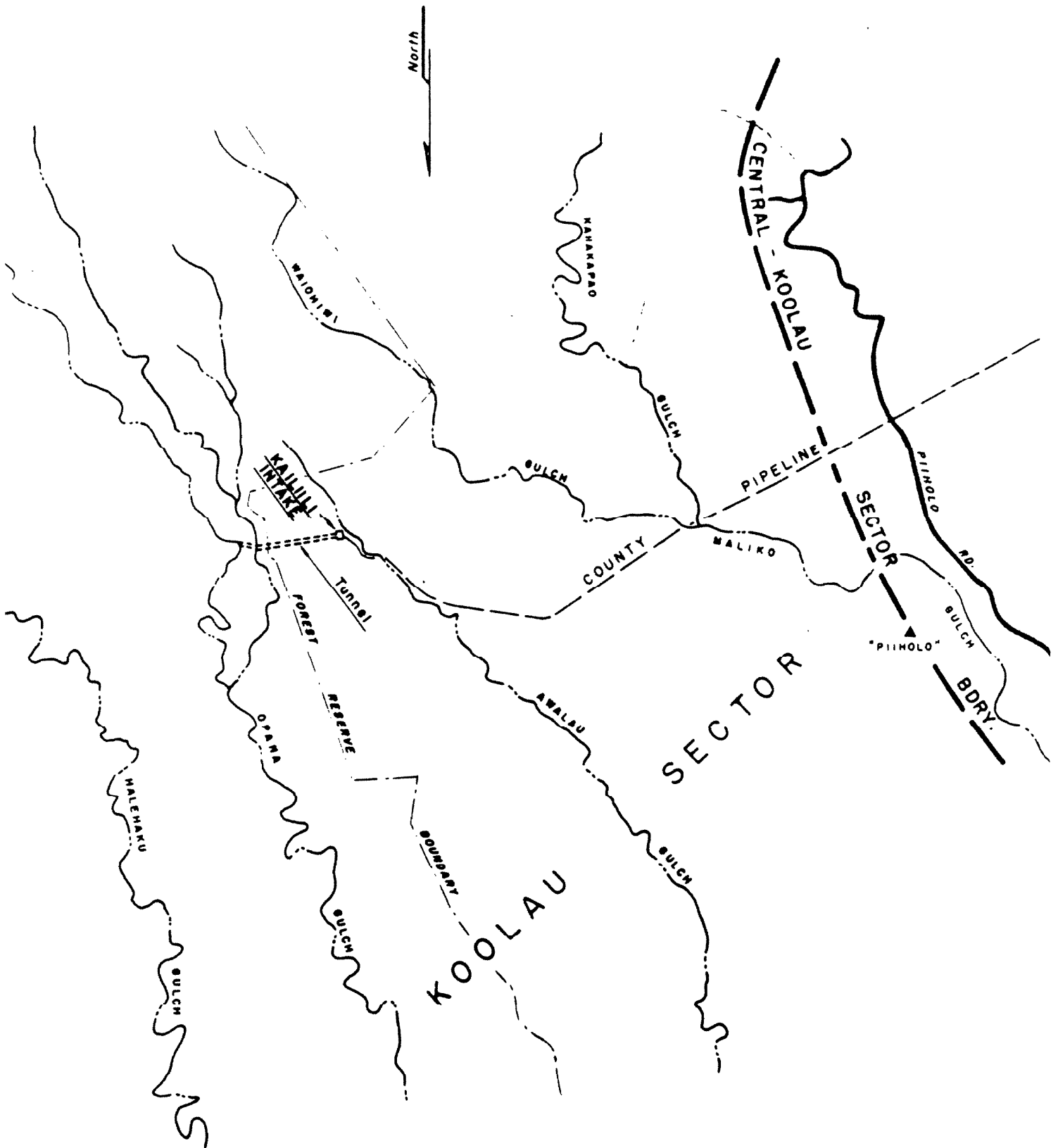
**MAP SHOWING
APPROXIMATE MAKAWAO WATER SYSTEM
SERVICE AREA
(MUNICIPAL)**

and tunnel systems are the upper most ditch owned by EMI Co. and has a capacity of approximately 190 MGD. EMI's irrigation system is further described by HC&S Co.** A large portion of the watershed (runoff) area for this system is owned by the State of Hawaii. EMI Co. has operated continuously under agreement with the State to collect water from the State owned land. The water agreements were included in the Nahiku, Keanae, Honomanu, and Huelo licenses and shown in Exhibit AO.

The smaller Kailiili System is located along the 2,000 foot elevation (approximately). This source is surface runoff water collected from East and West Opana Streams. The water collected from this system is divided among four parties: Maui County, Kaonoulu Ranch Co., Haleakala Ranch Co., and Maui Pineapple Co. (see Exhibit H for the location of the source).

The amount of water withdrawn from the Makawao Water System Sources for fiscal year ended June 30, 1987 is shown in the following table and by a schematic diagram for sources and service area in Exhibit I.

** See Reference for description of EMI's irrigation system.



SEE APPENDIX C FOR AQUIFER INFORMATION.

KAILILI WATER SOURCE

SOURCE FOR:
 Maui Land & Pineapple Co., Inc.
 County of Maui
 Haleakala Ranch
 Kaonoulu Ranch

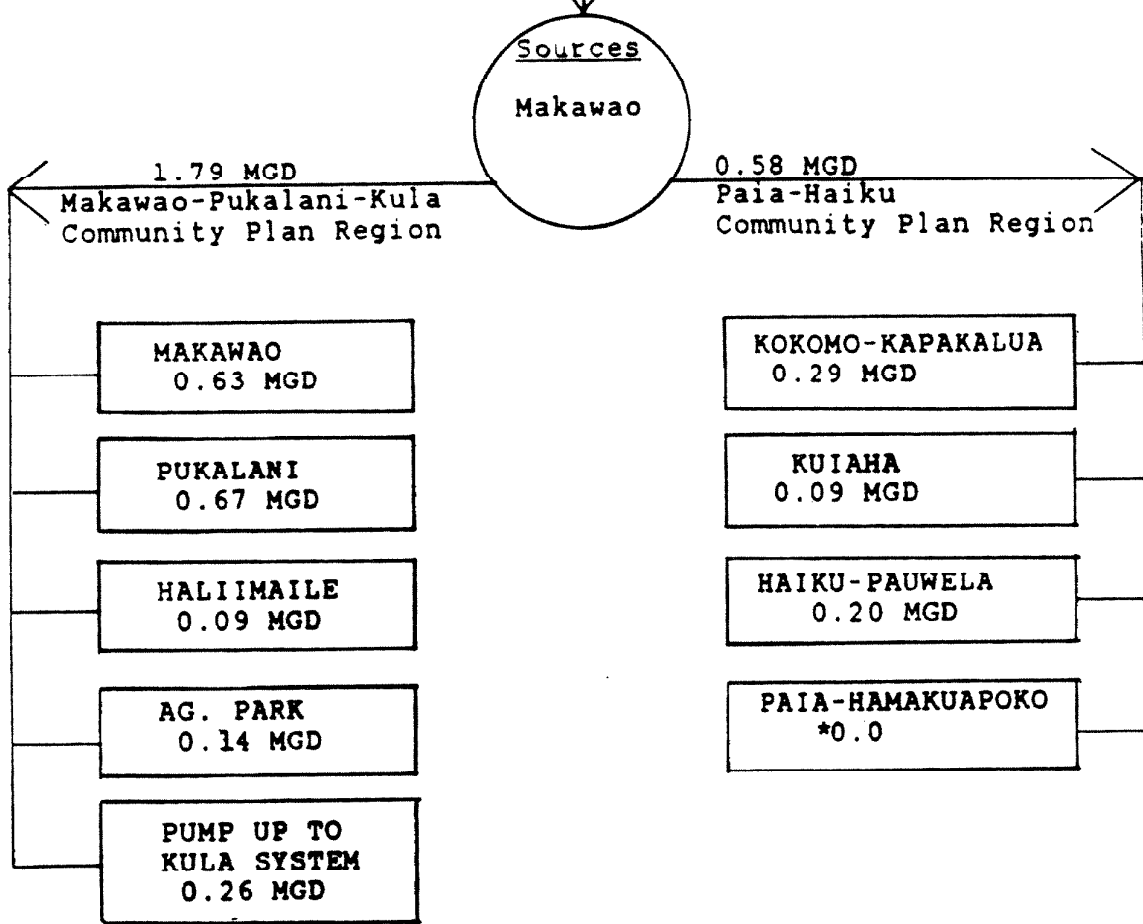
WATER WITHDRAWN FROM
 MAKAWAO WATER SYSTEM SOURCES FOR
 THE FISCAL YEAR 1987

<u>BY COMMUNITY PLAN:</u>	<u>MG</u>	<u>MGD</u>
Makawao-Pukalani-Kula	654	1.79
Paia-Haiku	<u>211</u>	<u>0.58</u>
Total	865	2.37

Further breakdown by sources are:

<u>BY SOURCES:</u>	<u>MG</u>	<u>MGD</u>
Kamole Forebay & Kailiili System (gravity)	816	2.23
Hamakua Ditch-Kula Ag Park Pump	<u>49</u>	<u>0.14</u>
	865	2.37

<u>Sources</u>	<u>Amount Withdrawn in 1987</u>
Kamole Forebay Intake)	816 MG
Kailili Intake)	
Hamakua Ditch Intake)	49 MG
(Kula Ag Park Pump)	
	865 MG
	or 2.37 MGD



Makawao Municipal Water System
By Community Plan Region
Schematic Diagram For
Sources and Distribution
For 1987

*Less than 10,000 gpd.

The future water projections for the Makawao Water System are summarized as follows:*

1. By service area and by community plan region in the following table.
2. By a schematic diagram for sources and service areas in Exhibit J.

MAKAWAO-PUKALANI-KULA COMMUNITY PLAN REGION

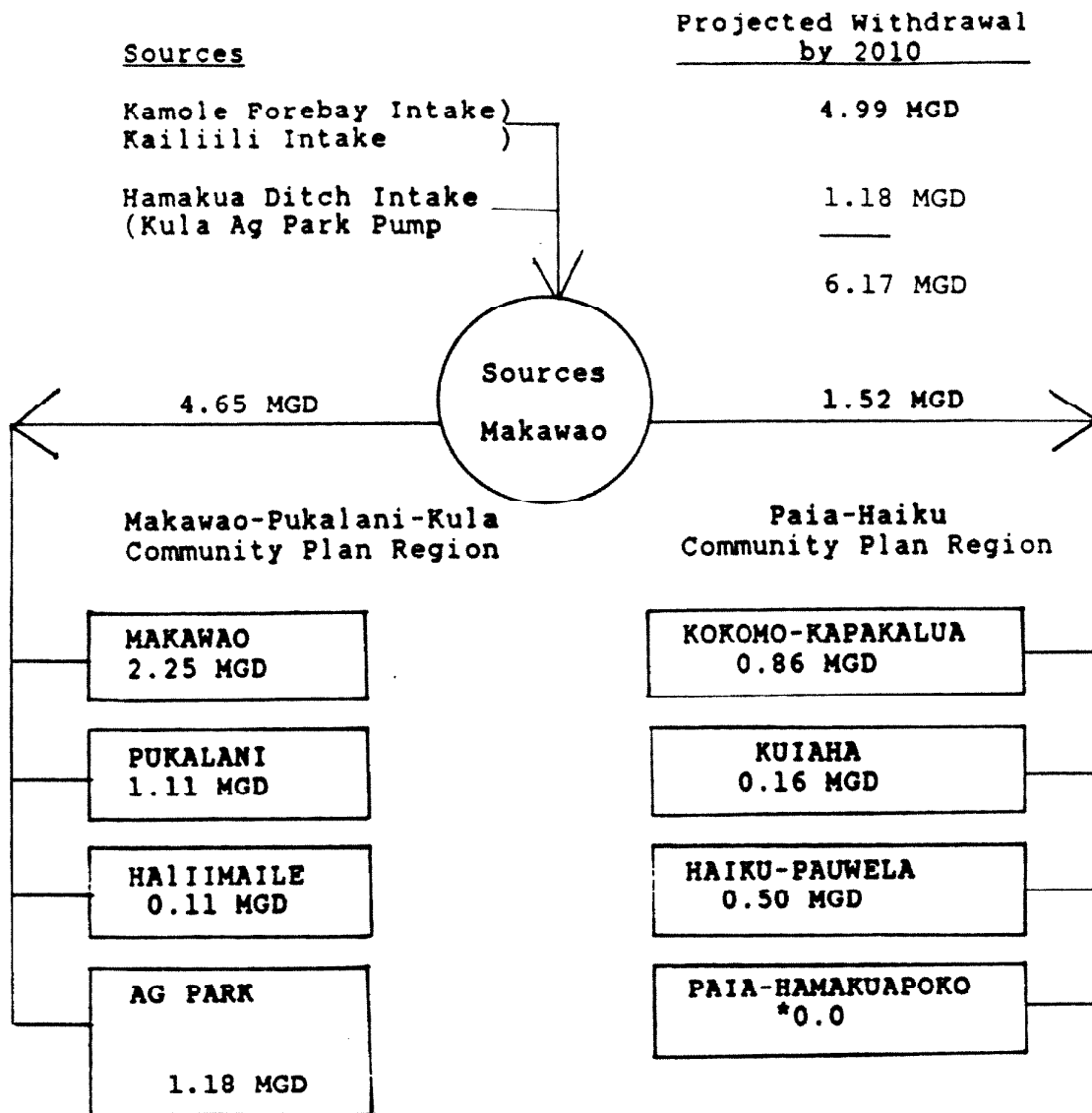
	<u>1987</u> (Actual)	<u>2010</u>
	<u>UNIT MGD</u>	
<u>Makawao System</u>		
Makawao	0.63	2.25
Pukalani	0.67	1.11
Haliimaile	0.09	0.11
Kula - pump	0.26	0.00
Kula Agriculture Park Pump	<u>0.14</u>	<u>1.18</u>
Total Makawao System	1.79	4.65

PAIA-HAIKU COMMUNITY PLAN REGION

	<u>1987</u> (Actual)	<u>2010</u>
<u>Makawao System</u>		
Kokomo-Kapakulua	0.29	0.86
Kuiaha	0.09	0.16
Haiku-Pauwela	0.20	0.50
Paia-Hamakuapoko	<u>**0.00</u>	<u>**0.00</u>
Total Makawao System	0.58	1.52
<u>Paia-Kuau (Central Maui)</u>	0.37	0.52

*Projection by Department of Water Supply

**Less than 10,000 gpd.



Makawao Municipal Water System
 By Community Plan Region
 Schematic Diagram For
 Sources and Distribution
 For Year 2010

*Less than 10,000 gpd.

**WATER DEVELOPMENT PLANS
Municipal System - Makawao**

The water supply requirements for the Makawao region were reviewed in the Department of Water Supply's study completed in February, 1988. The report developed estimates of future water demand using water consumption growth patterns for the period 1980 to 1987, in each of the community plan areas. The growth experienced in that period was used to project growth for the next twenty years. In areas, such as the Kula Agricultural Park, such calculations resulted in unrealistically high growth rates due to natural limits of available land. In such cases, growth in demand was capped at the estimated maximum demand.

The water usage derived in the study referenced above differ from actual production. Losses experienced in the system were not included in the study's estimate of required demand. These losses have been included in the estimate for total required production. The Water Development Plan incorporates system losses into the total projected water use to ensure sufficient well capacity is available to meet the requirements of real system operations. In Makawao the overall rate for losses was 18% of system sales.

The 1987 average day production required was 2.37 million gallons per day, including losses.* The Department of Water Supply expects that requirement, again including losses, to grow as to as much as 6.17 million gallons per day by the year 2010. The average expected growth in water usage in Makawao, which includes Haiku, Kuiaha, Pukalani, Haliimaile, and the Kula Ag Park District is expected to be 4.6% per year.

These years have been high growth years in all areas of the islands, except for Molokai. Continuation of growth at the same high rate for the next twenty years is unlikely in many areas. The projections likely represent the upper limit of growth in demand.

The major water source for the Makawao area is the Kamole Water Treatment Plant, which is fed by water from the East Maui Irrigation System. Agreements with East Maui Irrigation (E.M.I.) permit the Department of Water Supply to take up to 12 million gallons per day without prior notice, with an increase of an additional 4 million gallons per day with one year's notice. The total supply from this source, under current agreements which end December 31, 1993 is 16 million per day. The Kamole Treatment Plant, sited on the Wailua Ditch, conditions the water to meet Safe Drinking Water Act standards, and pumps the water up into the Makawao system.

*See Appendix A - Definitions.

The Kamole Water Treatment Plant has a present capacity of 8 million gallons per day. It was designed to have a final capacity of 12 million gallons per day, after addition of filters and other plant components. The expansion of the plant will be needed to meet the 2010 demand with sufficient reserves to meet peak day and peak period requirements in Makawao. In addition, as much as 2 million gallons per day may be required to meet drought demands from Upper and Lower Kula until the appropriate reservoir and intake structures are constructed in that area.

Based on the projected growth rates, the need to have 50% reserve capacity to handle peak periods, and possible delays in reservoir construction, the Kamole Water Treatment Plant will reach safe capacity by 2006. Plans are to upgrade the plant to the 12 million gallons per day capacity. The cost of such an upgrade are not known for several reasons.

The present Kamole Treatment Plant does not have any settling basins or any inlet storage reservoir. As a result it is sensitive to changes in incoming water quality, and weather conditions. Prior to determining the cost of an upgrade, a study must be conducted to determine the need for modifications in the plant design. Due to the number of years remaining on available plant capacity such a study is not planned for several years.

In addition to the Kamole Treatment Plant, the Department of Water Supply also has an untreated surface water source at Kailili supplying approximately .2 million gallons per day. This small surface source presently has a turbidity control system installed to ensure that it meets current turbidity standards. The long-term use of this source is under study. While it is an inexpensive and reliable source of water, the economics and safety issues relating to treatment of the water are not well defined. The United States Environmental Protection Agency is currently reviewing standards relating to surface water sources. In the event the Department of Water Supply is unable to justify it's continued use, the capacity of the Kamole Weir is more than sufficient to meet projected needs to the year 2010.

In addition to the existing sources, the Department of Water plans to develop a well in Haiku. This well, estimated to cost \$1,400,000 in current dollars, is projected to produce 540,000 gallons per day to supplement the Kamole Weir (See Exhibit K for approximate location).

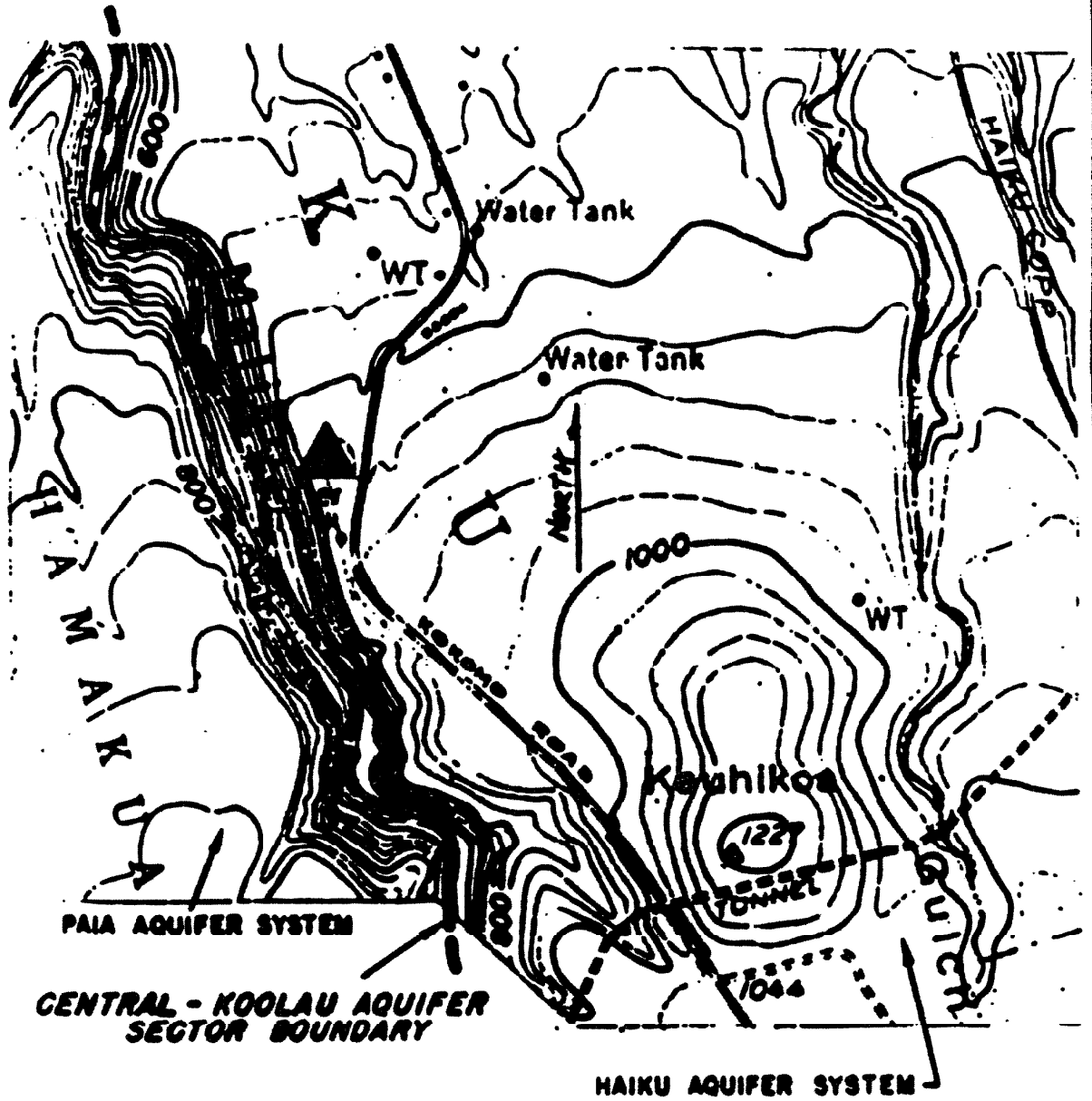
Based on present projections of growth, the Makawao system has a surplus of available water to the year 2006, without any additions to the system. Making the improvements to the Kamole Weir to increase it's capacity to 12 million gallons per day, and installation of a new well at Haiku will provide capacity past the year 2010.

However, the EMI source at times may not be able to supply 12 million gallons per day (see Page 86. Total EMI low flow 1983-1987 of 10.77 MGD). Insufficient flow to HC&S Co. could affect island power supply as well as their agricultural uses.

The industrial demands are as follows:

HC&S' power plant requirement from the Wailoa Ditch is 2-3 MGD. (The turbogenerators require saline-free water, thus, pumped water cannot be used.) If that water is not available, then HC&S has to shut down its power plants, thereby shutting down HC&S' factory and irrigation pumping operations as well. As a result, MECO would also lose the ability to meet 15-20% of the island-wide power demand.

HAIKU DEEP WELL



SEE APPENDIX C
FOR AQUIFER INFORMATION.

KULA WATER SYSTEM

General

The Kula Water System consists of the Upper Kula System and Lower Kula System and supplement from Makawao System. These systems serve Kula in the Makawao-Pukalani-Kula Community Plan Region as shown in Exhibit L.

Upper Kula System

The Upper Kula Water System runs approximately along the 4,000 foot contour level. The source is runoff water collected from Haipuaena, Puohakamoa, and Waiakamoi Streams. The treatment plant is located at Olinda and has a capacity of 1.7 MGD and may be expanded to 2.5 MGD. The quantity of water drawn from this system was 311 million gallons or 0.85 MGD for the 1987 fiscal year. The source area is within the Koolau Sector.*

Lower Kula System

The Lower Kula Water System runs along approximately the 3,000 foot contour level. The source is also runoff water collected from the Haipuaena, Puohakamoa, Waiakamoi, and Honomanu Streams and in the Koolau Sector.* The amount of water drawn from this system for the 1987 fiscal year was 777 million gallons or 2.13 MGD.

Makawao System

During dry weather, additional water is supplemented to the Kula Water System through a series of pumps from the Makawao System. The quantity pumped for the 1987 fiscal year was 96 million gallons or 0.26 MGD.

* See Appendix C for information on aquifer.

Summary

The withdrawal for the Kula Water System for the 1987 fiscal year was:

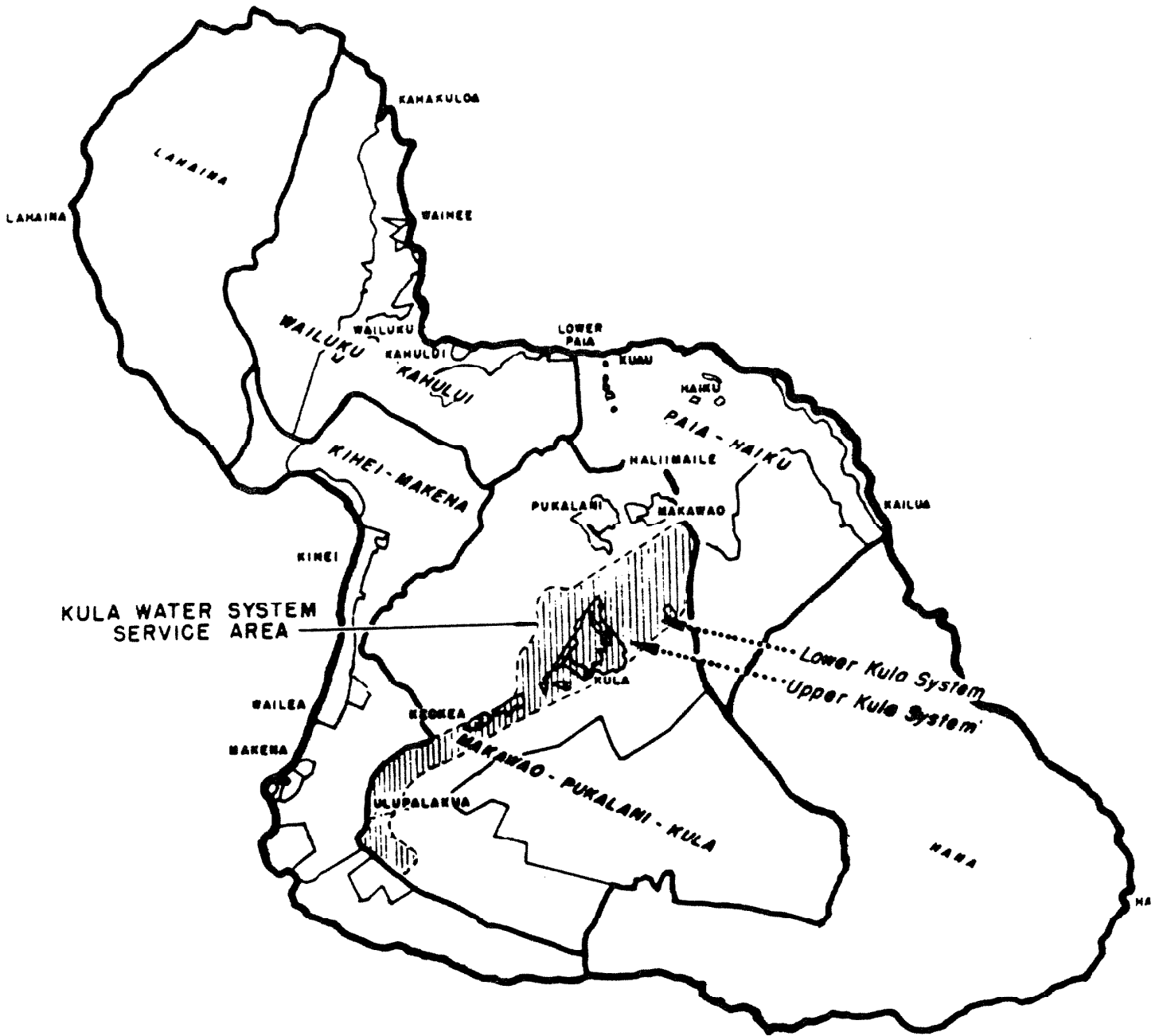
	<u>Yearly Total</u>	<u>Average Day</u>	<u>Pump Up Yearly Total</u>	<u>Average Day</u>
<u>Kula Sources</u>				
Upper Kula System	311 MG	0.85 MGD		
Lower Kula System	777 MG	2.13 MGD		
<u>Makawao System</u> (Pump up to Kula System)	_____	_____	96 MG	0.26 MGD
Total	1,088 MG	2.98 MGD	96 MG	0.26 MGD

Schematic diagram shown in Exhibit M.

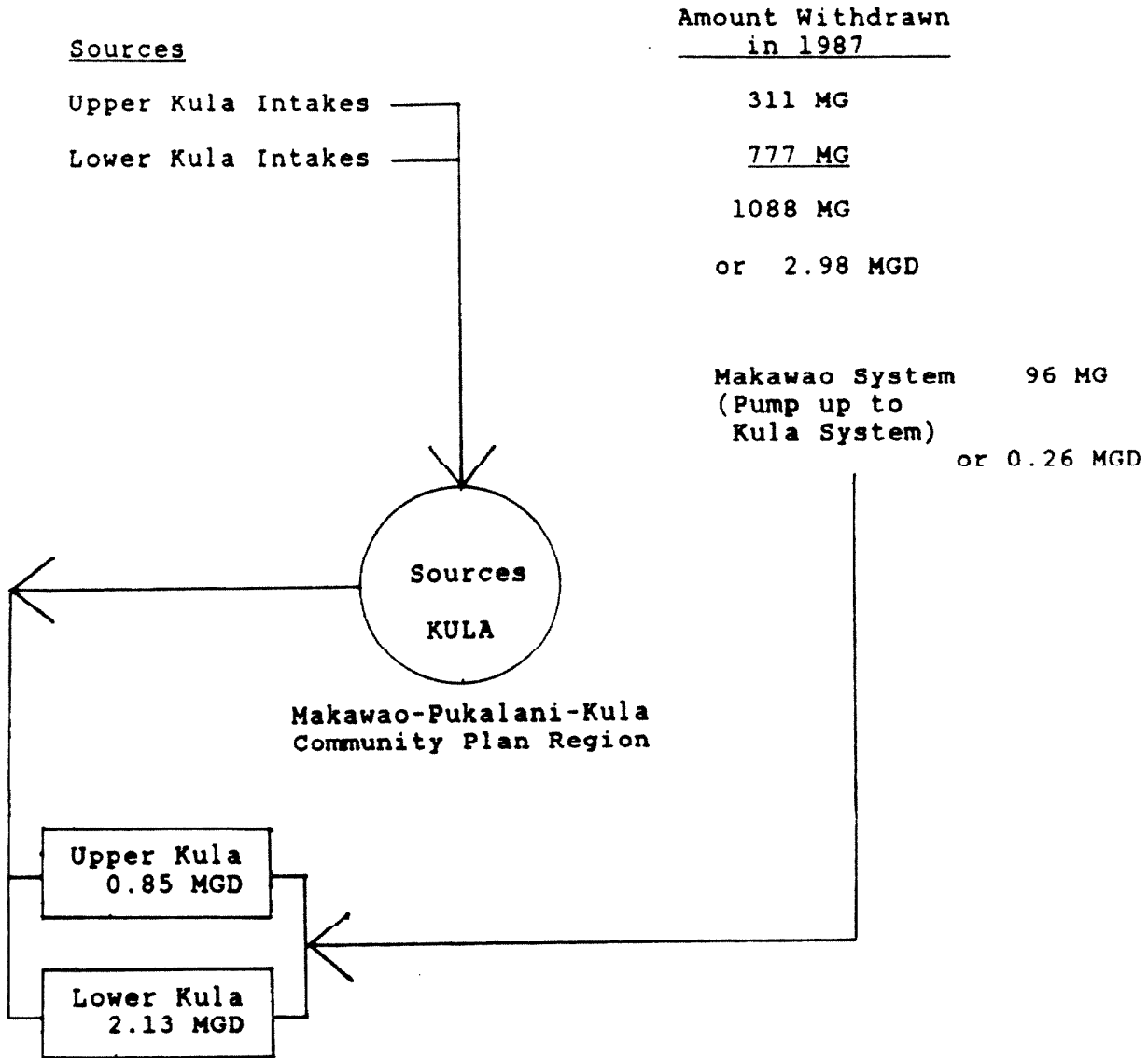
"Kula Rule"*

In the past, the Kula area has experienced very dry periods and the water sources could not meet the water demand for the area. A "back-up" pumping system was constructed to supplement additional water to the Kula system. Because of the unpredictable weather, the huge cost of improvements needed to increase the source supply, and the high cost of operation and maintenance of the Kula system, the County of Maui had enacted the Kula Rule "regulating for an interim period the issuance of water meters and the approval of subdivision applications from the upper Kula waterline and lower Kula waterline". The rule was enacted in November, 1977. This rule has been effective in "slowing" the water demands for the area enabling the County to keep up with the improvements needed to meet the demands.

*Dept. of Water Supply Rule.



MAP SHOWING
 KULA WATER SYSTEM SERVICE AREA
 (MUNICIPAL)

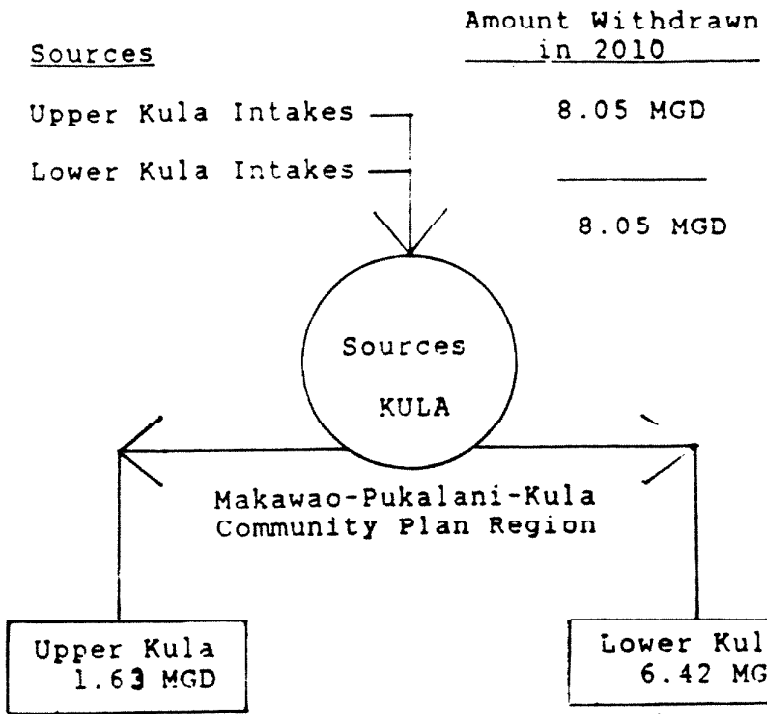


**Kula Municipal Water System
 by Community Plan Region
 Schematic Diagram for
 Sources and Distribution
 for the year 1987**

Future Water Projection - Kula*
Makawao-Pukalani-Kula Community Plan Region

	<u>1987</u> <u>(Actual)</u> <u>MGD</u>	<u>2010</u> <u>MGD</u>
<u>Kula System - "Kula Rule" in Effect</u>		
Upper Kula)		
Lower Kula)	3.24	8.05

* From Department of Water Supply



Kula Municipal Water System
by Community Plan Region
Schematic Diagram for
Sources and Distribution
For the Year 2010

MAKAWAO-PUKALANI-KULA AND PAIA-HAIKU

COMMUNITY PLANS

FUTURE WATER PROJECTIONS - SUMMARY

The following table is a summary of future withdrawals for Makawao-Pukalani-Kula and Paia-Haiku community plans.**

	<u>1987</u> (Actual)	<u>2010</u>
<u>Paia-Haiku Community Plan Region</u>		
Makawao System	0.58	1.52
Central Maui System (Wailuku Aquifer Sector)	<u>0.37</u>	<u>0.52</u>
Total	0.95	2.04
<u>Makawao-Pukalani-Kula Community Plan Region</u>		
Makawao System	1.53	4.65
Kula System ("Kula Rule" in effect)	<u>3.24</u>	<u>8.05*</u>
Total	4.77	12.70

*Shown in Exhibit N.

**From Department of Water Supply.

WATER DEVELOPMENT PLANS

Municipal System: KULA

The Department of Water Supply prepared a County-wide Source Study for the municipal water system. The report, completed in February, 1988, developed estimates of future water demand using recent growth patterns in each of the community plan areas. The growth in consumption from the years 1980 to 1987 was used as the base for projected growth for the next twenty years. The 1987 average day production required for Upper Kula was 0.98 million gallons per day and for Lower Kula was 2.26 million gallons per day, for a total average production per day of 3.24 million gallons. The Department of Water Supply expects that requirement to grow to 1.63 million gallons per day in Upper Kula, and 6.42 million gallons per day in Lower Kula by the year 2010, for a total of 8.1 million gallons per day. The average expected growth in water usage in the combined Upper and Lower Kula combined is projected at 4.1% per year.

These years have been high growth years in all areas of the islands, except for Molokai. Continuation of growth at the same high rate for the next twenty years is unlikely. The projections proposed above are likely to represent the upper limit of growth in demand.

The water usage derived in the study used water sales to develop projections of future demand. The projected water production estimates above were corrected for water losses and represent actual production requirements. Losses experienced in the system are calculated as 18% of total production in Upper and Lower Kula. These losses have been included in the estimate for total required production. The Water Development Plan incorporates system losses into the total projected water use to ensure sufficient well and surface capacities are available to meet the requirements of real system operations.

Based on the report and the projections for water use in Upper and Lower Kula the Department of Water Supply will develop approximately 5.6 million gallons per day for new surface source capacity between 1989 and the year 2010. This capacity will be developed by improving intakes in the upcountry region, and by increasing storage through the addition of several new reservoirs. The additional average daily use of 5 million gallons per day will be supplied by the additional domestic capacity of 5.6 million gallons per day. During periods of peak demand, or prolonged drought, water needs will be met by draft from storage, and if necessary, supplements from the Kamole Weir.

These improvements are intended to address the following:

Provide a 90-day drought security

Assist family type subdivisions

Provide for agricultural (farming) opportunities

Assist the Department of Hawaiian Homes with the subdivision at Keokea

Assist existing users

The total cost of the source development projects in Kula is projected as \$73,266,000 in current (1988) dollars. The bulk of these costs are expected to be incurred in installing a transmission line from Waiakamoi to the Olinda Treatment Plant (\$7,500,000), increasing the capacity of the Piiholo Reservoir (\$5,000,000), the building of the Kahakapao Reservoir (\$13,000,000), Waihou Reservoir (\$12,000,000), and the Kailua Reservoir (\$23,000,000). Additional costs include building of a treatment plant in Lower Kula, reconstructing and improving water intakes and upgrading the capacity of the Olinda Treatment Plant.

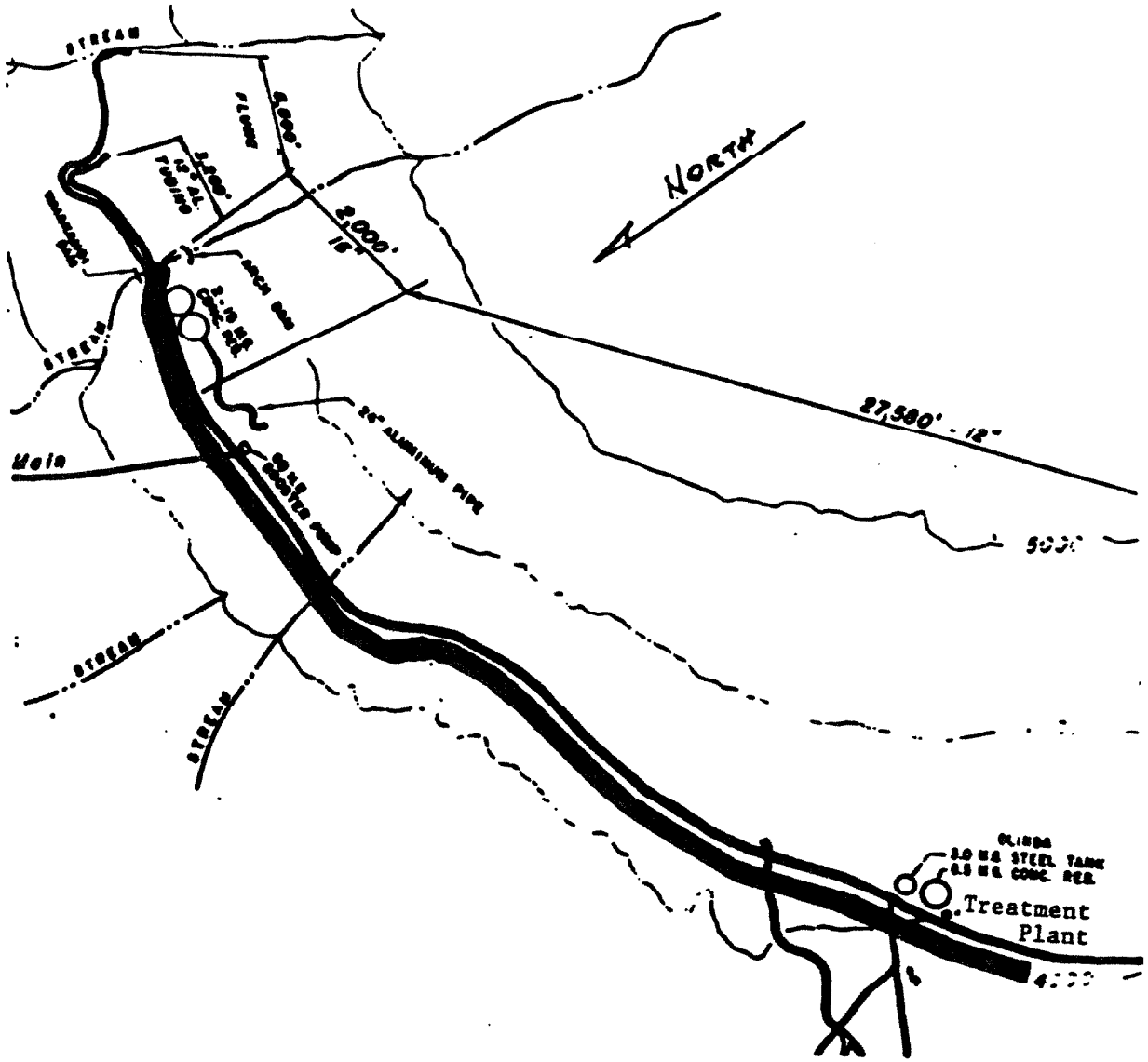
The following list* and Exhibits* Q to AB show a summary of the projects.

*From draft copy of twenty-year County-wide Source Development Program, February 10, 1988, and Upcountry Water System Improvements Master Plan, and updated 9/89 by the Department of Water Supply.

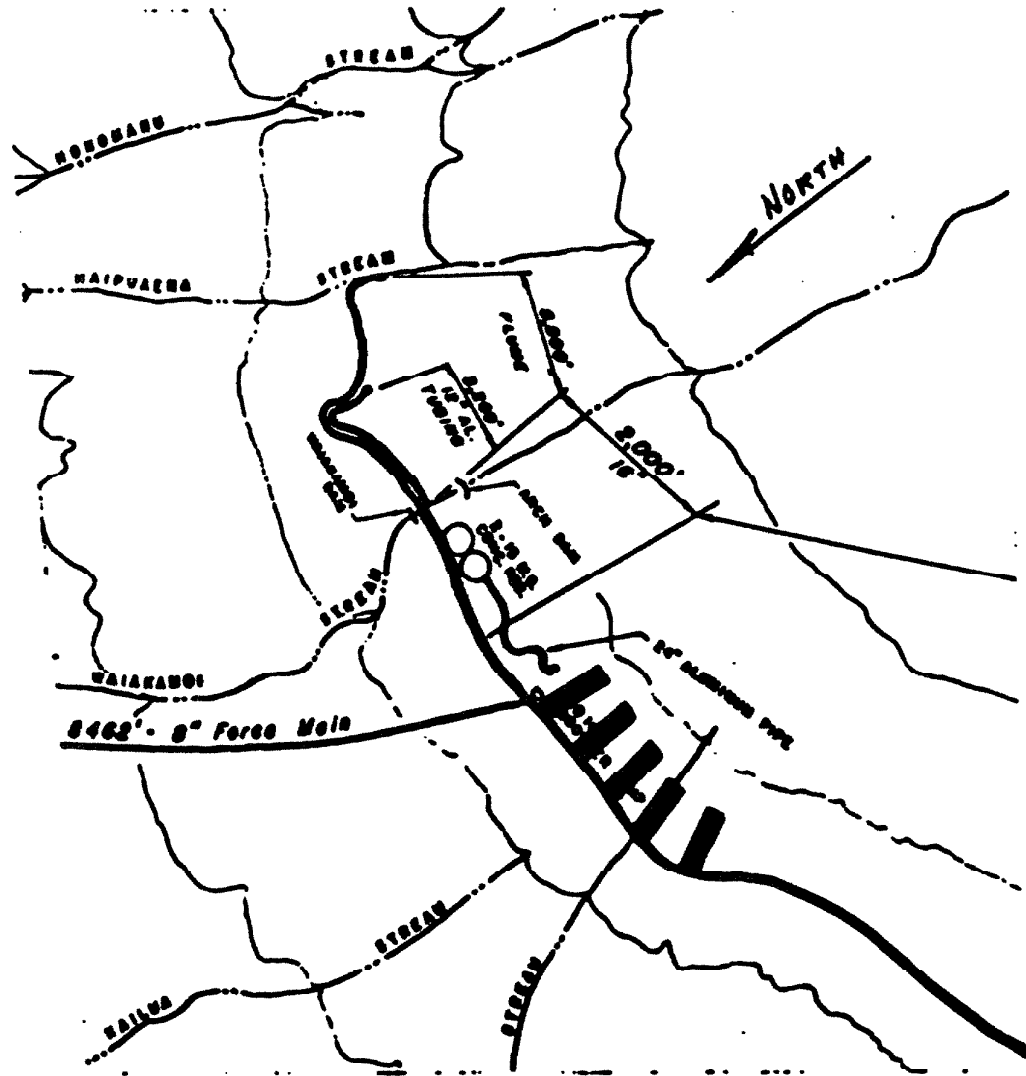
SOURCE DEVELOPMENT PROJECT LIST
FOR KULA WATER SYSTEM

<u>PROJECT</u>	<u>COST</u>	<u>EXHIBIT</u>
36" Transmission Pipeline	7,500,000	O
Intakes W. of Waiakamoi	80,000	P
Fix Waiakamoi Intakes & Pipe	420,000	Q
100 M.G. Kahakapao Reservoir	13,000,000	R
Expand Olinda Plant to 2.5 MGD	315,000	S
50 M.G. Mahanalua Reservoir	5,400,000	T
75 M.G. Waihou Reservoir	12,000,000	U
Check valves, W. & Middle Puoho	49,000	V
Relocate E. Waiakamoi Intake	97,000	W
Intakes, 10th Branch, Kailua	134,000	X
New Intake, Kailua Stream	127,000	Y
Modify Piping & Controls, Piiholo Reservoir	30,000	No exhibit
Raise Piiholo Reservoir Walls, etc.	4,950,000	Z
300 M.G. Kailua Reservoir	23,144,000	AA
2.5 MGD L. Kula Treatment Plant	<u>5,980,000</u>	AB
TOTAL	\$73,226,000	

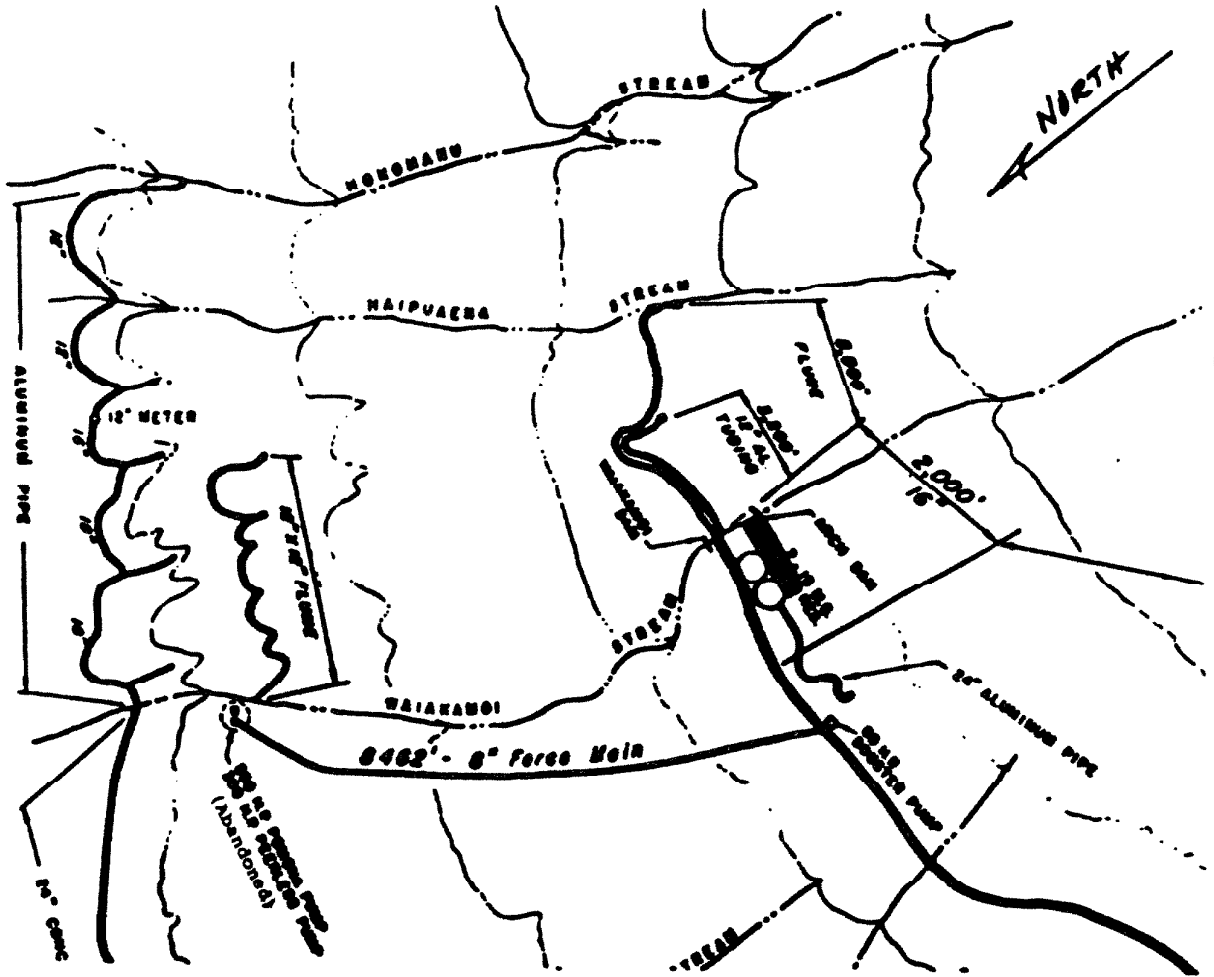
36" TRANSMISSION PIPELINE



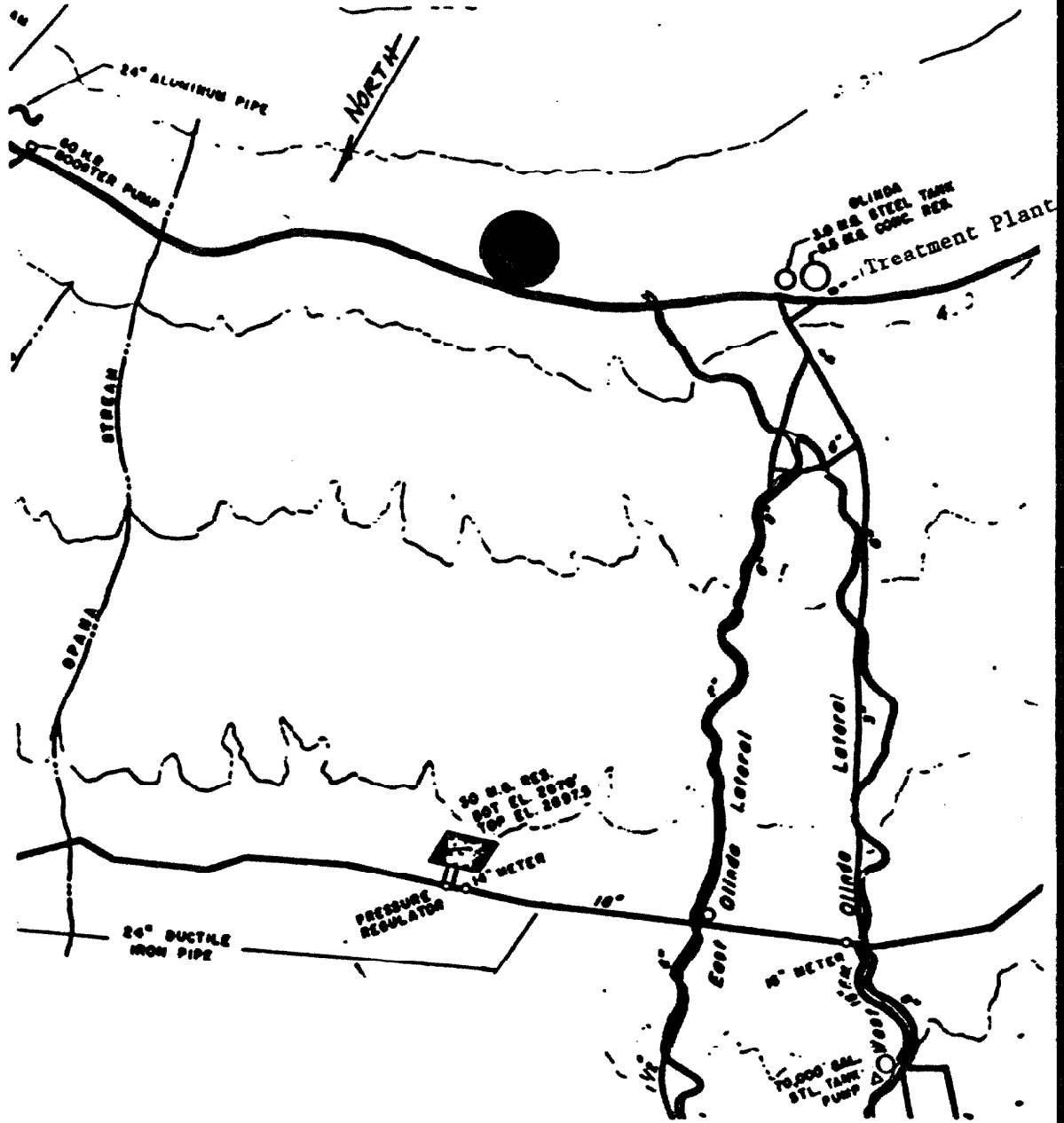
INTAKES W. OF WAIAKAMOI



FIX WAIAKAMOI INTAKES & PIPE

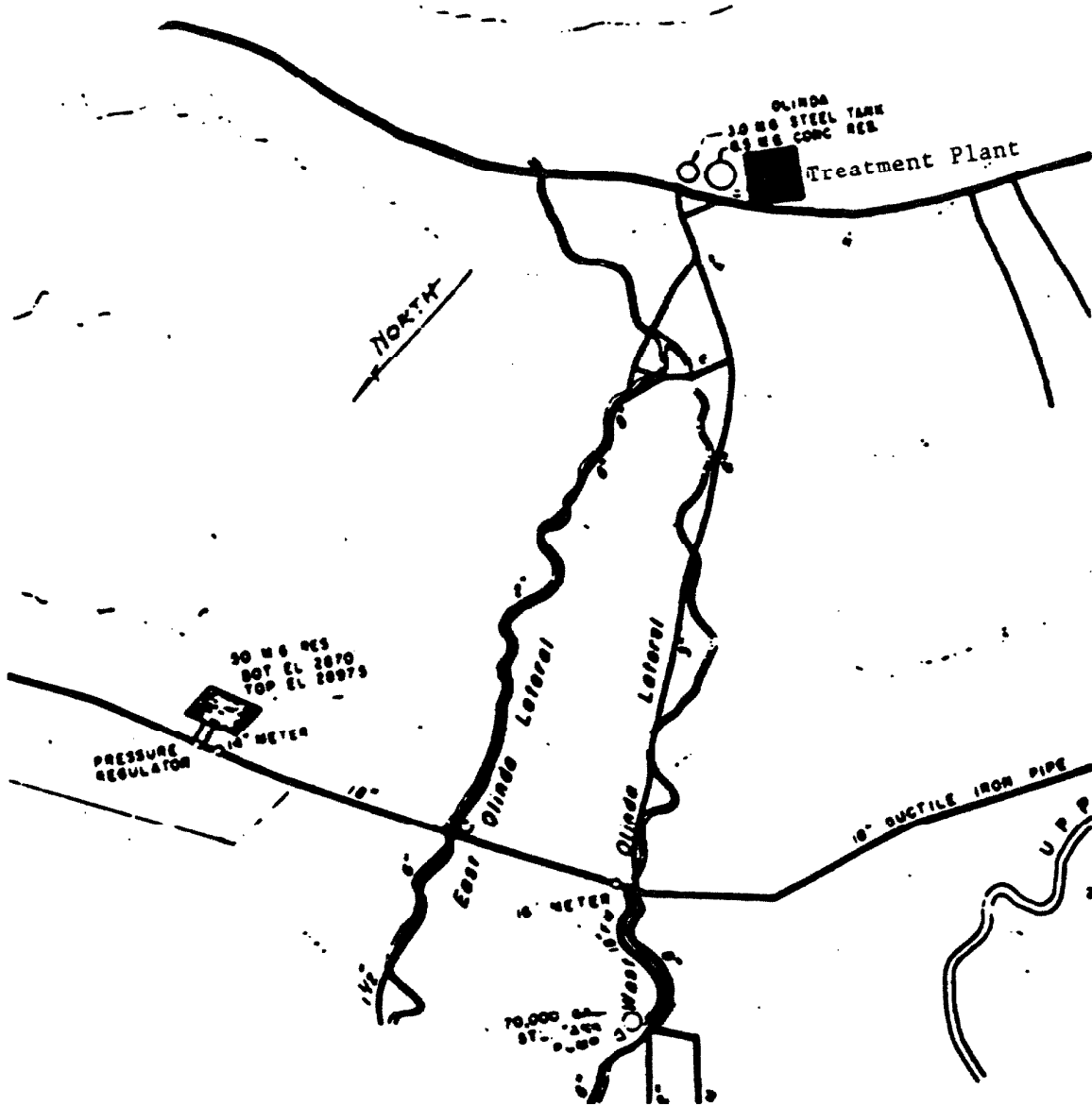


100 M.G. KAHAKAPAO RESERVOIR



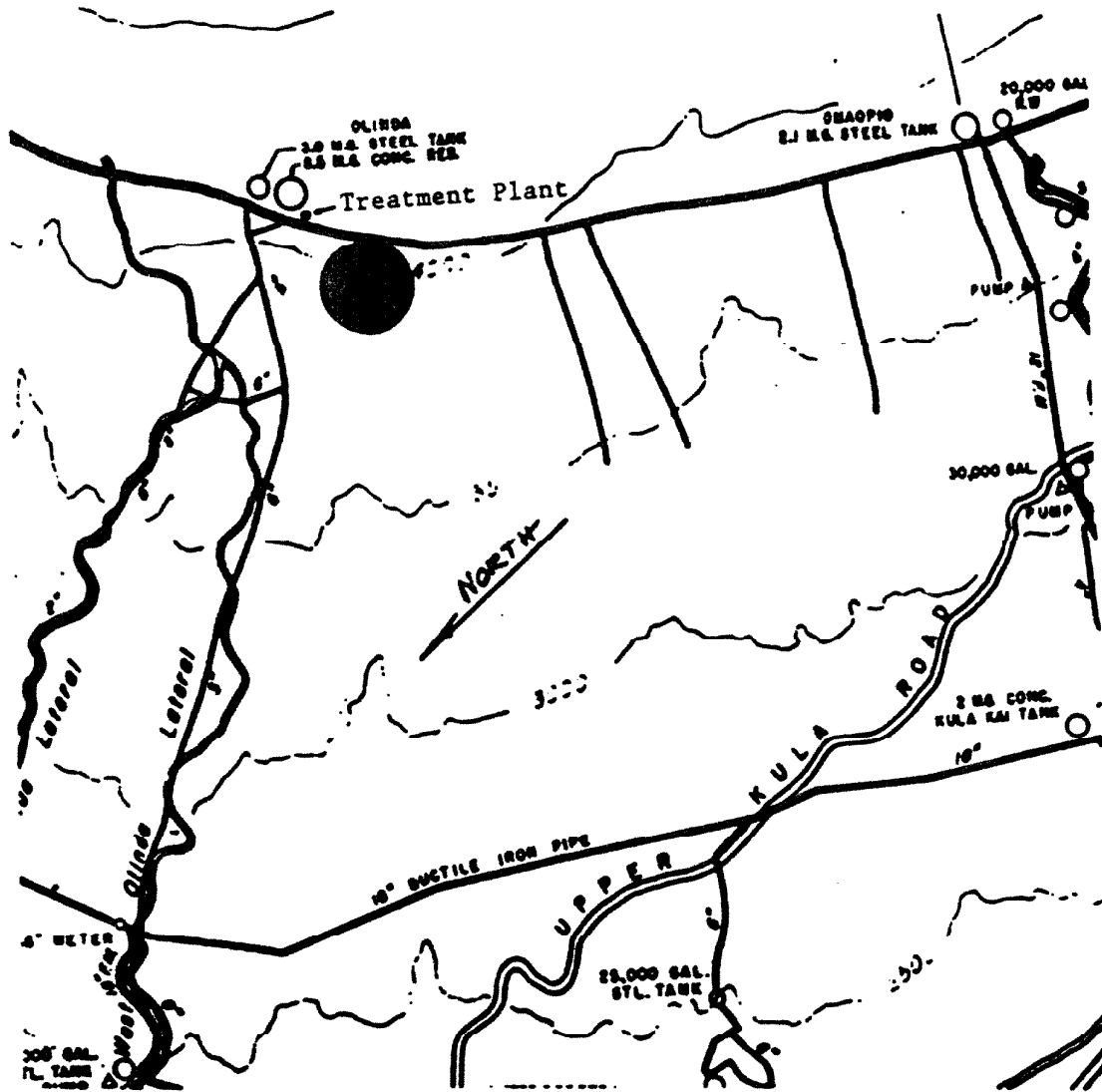
KULA WATER SYSTEM

EXPAND OLINDA TREAT. PLT.



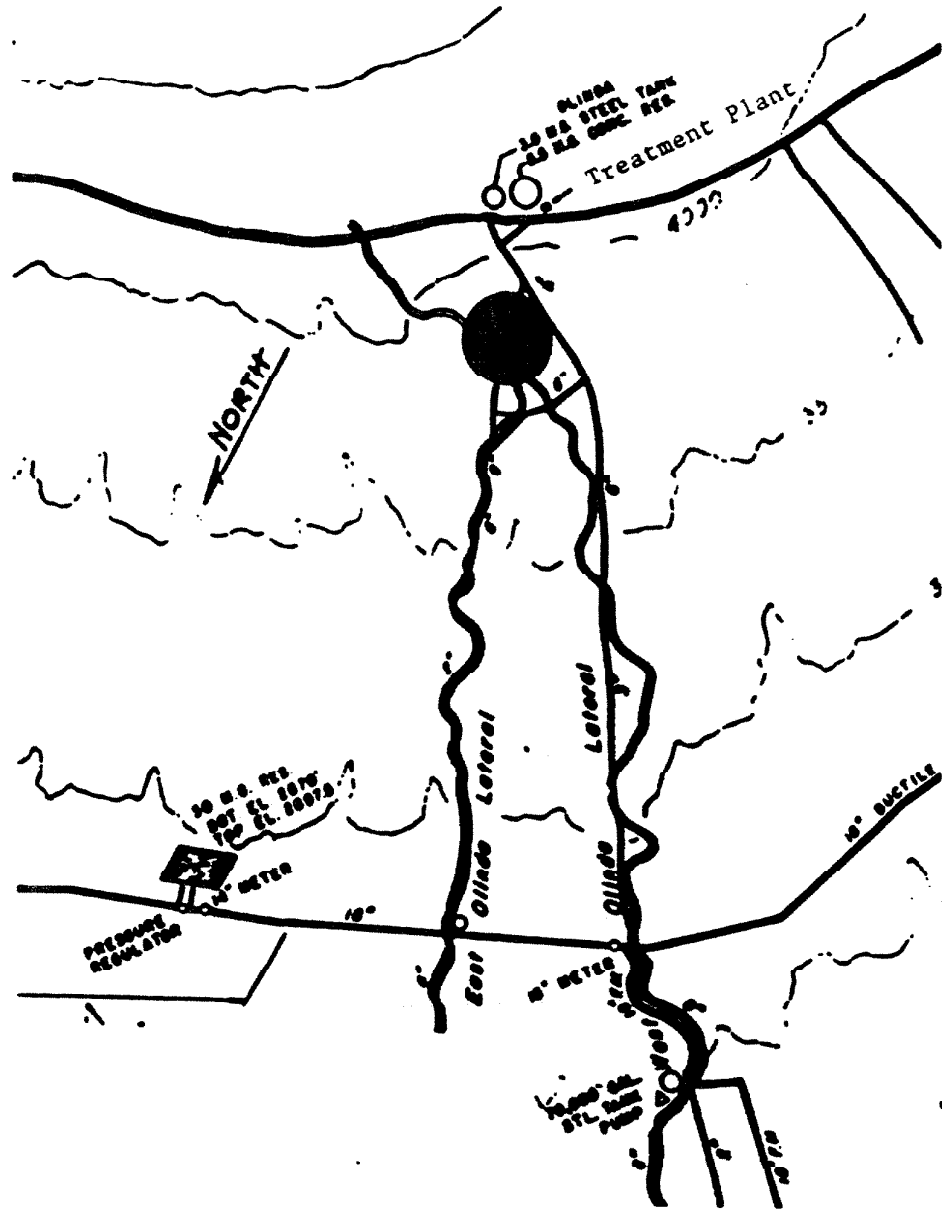
KULA WATER SYSTEM

50 M.G. MAHANALUA RESERVOIR



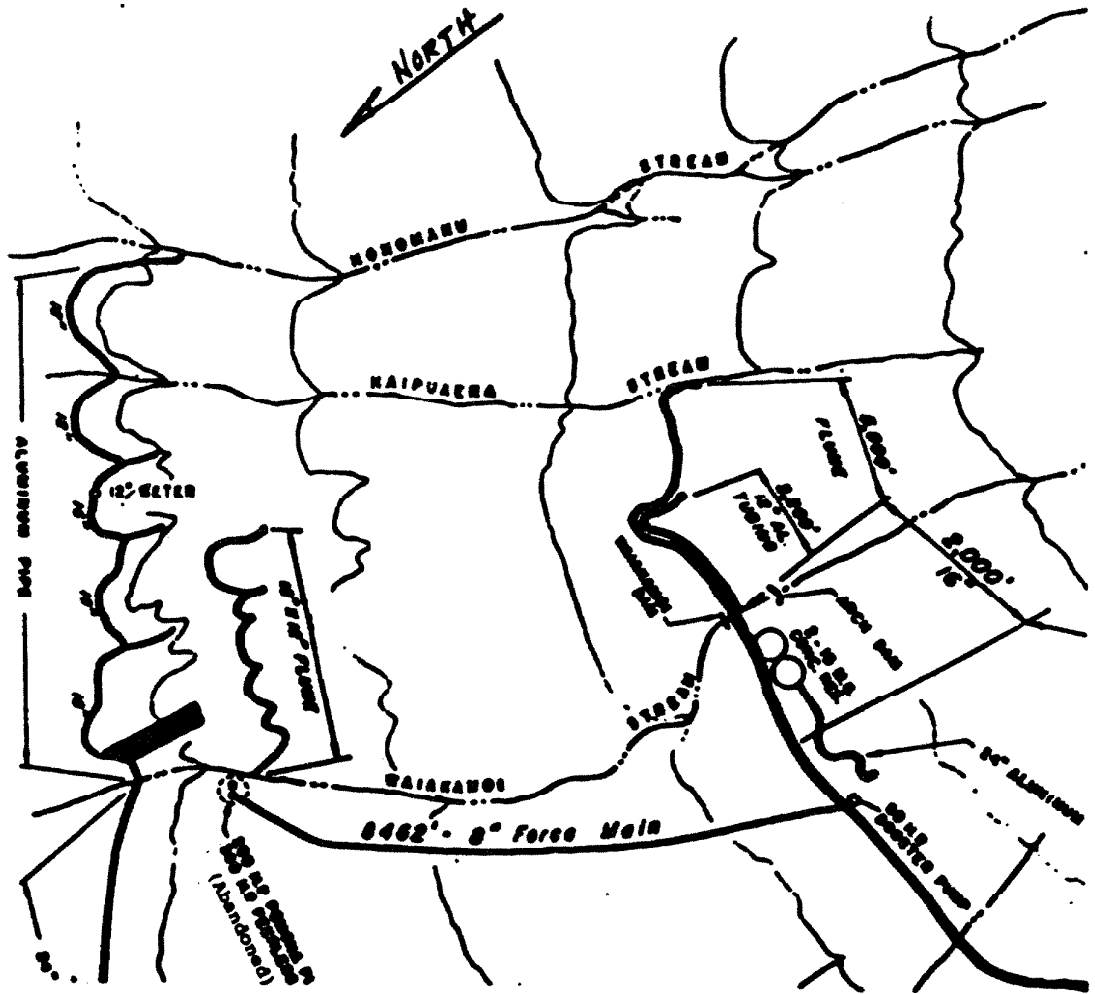
KULA WATER SYSTEM

75 M.G. WAIHOU RESERVOIR



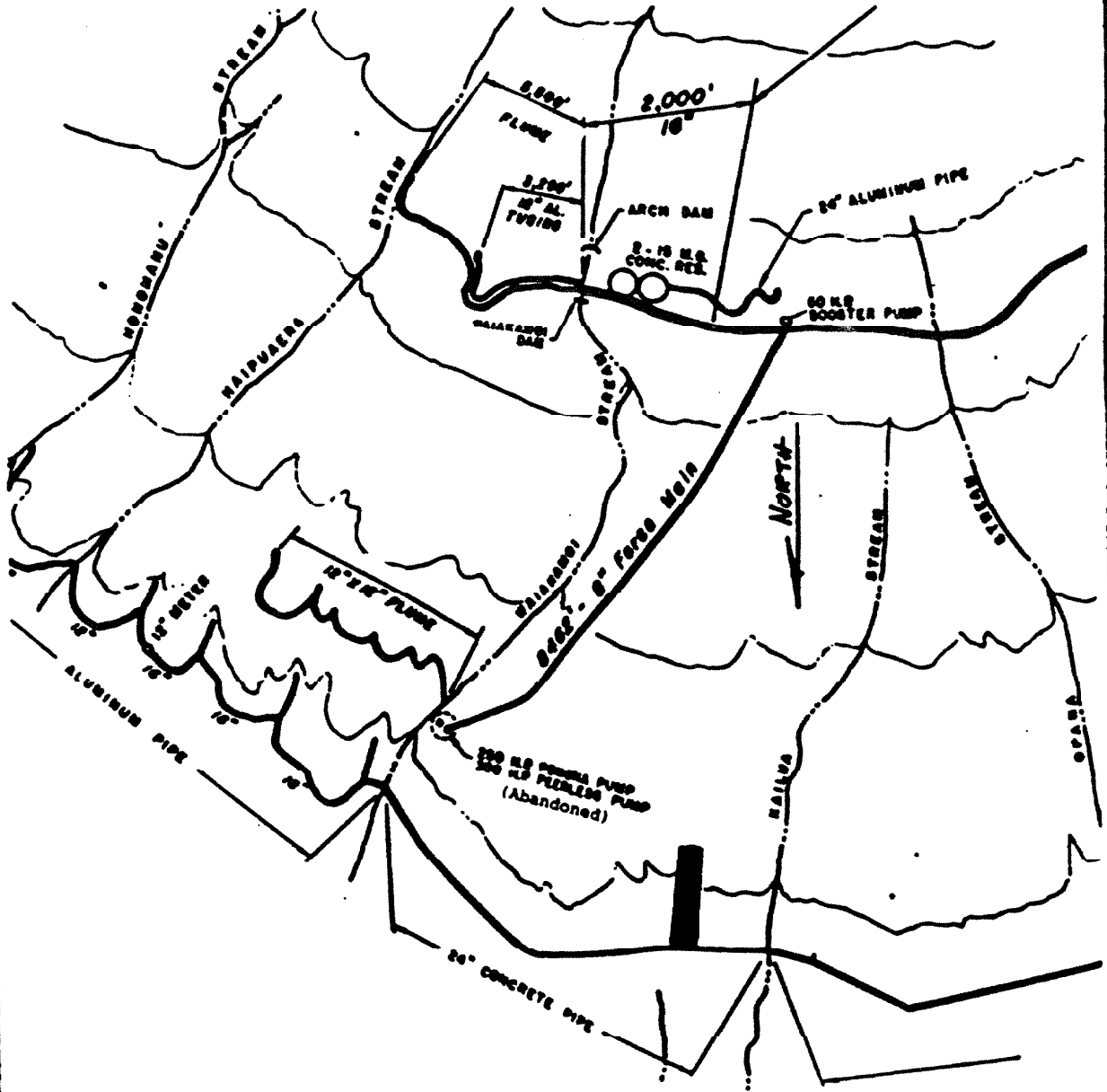
KULA WATER SYSTEM

RELOCATE E. WAIAKAMOI INTAKE



KULA WATER SYSTEM

INTAKES, 10TH BR. KAILUA



KULA WATER SYSTEM

NEW INTAKE, KAILUA STREAM

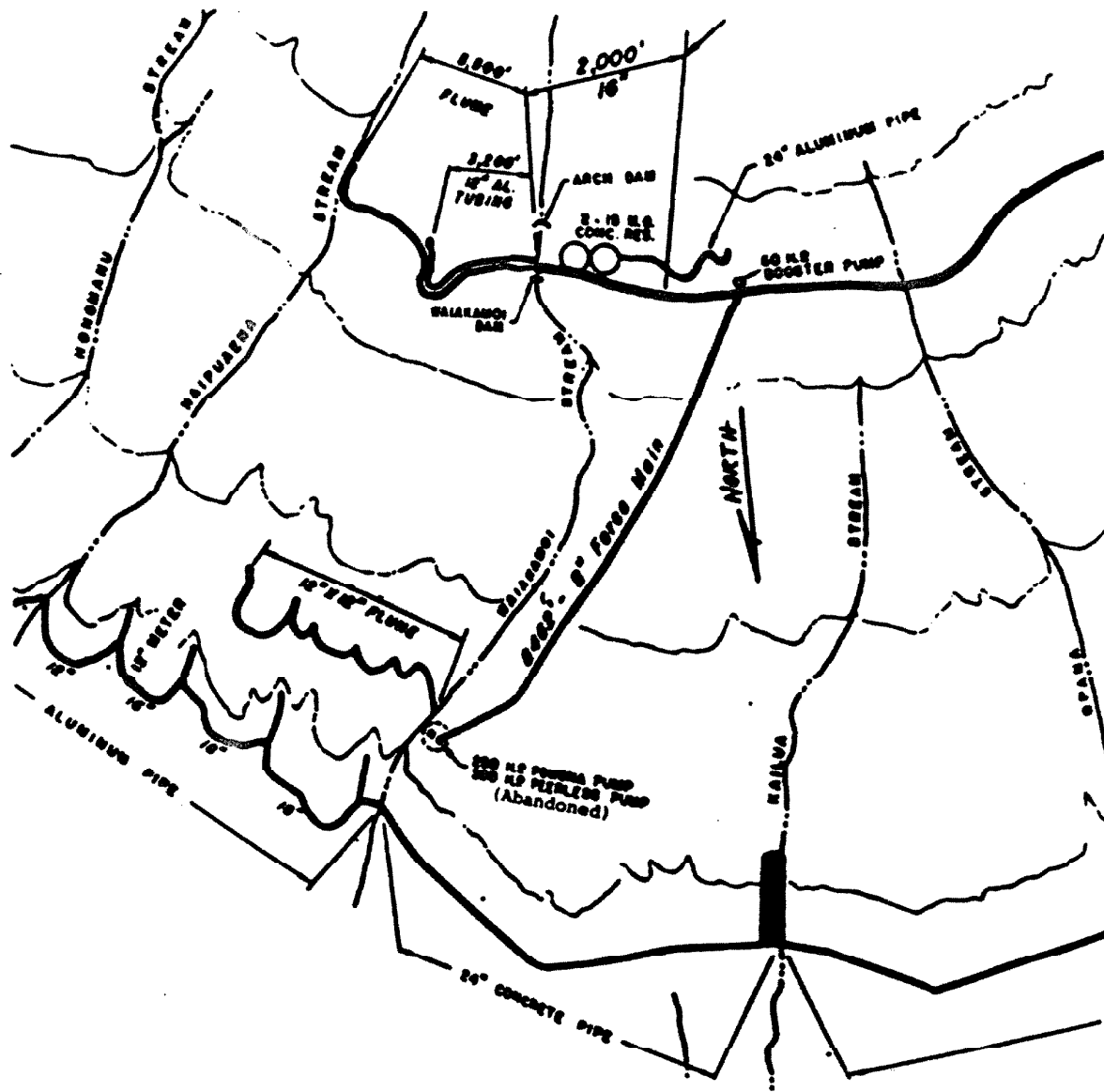


EXHIBIT Y

KULA WATER SYSTEM

RAISE PIIHOLO RESERVOIR WALLS MODIFY PIPING AND CONTROLS

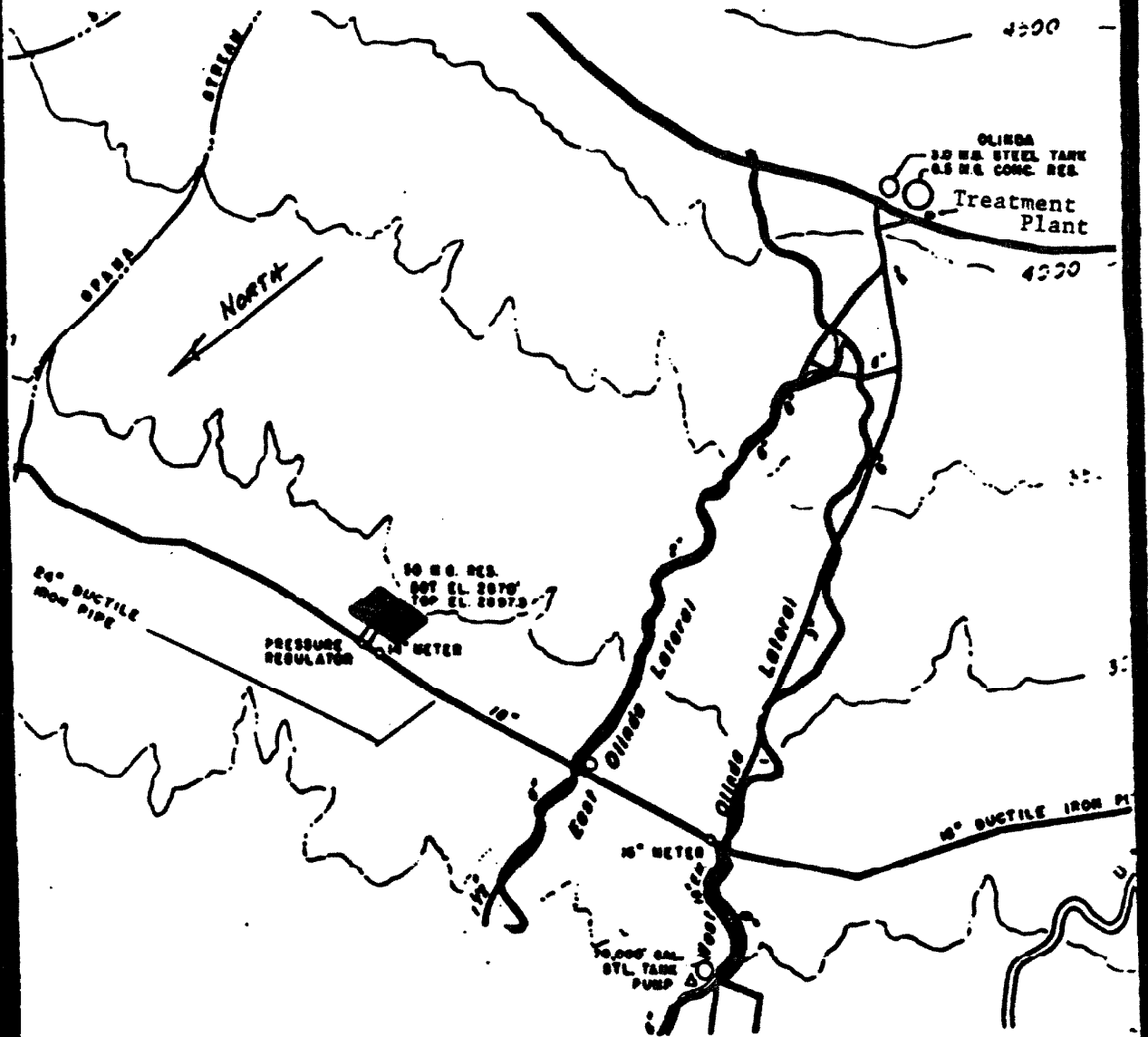
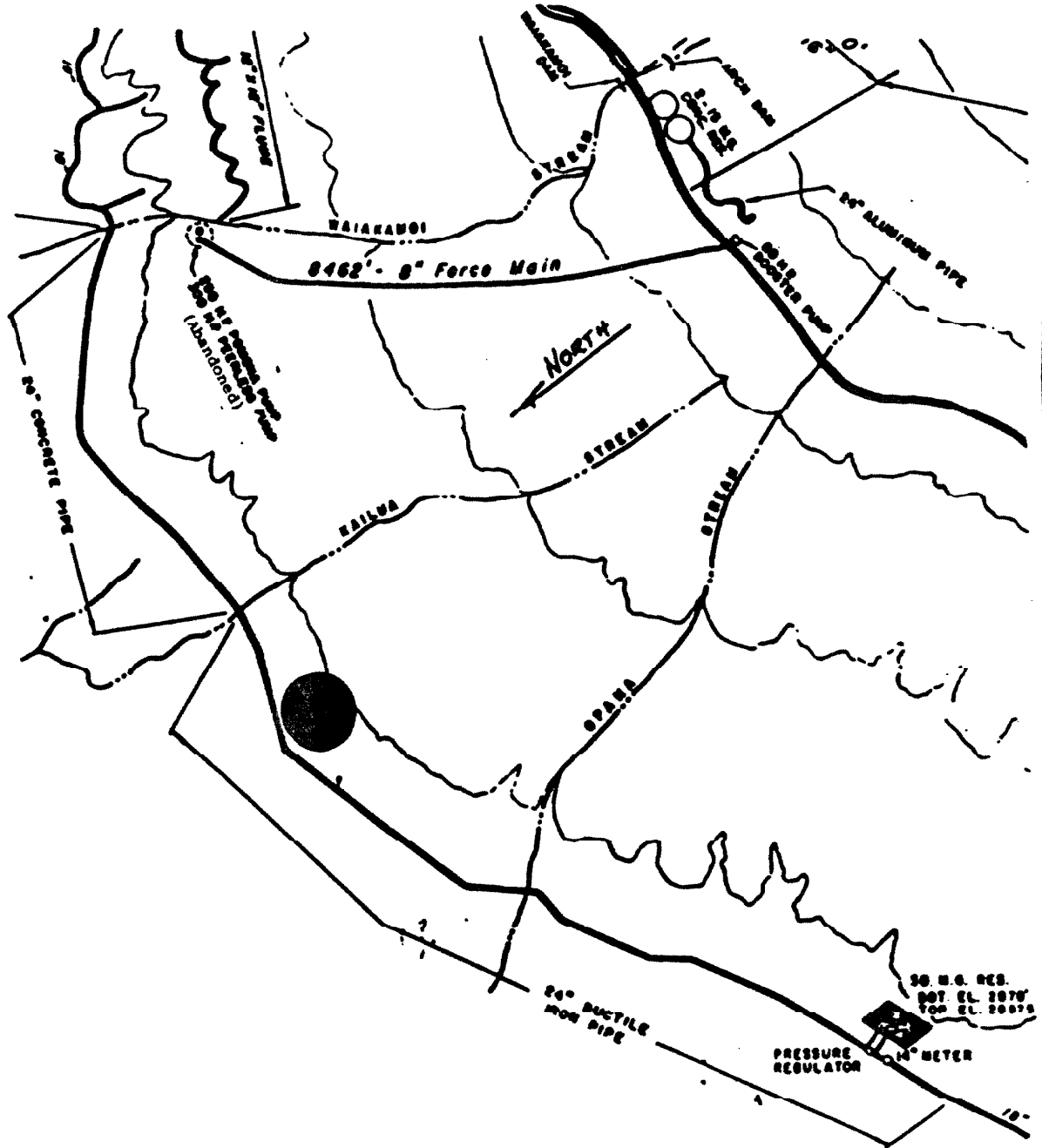


EXHIBIT 2

KULA WATER SYSTEM

300 M.G. KAILUA RESERVOIR



KULA WATER SYSTEM

2.5 M.G.D. L. KULA TREAT. PLANT

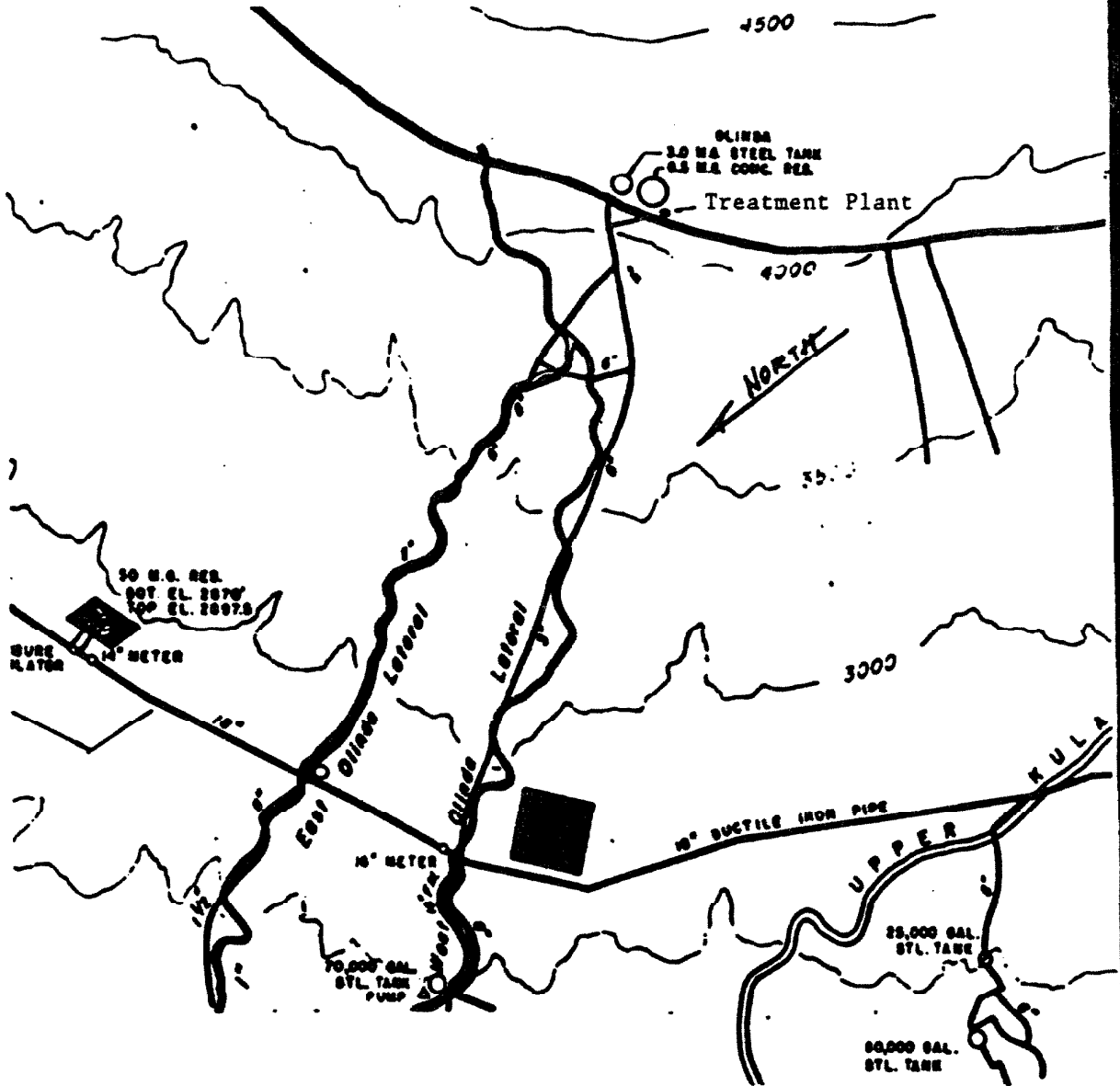


EXHIBIT AB

HANA WATER SYSTEM - MUNICIPAL

General

The Hana water system consists of four small separated water systems. They are:

1. Keanae System
2. Nahiku System
3. Hana System
4. Kaupo System

These (municipal) water systems serve only a small portion of the areas shown in the Hana Community Plan. Exhibit AC shows the service areas.

Keanae System

This water system serves the Keanae community. There are 74 water meters serving the area. The Department of Water Supply reports 12.8 MG was withdrawn from the ground water source and 2.9 MG from surface source (Wailuanui Stream) in the 1987 fiscal year. Presently the surface source water system serves as a standby source. See Exhibit AD.

Nahiku System

This water system serves mainly the lower Nahiku community. There are 26 meters serving this area. The Department of Water Supply reported 3.1 MG was withdrawn from the ground water source for the fiscal year 1987. See Exhibit AE.

Hana System

This water system serves the Hana Community. There are 312 water meters serving the area. The Department of Water Supply reports 78.7 MG or 0.2 MGD was withdrawn from the Wailua

Surface Source and Wakiu Ground Water Source in 1987 fiscal year. The water withdrawals are as follows:

Wailua Stream	37.8 MG	0.1 MGD
Wakiu Wells A and B	<u>40.9</u> MG	<u>0.1</u> MGD
	78.7 MG	0.2 MGD

Wailua Surface Water Source and Wakiu Wells are located in the Hana Aquifer Sector*. (See Exhibit AF for location of sources.)

Kaupo Water System

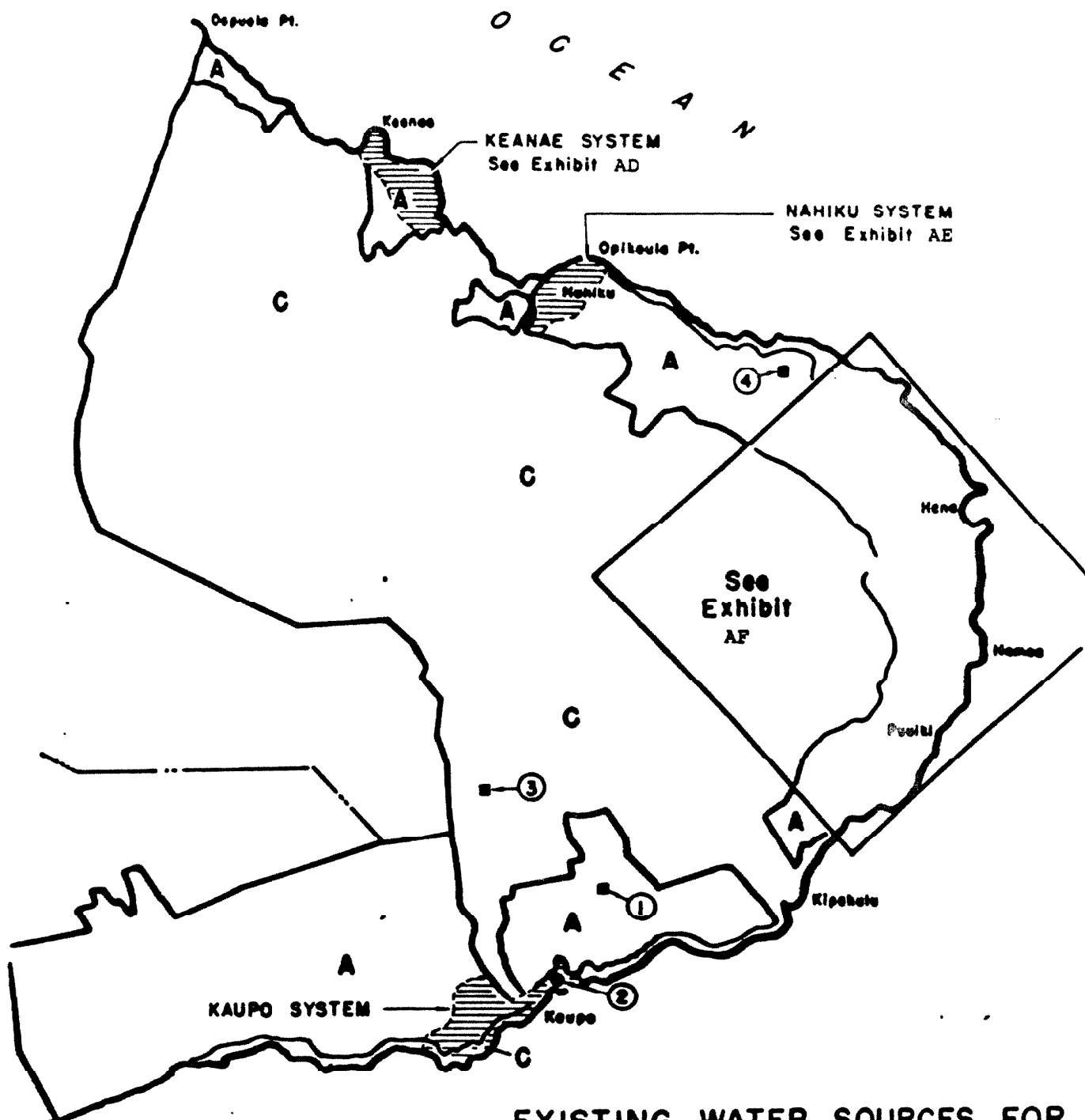
Kaupo is a remote area, accessible by narrow Piilani Highway either from Kipahulu or Ulupalakua. Exhibit AC shows the approximate service area.

The Kaupo Water System is small and interconnected with the Kaupo Ranch Water System. Most of the water services are located along the Piilani Highway.

The amount of water withdrawn from the surface and groundwater sources was 1.7 MG for the 1987 fiscal year.

The main surface sources are the Kalepa Stream (intake) and Naholoku Stream (intake). The Punahoa Spring supplements the surface water system. See Exhibit AC.

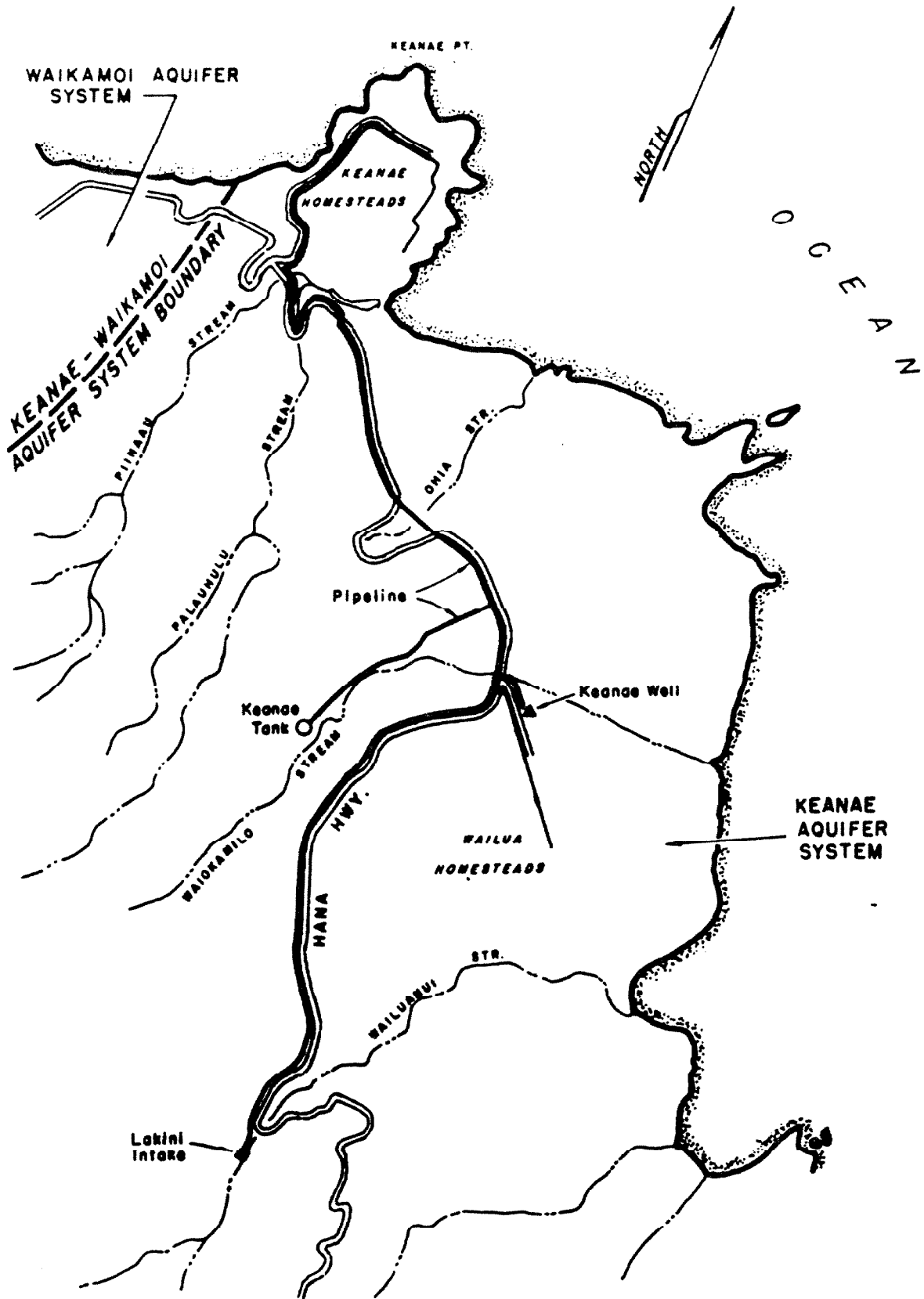
*See Appendix C for information on aquifers.



SYSTEM	SOURCE
* 1. Kaupo Ranch	Kolepa Intake
2. Kaupo Ranch	Punahoa Spring
3. Kaupo Ranch	Manowainui Intake
4. Hana Ranch	Honomoale Intake

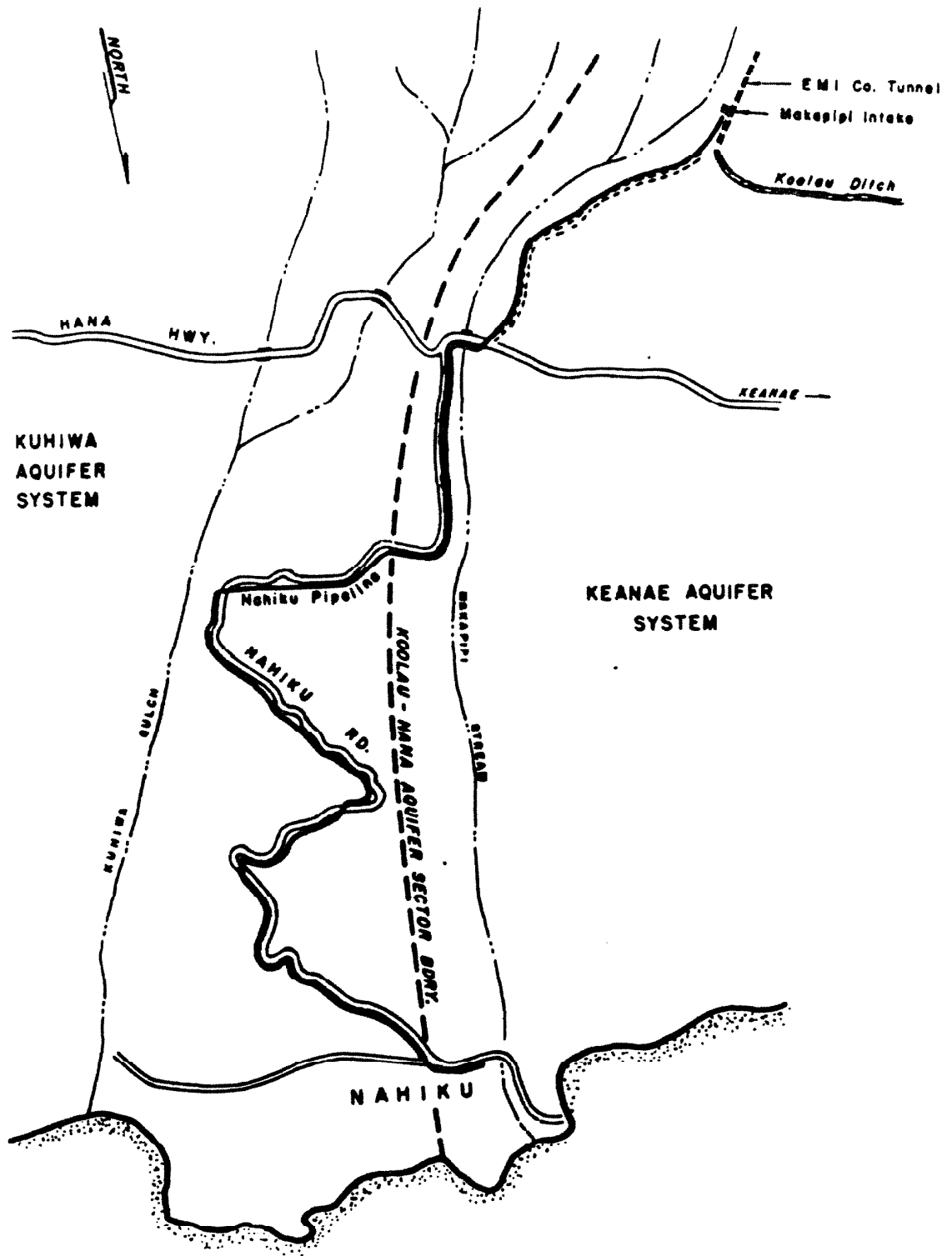
*And County of Maui

EXISTING WATER SOURCES FOR MUNICIPAL & PRIVATE SYSTEM HANA COMMUNITY PLAN



**MUNICIPAL - KEANAE WATER SYSTEM
HANA COMMUNITY PLAN**

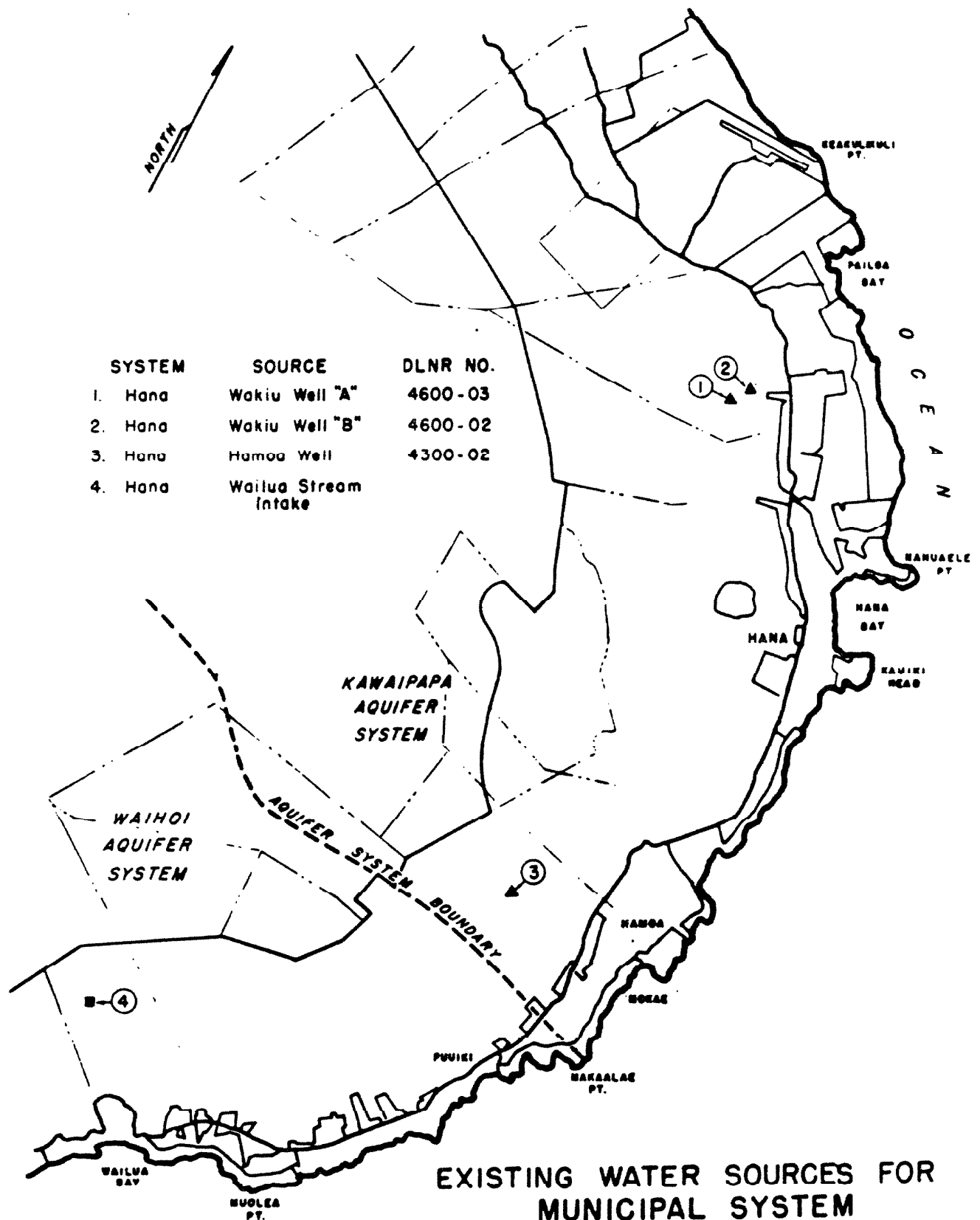
SEE APPENDIX C FOR AQUIFER
INFORMATION.



SEE APPENDIX C FOR
AQUIFER INFORMATION.

O C E A N

**MUNICIPAL - NAHIKU WATER SYSTEM
HANA COMMUNITY PLAN**



SYSTEM	SOURCE	DLNR NO.
1. Hana	Wakiu Well "A"	4600-03
2. Hana	Wakiu Well "B"	4600-02
3. Hana	Hamoa Well	4300-02
4. Hana	Wailua Stream Intake	

EXISTING WATER SOURCES FOR
MUNICIPAL SYSTEM
HANA COMMUNITY PLAN
EXHIBIT AF

See Appendix C for
Aquifer information.

The projected future water demand is:

	<u>1987</u>	<u>2010</u>
Keanae	0.04 MGD	0.05 MGD
Nahiku	0.01 MGD	0.02 MGD
Hana	0.22 MGD	0.35 MGD
Kaupo	<u>0.01</u> MGD	<u>0.01</u> MGD
Total	0.28 MGD	0.43 MGD

WATER DEVELOPMENT PLANS

Municipal System - Hana

The water supply requirements for the Hana District were reviewed in the Department of Water Supply's study completed in February, 1988. The report developed estimates of future water demand using water consumption growth patterns for the period 1980 to 1987, in each of the community plan areas. The growth experienced in that period was used to project growth for the next twenty-three years. In areas such as Nahiku, such calculations resulted in unrealistically negative growth due to recent drops in water use. In such a case, we assumed that water use would remain constant rather than continuously decreasing.

The water usage derived in the study referenced above differs from actual production. Losses experienced in the system were not included in the study's estimate of required demand. These losses have been included in the estimate for total required production. The Water Development Plan incorporates system losses into the total projected water use to ensure sufficient well capacity is available to meet the requirements of real system operations. In three of the four systems which comprise the Hana District, the water loss figures are not well defined. For these districts we assumed water losses were small and on the order of 10 to 20%.

The 1987 average production use was .28 million gallons per day, including losses. The Department of Water Supply expects that requirement, again including losses, to grow to as much as 0.43 million gallons per day by the year 2010. The average expected growth in water usage in Hana District, which includes Hana town, Keanae, Nahiku and Kaupo is expected to be 2.14% per year.

The major water sources for Hana town are the Wailua Stream and the Wakiu Wells. These two sources have a capacity of approximately .1 and .2 million gallons per day, respectively. These will soon be supplemented by the Hamoa Well (see Exhibit AF-1) with a capacity of .3 million gallons per day. The long-term use of the Wailua source has not yet been decided. However, the capacity of the two sets of wells in Hana town, with a total capacity of .5 million gallons per day, will meet the demands expected to year 2010 without additional source development. In the event additional sources are required due to higher than expected growth, the Hana Aquifer has a sustainable yield much in excess of any reasonable projections of growth between now and year 2010. The calculated sustainable yield of the Hana area aquifers (before adjustment for E.M.I. ditch transfers) totals 133 million gallons per day.

The Keanae system has a present production requirement of .04 million gallons per day. The year 2010 projected production requirement is .05 million gallons per day. The installed pump capacity of the Keanae well is .144 million gallons per day.

Based on present growth rates, there is sufficient installed capacity, without using the backup source of the Wailuanui Stream. In the event further well development is required in Keanae, the Keanae Aquifer has a sustainable yield (before E.M.I. transfers) of approximately 96 million gallons per day.

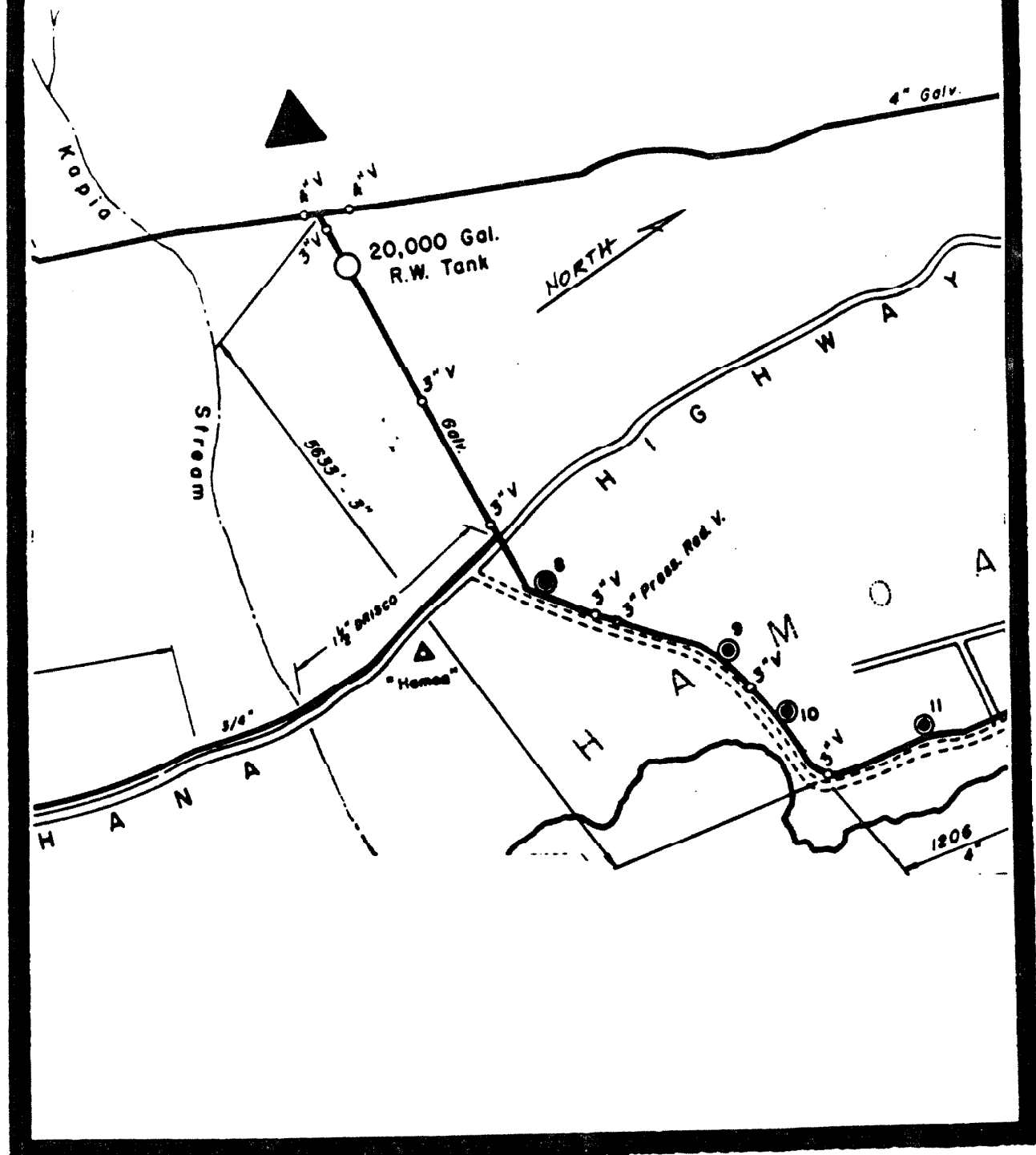
The Kaupo system currently uses about .0047 million gallons per day from the Kalepa Stream and the Naholoku Stream. The Punahoa Spring supplements the surface water system. There is presently sufficient water to meet current demands. In the event future well development is needed, the Kaupo aquifer has a sustainable yield of approximately 18 million gallons per day, before transfers. The Department of Water Supply is considering the installation of a well in the Kaupo area. Further study is required prior to any decision.

The Nahiku system currently uses about 8500 gallons per day from the E.M.I. Tunnel, a ground water source. Use of water in Nahiku has been slowly declining. There are no plans to increase the size of the system serving Nahiku. In the event further source development is required, Nahiku is located on the Kuhiwa Aquifer, which has a sustainable yield of 16 million gallons per day before E.M.I. transfers are taken into account.

Based on present growth projections, no additional sources are needed in these areas for domestic use until at least 2010. In the event that additional water sources are required for development, there is about 300 million gallons per day of untapped aquifer sustainable yield (before making adjustments for E.M.I. withdrawals).

HANA DISTRICT

HAMOA WELL



LAHAINA WATER SYSTEMS

General

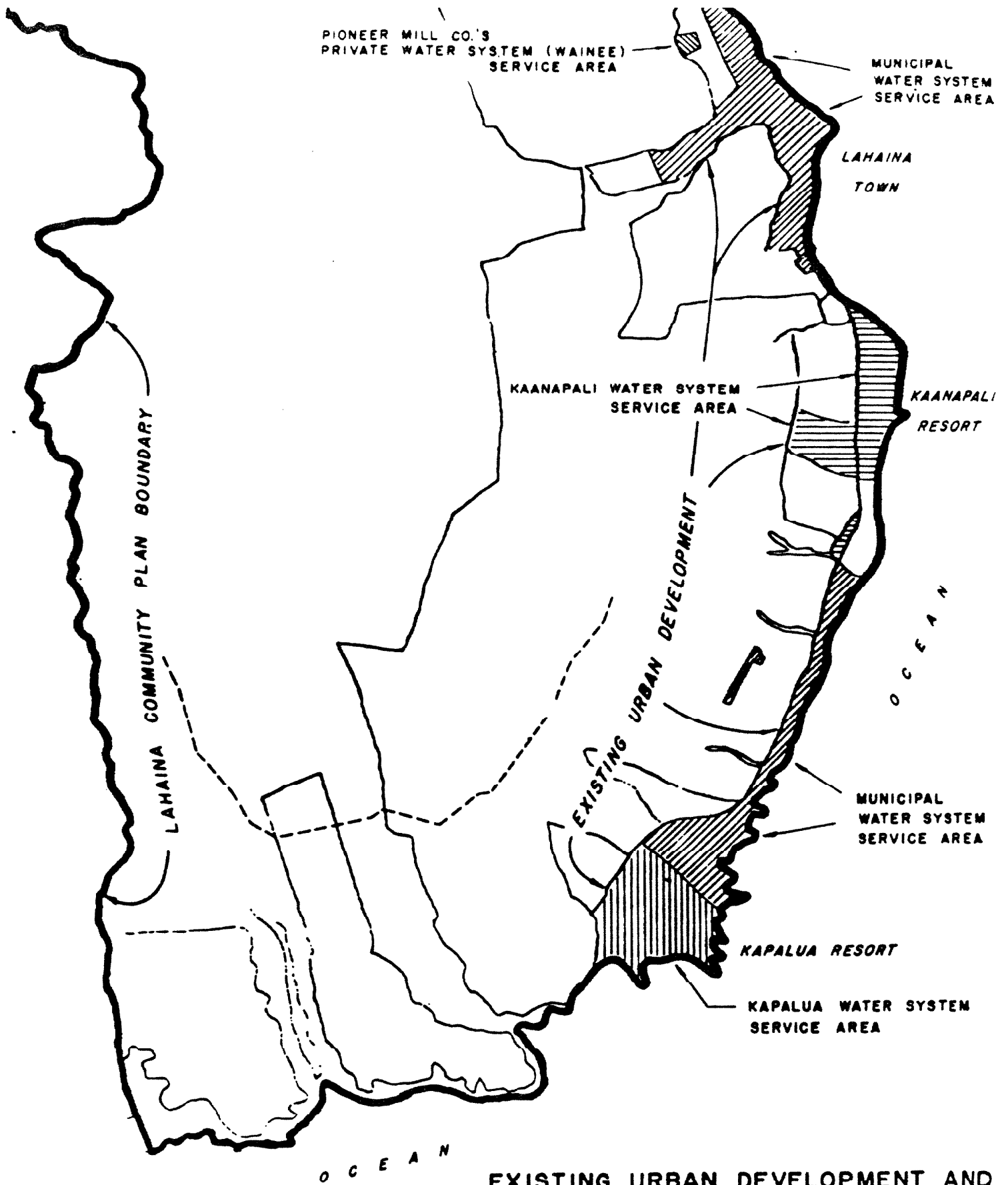
The Lahaina water systems include the Municipal (County), Kaanapali, Kapalua, Pioneer Mill Co., and State of Hawaii water systems. These systems serve the urban, rural, and a portion of the agricultural areas of the Lahaina Community Plan region.* The water service areas for each system are shown in Exhibit AG. A brief description of each water system is covered in the following sections.

Municipal (County) water system serves the coastal areas from Launiupoko to Kaanapali, and from Honokowai to Napili as shown in Exhibit AH. For fiscal year 1987, the water usage (including water system losses) was 2,063 MG or 5.7 MGD of which 918 MG was withdrawn from the surface sources, and 1,145 MG from the West Maui ground water sources.

Three surface water sources and eight wells (ground water) service the existing municipal water system. The Kanaha intake taps surface water from the Kanaha Valley, and the Alaeloa and Honokohau intakes withdraw surface water from Maui Pineapple Company's Honokohau Ditch. The Honokohau Ditch receives its water from the Honolua and Honokohau Valleys.

A battery of the county's ground water wells sources is located in Kanaha and in the Napili areas. The Kanaha and Lahainaluna (Waipuka) wells are located in the vicinity of the

* See Appendix B for information on Lahaina Community Plan.



EXISTING URBAN DEVELOPMENT AND ASSOCIATED WATER SYSTEM

Lahainaluna High School. The Napili and Honokahua "A" wells are located inland (mauka) of the Napili Community. The amounts of water withdrawn from each source are shown in the following table.

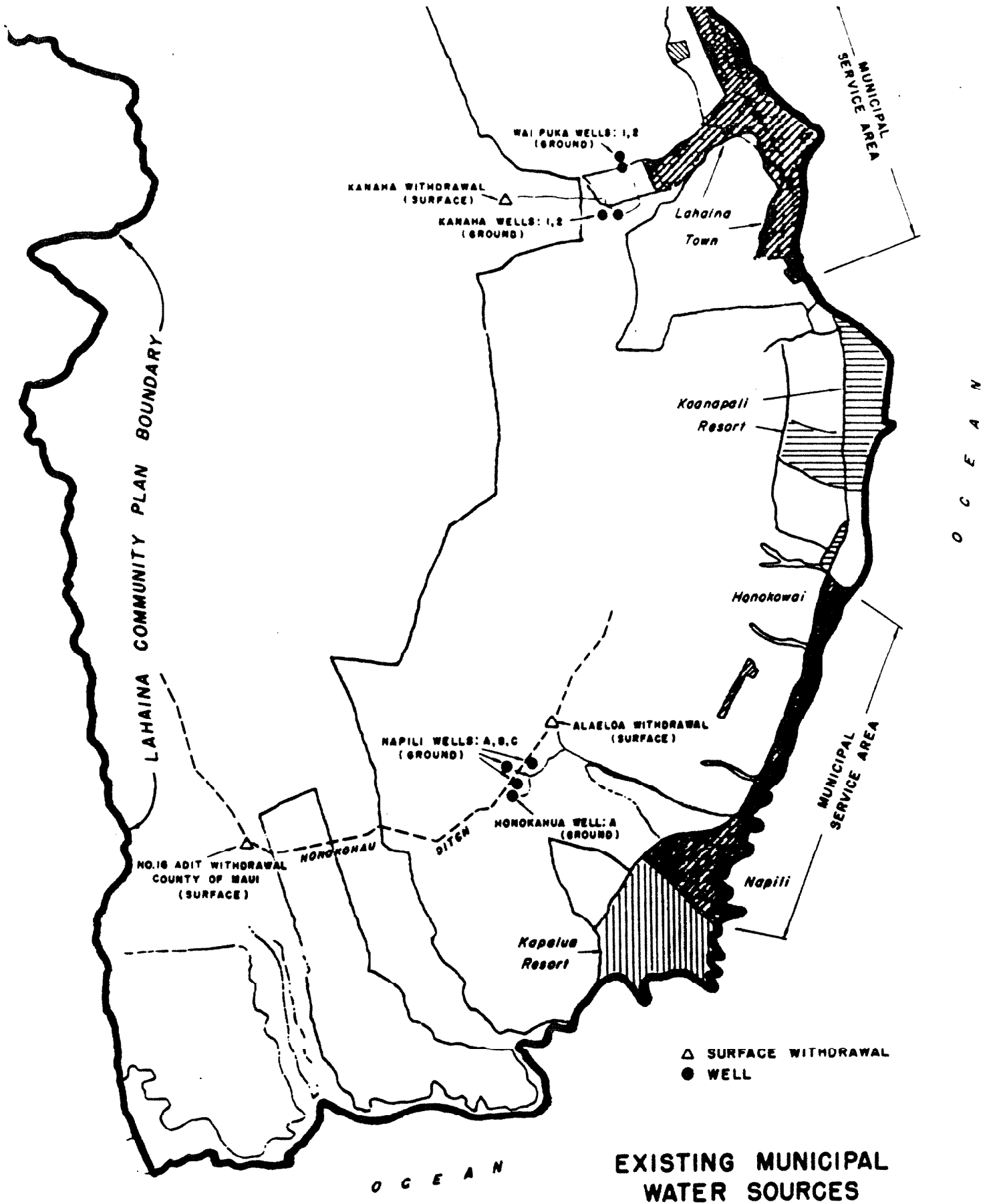
MUNICIPAL SOURCES

EXISTING

<u>Surface Water Sources</u>	<u>Water Withdrawn For Fiscal Year 1987</u>		<u>Pump Capacity MGD</u>
	<u>Total</u>	<u>Daily Avg.</u>	
Kanaha	459,796,000 gal.	(1.260 MGD)	
Honokohau Ditch (Alaeloa)	454,123,000 gal.	(1.244 MGD)	
Honokohau Ditch (No. 16 Adit)	<u>4,383,000 gal.</u>	<u>(0.012 MGD)</u>	
Total Surface Water	918,302,000 gal.	(2.516 MGD)	
<u>Ground Water Sources</u>			
Lahainaluna (Waipuka) 1 & 2 (5339-01, 5339-02) *	61,337,000 gal.	(0.168 MGD)	0.36
Kanaha #1 (5339-03)	63,515,000 gal.	(0.174 MGD)	0.50
Kanaha #2 (5339-04)	55,972,000 gal.	(0.153 MGD)	0.50
Napili A (5838-01)	354,889,000 gal.	(0.972 MGD)	1.00
Napili B (5838-02)	168,000 gal.	(0.001 MGD)	1.00
Napili C (5838-04)	609,376,000 gal.	(1.669 MGD)	1.70
Honokahua A (5838-03)	<u>---</u>	<u>---</u>	<u>0.72</u>
Total Ground Water	1,145,257,000 gal.	(3.138 MGD)	6.21
TOTAL SURFACE AND GROUND WATER	2,063,559,000 gal.	(5.654 MGD)	

Exhibit AH shows the location of the sources.

*Numbers within () after well names refer to Dept. of Land and Natural Resources Well No.



The Department of Water Supply projects the following water demands for the urban area:

<u>Year</u>	<u>Projected Average Daily Demands</u>
1987 - actual	5.7 MGD - actual
1990	5.8 MGD
2000	9.7 MGD*
2010	10.8 MGD*

* Includes 3 MGD for Housing Finance & Development Corporation's development. Refer to State of Hawaii Project Plan.

WATER DEVELOPMENT PLANS

Municipal System

The Department of Water Supply prepared a County-Wide Source Study for the municipal water system. The report, completed in February, 1988 developed estimates of future water demand using recent growth water consumption patterns in each of the community plan areas. The growth in consumption from the years 1980 to 1987 was used as the base for projected growth for the next twenty years. The 1987 average day production required was 5.7 million gallons per day. The Department of Water Supply expects that requirement to grow to 10.8 million gallons per day by the year 2010. The average expected growth in water usage in West Maui District is expected to be 2.9% per year. These years have been high growth years in all areas of the island, except for Molokai. The projections likely represent the upper limit of growth in demand.

The water usage derived in the study referenced above differ from actual production. Losses experienced in the system were not included in the study's estimate of required demand. These losses have been included in the estimate for total required projection. The Water Development Plan incorporates system losses into the total projected water use to ensure sufficient well capacity is available to meet the requirements of real system operations.

Based on the report and the projections for water use in West Maui, the Department of Water Supply will develop approximately 4.0 million gallons per day of new source capacity between 1989 and the year 2007. This capacity will be developed by drilling and installing five new wells tentatively named Honokahua "B", Honokahua "C", Honokahua "D", Honolua "A", and Honolua "B". Additional 1.0 MGD is currently being investigated with Maui Pineapple Company from Honokohau Ditch. Approximate well sites are shown in Exhibit AI.

Other growth above that assumed by the community plan or the constant annual rate projected may take place. The State Housing Finance & Development Corporation (HFDC) has proposed a 1,134 acre residential community in the Lahaina area. According to the State, this project is now in the planning stages. The preliminary estimates for HFDC's proposed project indicate a demand of approximately 3 million gallons of water a day to service the planned community. The water requirements for this development will be met by sources provided by HFDC.

To meet the needs of this proposed HFDC development, additional well sites are contemplated in USGS Area "B"* . A well field with a total capacity of 4 MGD is proposed in this area between Kahana Stream and Launipoko Stream. The estimated capacity of each well is 0.3 MGD.

Longer range considerations are being discussed in Area "A". Geologists suggest that dike structures restrain flow from the wet uplands, restricting the lens capacity between Honokahau

*See Appendix D for USGS and aquifer A, B, C.

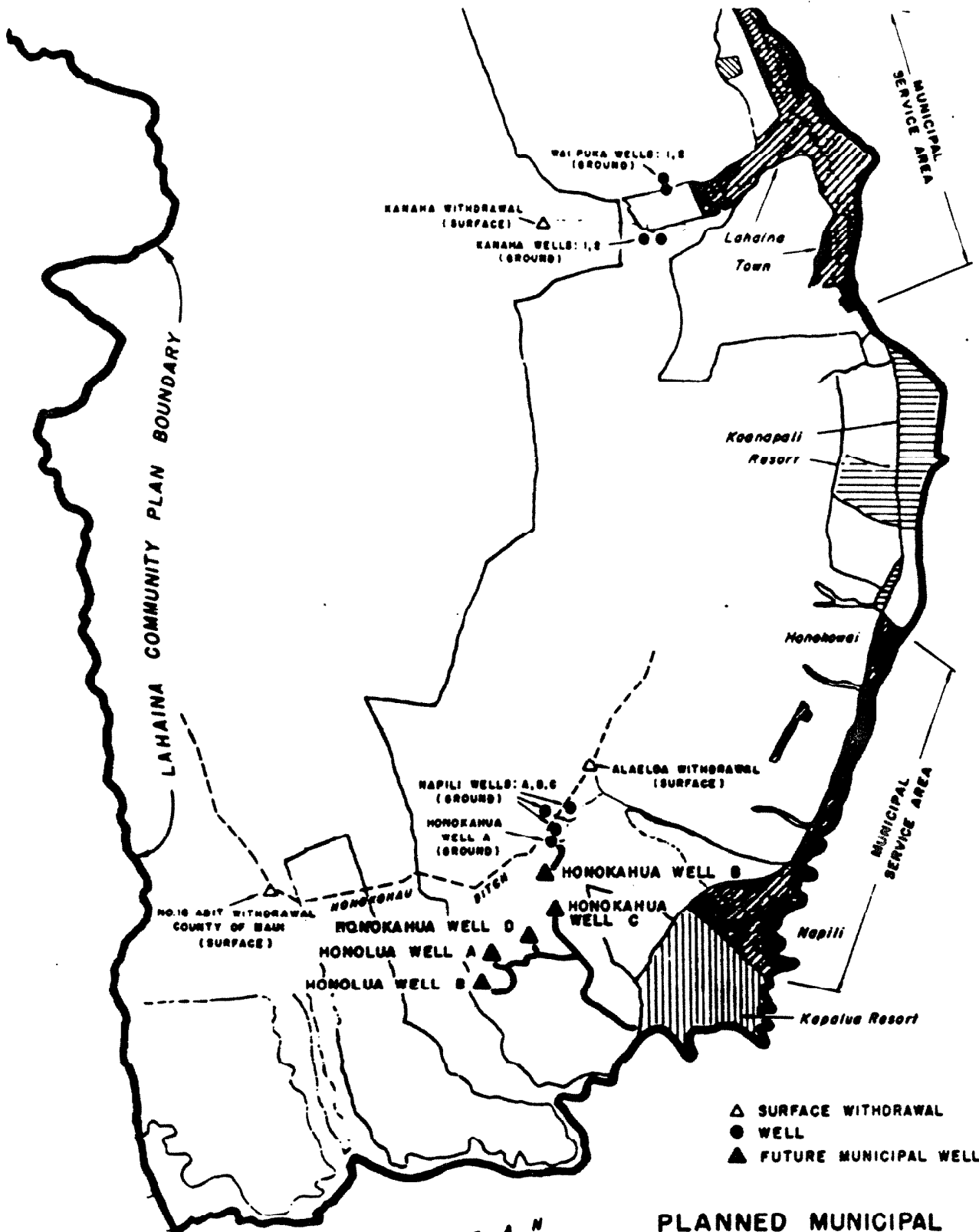
Stream and the Olowalu Gulch. Much of this restrained flow may be available to wells or a tunnel between Honolua Stream and Honokohau Stream. Estimates of available capacity between these streams may be as high as 5 MGD. At least one exploratory well is required in this area to both determine potential capacities and to identify potentially adverse effects on existing wells in Area "B".* The exploratory well is also required due to changes in geologic conditions between Area "A" and Area "B".

The projected cost, in 1989 dollars, for initial source developments for West Maui (which does not include HFDC projections) is:

<u>Description</u>	<u>Cost (Est.)</u>	<u>Year Start</u>	<u>Source Gal./Day</u>
Honokahua Well "B"	\$2,100,000	1987	800,000
Honokahua Well "C" **	8,765,000	1990	800,000
Honokahua Well "D"	4,614,000	1994	800,000
Honolua Well "A"	3,656,000	1998	800,000
Honolua Well "B"	4,185,754	2002	800,000

*See Appendix C for aquifer information.
USGS Area B includes Honokowai and Launipoko Systems of the Maui Aquifer Classification.

** Well plus transmission line.



- △ SURFACE WITHDRAWAL
- WELL
- ▲ FUTURE MUNICIPAL WELL

PLANNED MUNICIPAL WATER SOURCES

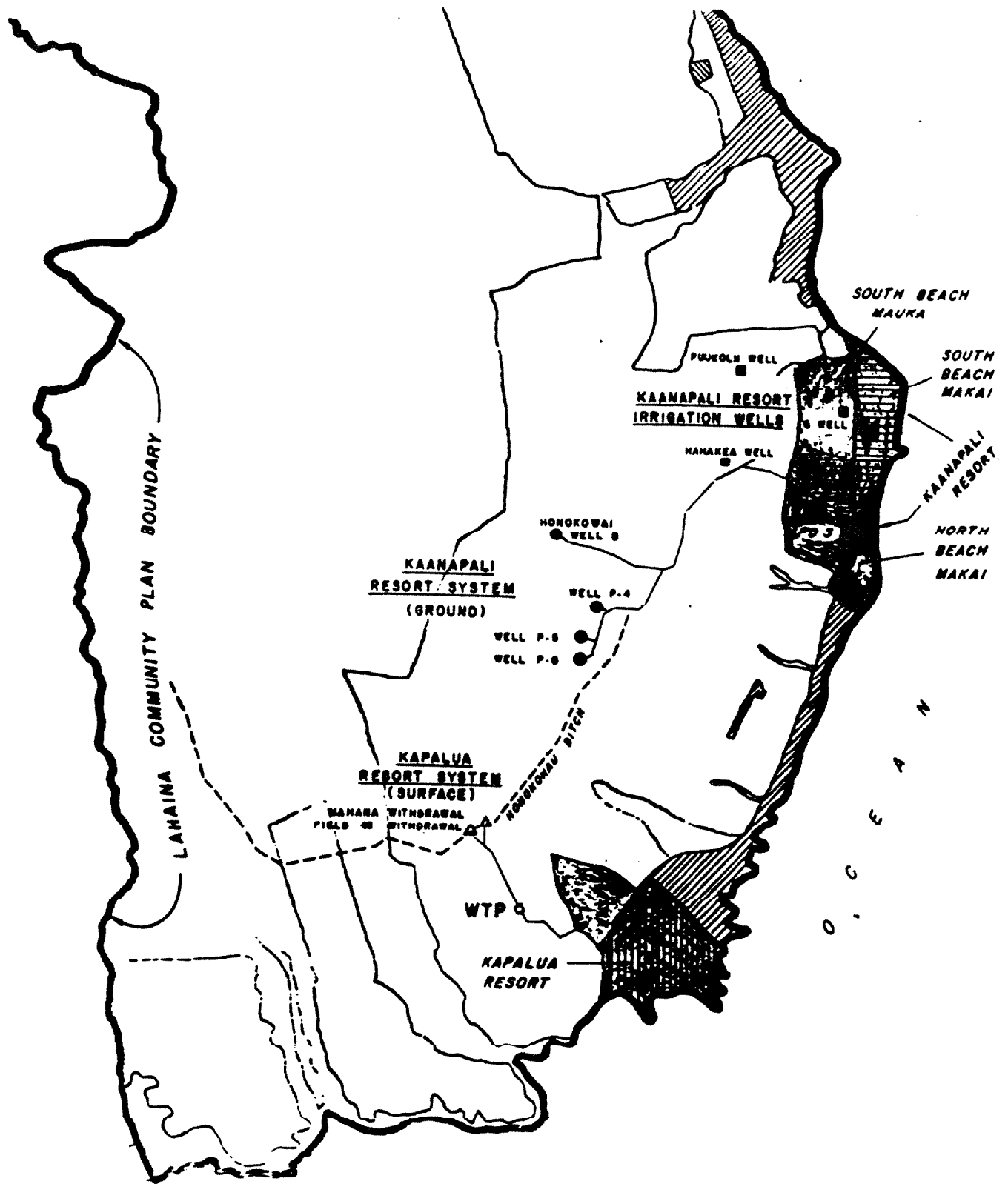
Kaanapali (Private) Water System serves the Kaanapali Resort areas as shown in Exhibit AJ. During 1987, the system served approximately 600 acres of land within the urban areas. The existing average domestic water usage was 2.52 MGD as shown below:

<u>Land Uses</u>	<u>Water Usage</u> <u>MGD</u>
Hotel	1.46
Business/Commercial	0.15
Apartment (condo units)	0.55
Single Family	0.18
Others (maintenance shop, etc.)	<u>0.18</u>
Total (domestic)	2.52

The domestic water withdrawn from each source is shown below.

<u>Existing Domestic Water Sources</u>	<u>1987 Withdrawal</u>	<u>Pump Capacity</u> <u>MGD</u>
Honokowai B Well (DLNR 5638-03)	0.84 MGD	1.3
Kaanapali P-4 Well (DLNR 5739-01)	0.40 MGD	1.5
Kaanapali P-5 Well (DLNR 5738-01)	0.80 MGD	1.5
Kaanapali P-6 Well (DLNR 5739-02)	<u>0.48</u> MGD	<u>1.5</u>
Total (domestic)	2.52 MGD	5.8

The location of the sources are shown in Exhibit AJ.



**EXISTING WATER SOURCES
KAANAPALI AND KAPALUA RESORT AREAS**

The owners project the following average daily demand
(including) losses by the years shown:

<u>Area</u>	<u>1990</u> <u>MGD</u>	<u>2000</u> <u>MGD</u>	<u>2010</u> <u>MGD</u>
South Beach Makai	2.32	2.38	2.38
North Beach Makai	0	1.94	1.94
Project District No. 3	0	1.03	1.03
South Beach Mauka	<u>0.48</u>	<u>1.39</u>	<u>1.39</u>
Total Domestic	2.80	6.74	6.74

KAANAPALI WATER CORP. WATER DEVELOPMENT PLAN*

Kaanapali Water Corp. (KWC) is an operating public utility engaged in the provision of domestic water to the Kaanapali area and is regulated by the State Public Utilities Commission. Water quality standards are enforced by the Department of Health through the Safe Drinking Water Act and the Underground Injection Control Program.

KWC provides potable, fire protection and irrigation water for developed areas (other than golf courses and roadway landscaping) within the Kaanapali Resort. (Irrigation water requirements for the golf courses and roadway landscaping are currently met by a separate private water system with an average daily demand of 2.0 MGD.) Present average domestic consumption within the resort is approximately 2.52 million gallons per day.

The water source for KWC is basal ground water obtained from four deep wells: Honokowai B constructed in 1976, and three wells located in Mahinahina (P-4, P-5, and P-6) constructed in 1982 (shown on Exhibit AJ). All four wells have vertical line-shaft pumps with above ground motors. Wells P-4 and P-6 are also equipped with a combination right-angle drive and manually activated diesel engine. Each of these wells is capable of producing approximately 1 million gallons per day.

It is anticipated that future average consumption will increase to approximately 6.7 million gallons per day. KWC

* By Kaanapali Water Corp.

(Kaanapali Water Corp. continued)

intends to fulfill its future source requirements with the development of additional ground water sources that can be integrated into the existing transmission, distribution, and storage systems located mauka of the Kaanapali Resort.* Other source alternatives that may be considered in the future, depending on technological advancements, water quality requirements, economics, etc., may include desalinization, treatment of surface water, development of the high level dike system, or the transport of water from other aquifers.

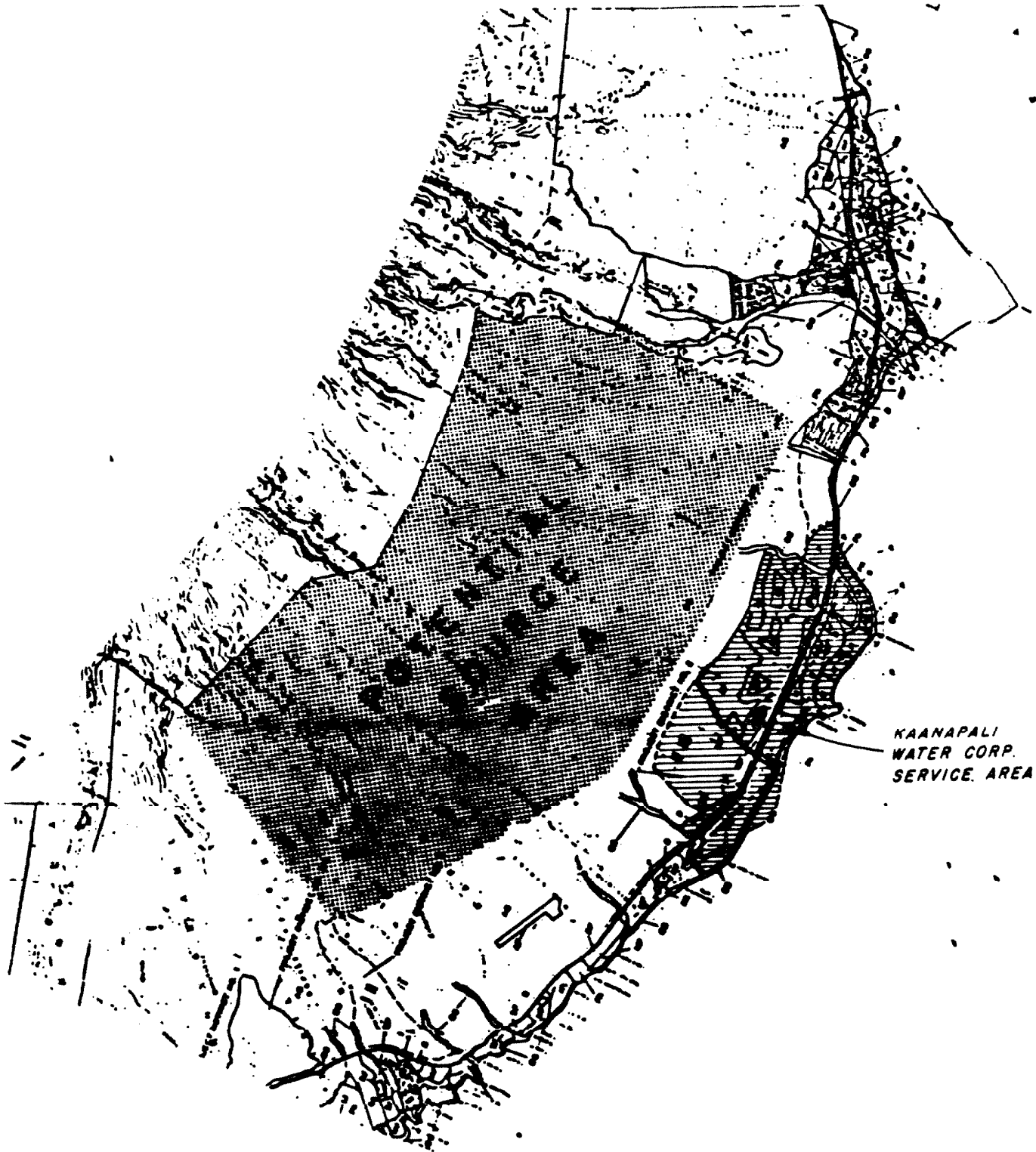
*A potential source area is shown in Exhibit AK.

KAANAPALI RESORT*
WATER DEVELOPMENT PLAN

Domestic

<u>Year</u>	<u>Add'l. Source Capacity MGD</u>
1990	
2000	4.0
2010	

* This section by Amfac Property Investment Corp.



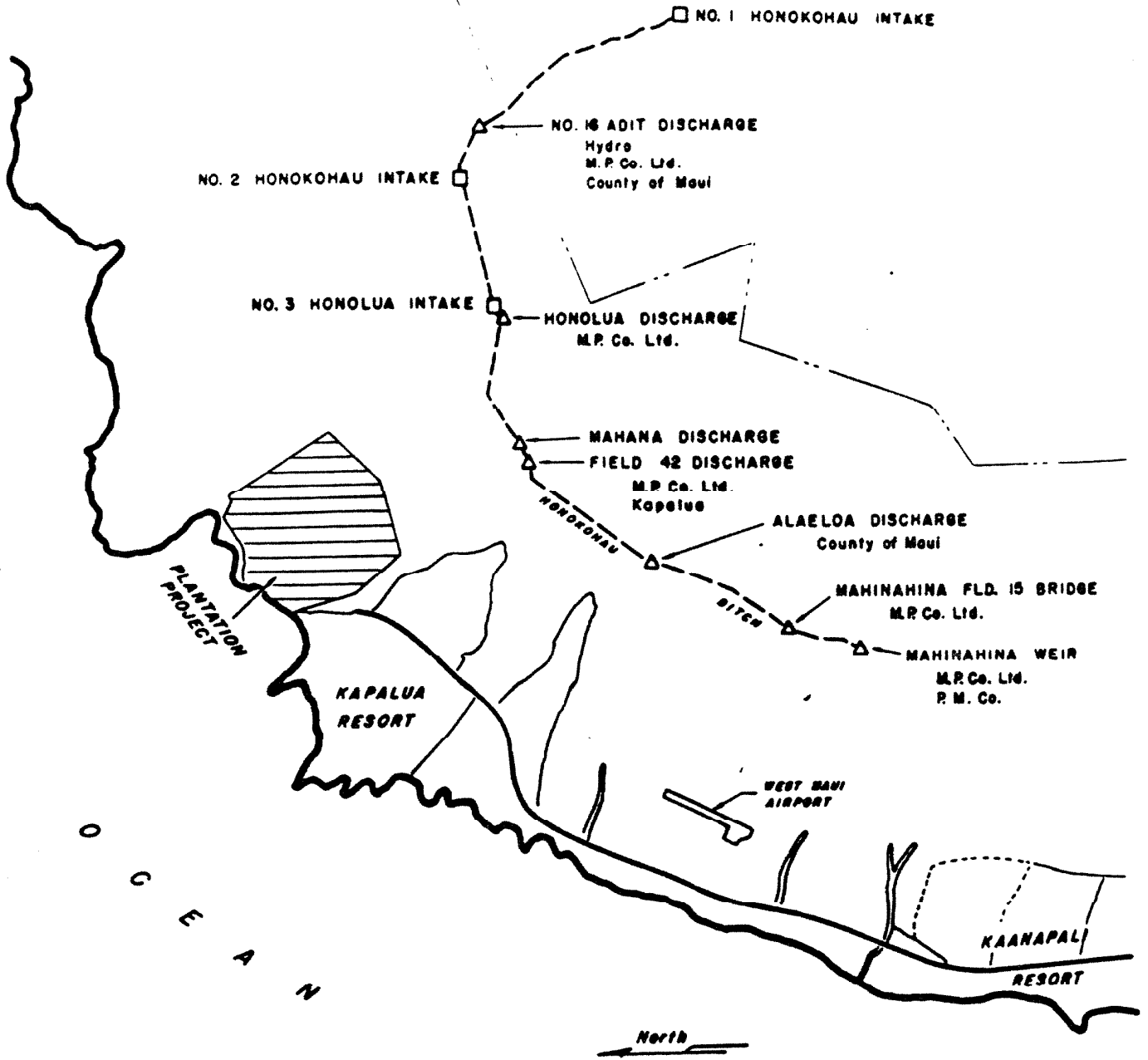
KAANAPALI WATER CORPORATION
DEVELOPMENT PLAN
DOMESTIC AND NONCROP IRRIGATION WATER
(POTENTIAL SOURCE AREA)

Kapalua (Private) Water System serves the Kapalua Resort areas as shown in Exhibit AJ. During 1987, the system served approximately 600 acres of land within the urban area. The Plantation Project, the Village Golf course, and Project District No. 1-A are located mauka of the new Honoapiilani Highway, and the remainder of Kapalua Resort Development, including Project District No. 1, is located makai of the new Honoapiilani Highway. The water usage was 0.61 MGD for the year 1987. The breakdown is shown below:

<u>Land Uses</u>	<u>Water Usage</u> <u>MGD</u>
Hotel	0.130
Business/Commercial	0.116
Apartment	0.318
Single Family	0.004
Open Area	<u>0.042</u>
	0.610

The water supply is currently withdrawn from Honokohau Ditch System. See Exhibits AJ and AL. The domestic water system is provided with a water treatment plant. The water use projections are:

<u>Use</u>	<u>Projected Daily Average Demands in MGD</u>			
	<u>1987</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>
Hotel	0.130	0.448	0.525	0.551
Business/Commercial	0.116	0.151	0.210	0.242
Apartment	0.318	0.343	0.525	0.761
Single Family	0.004	0.024	0.158	0.279
Open Area	<u>0.042</u>	<u>0.052</u>	<u>0.105</u>	<u>0.152</u>
Total	.610	1.018	1.623	2.185



**HONOKOHAU DITCH
EXISTING INTAKES AND DISTRIBUTION (SUB-INTAKES)**

KAPALUA RESORT WATER SYSTEM WATER DEVELOPMENT PLAN

BY KAPALUA LAND CO.

The Kapalua Water Co. maintains and operates the domestic water system in the resort area. This private system is regulated by the State Public Utilities Commission. The Department of Health also is the enforcement agency of the Safe Drinking Water Act, Underground Injection Control, and other health related programs.

Presently the domestic and irrigation waters are supplied from the Honokohau Ditch. The domestic water system is treated while the irrigation for the two golf courses is not. The domestic use (treated water) is approximately 0.61 MGD while the irrigation use (untreated water) is approximately 3 MGD for the two golf courses. Maui Pineapple Co., Ltd. operates the irrigation system.

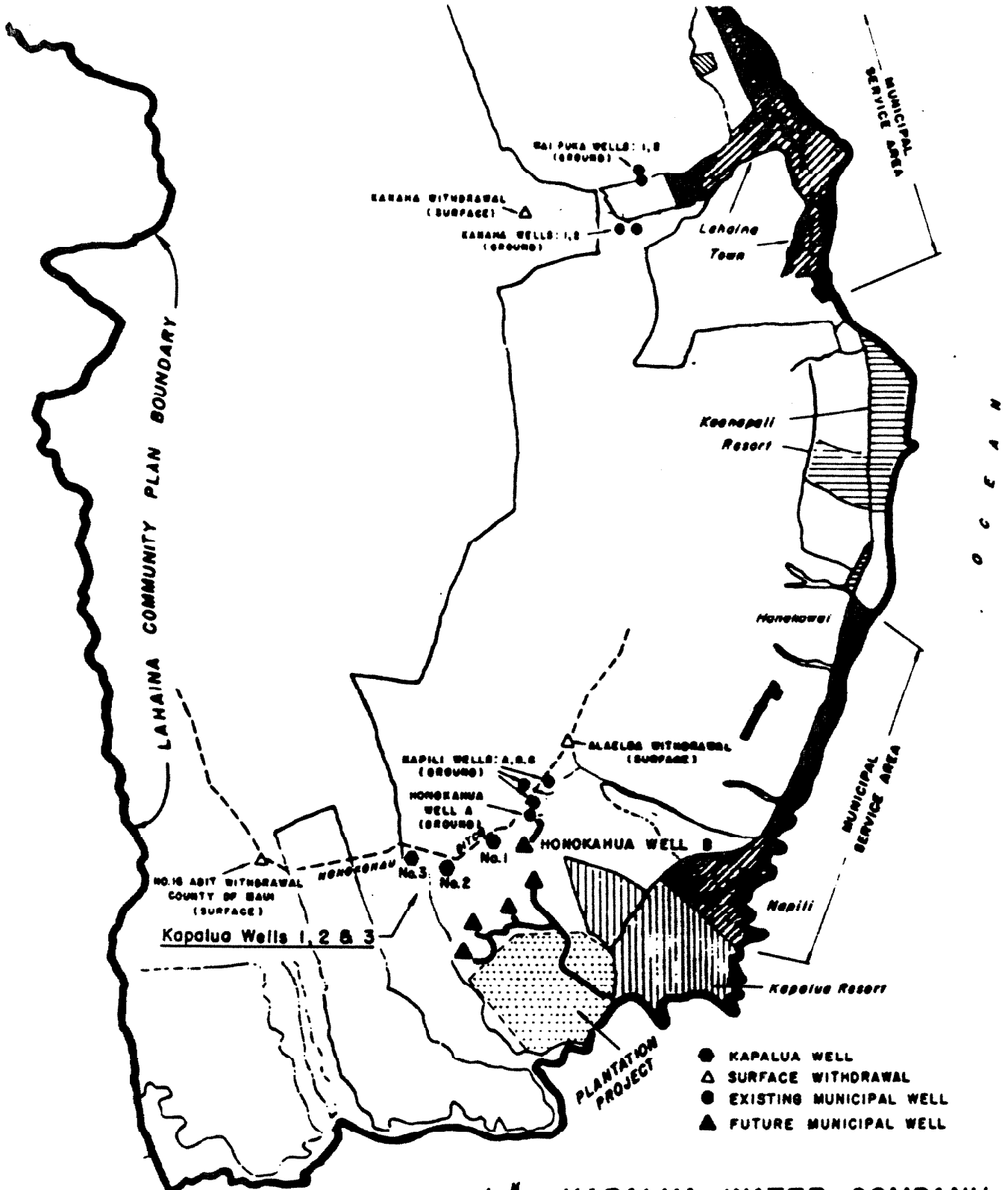
For the future and long-range development plan*, Kapalua Water Co., Ltd. plans to construct a separate duo-water supply system: the domestic supply from a more dependable ground water source, and the irrigation supply from the Honokohau surface water source. The initial phase calls for the drilling of a 1.0 MGD well mauka of the resort area as shown as Kapalua Well No. 1 in Exhibit AM, and designated by DLNR as Well No. 5938-02. This project includes the piping and appurtenances and is estimated

* The total strategy for Kapalua's water needs and development plan is an ongoing, changing, dynamic program. This summary is part of the current plan.

(Kapalua Resort Water System continued)

to cost approximately \$800,000. Two additional wells together with appurtenant reservoirs and piping are planned for domestic water service.

The additional 1.5 MGD future irrigation system for the third golf course will draw from the Honokohau Ditch.

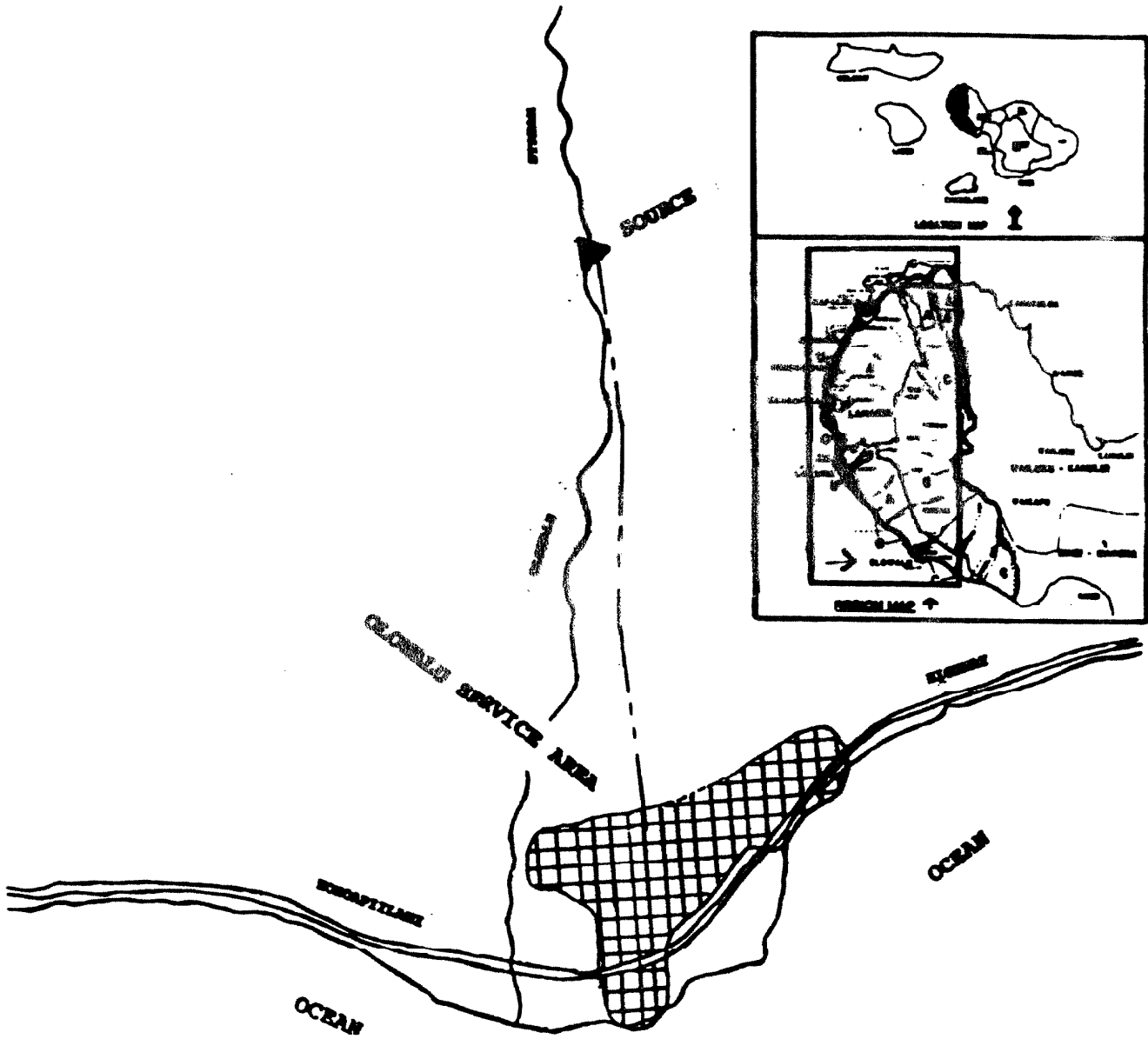


O C E A N KAPALUA WATER COMPANY
DOMESTIC DEVELOPMENT PLAN

Other Private Domestic Water Systems include the small private domestic water systems in this region.

- A. Wainee Water System is an old plantation system (Pioneer Mill Co.) and provides approximately 0.2 MGD. The source is an intake from Kauaula Stream. This water system may eventually be incorporated into the municipal system as the surrounding area develops provided that the system meets the provisions of the Safe Drinking Water Act and the pipelines are improved to county standards. See Exhibit AG for service areas.
- B. Olowalu Water System is also an old Pioneer Mill Co. system providing approximately 0.072 MGD. The source is an intake from Olowalu Stream. The service area is shown in Exhibit AN. Future development plans for the area are in the preliminary stages and, therefore, consumption quantities under developed conditions are not available.
- C. Lahainaluna High School Water System is owned and operated by the State of Hawaii for the school. The surface source intake (Kanaha Valley) is the same as the County of Maui. The system now provides 0.08 MGD. The State of Hawaii projects 0.11 MGD in 2010.

EXISTING DOMESTIC SYSTEM
(OLOMALU)
PIONEER MILL CO.



MISCELLANEOUS WATER SYSTEMS

The following is a list of other existing domestic water systems:

Hana Town Water System
Kailua
Camp Maluhia
Haleakala National Park
Visitor Center - National Park
Mark Edison
Kaeleku Agricultural Park
Haleakala Optical Station
Aina O Kipahulu Association
Kaunahine State Park
Other private agriculture and urban associated water systems.

The following is a list of other additional projected future water systems:

*Other private agriculture and urban associated water system.

*Includes other privately operated water systems for developments and subdivisions.

WITHDRAWAL FOR AGRICULTURAL WATER USE - PRIVATE SYSTEMS

The 1987 withdrawal for agricultural private irrigation systems was 517.5 million gallons per day.

The withdrawal for the year 2010 is an estimated 507 million gallons per day.

The systems are broadly summarized as crop and non-crop. Non-crop category includes irrigation of landscaping plants, parks, and grazing areas.

Crop Systems

Pioneer Mill Company projects a reduction of 16.2 MGD from year 1987 to year 2010. The company plans conversion of agricultural land to urban areas (included in Lahaina Community Plan and HFDC plan). Pages 70-75 describe urban development plans.

Wailuku Agribusiness (WAB) projects an increase of 18.3 MGD from year 1987 to year 2010. A major crop conversion plan should mature by year 2000. Total diversions by WAB of approximately 82.3 MGD average are planned as unchanged. C. Brewer Properties have plans to convert WAB land from agricultural to urban use. Appendix pages R-9 to R-12 give further details.

HC&S Co.-EMI surface withdrawals include flows to the sub-intakes of the municipal Makawao water system summarized in Page 20 and HC&S Co. boiler use mentioned in Page 102.

WAB low and high flow days for 1983-1987 indicate potential inadequate surface supply periods by the year 2010.

The Agricultural Withdrawal Summary on Page 86 lists several low and high surface flows between 1983-1987. For the ranges listed, there is a 9 to 1 difference between low and high flows.

Non-Crop Systems

Withdrawals for non-crop systems are 9.1 million gallons per day for 1987. Withdrawals for year 2010 are estimated at 13.8 million gallons per day.

Future Plans

Withdrawals and plans for withdrawals for permitted uses of agriculturally classified land have not been tabulated. Future updates may need fill-in form process.

Future work may include updated summaries especially when there are two or more consumers from a common surface diversion.

The following is a Summary Table of water withdrawal for agricultural private irrigation systems.

TOTAL WATER WITHDRAWAL FOR
AGRICULTURE - PRIVATE IRRIGATION SYSTEMS

UNIT - MGD

<u>SUMMARY TABLE</u>	<u>TOTAL WITHDRAWAL</u>		<u>SURFACE WITHDRAWAL</u>
	<u>1987</u> <u>Ave.</u>	<u>2010</u> <u>Ave.</u>	<u>1983-1987</u> <u>Low & High*</u>
<u>CROP</u>			
Pioneer Mill	65.4	49.2	25.6-66.3
Maui Pineapple Co., Ltd.			
Honolua	4.5	5.5	
Haliimaile	0.2	0.2	
HC&S Co.	356.	356.	EMI 10.77-405.12 West 5.51-124.04
Wailuku Agribusiness	26.7)	45.0	
Others**	55.6)	37.3	Tot. 34.58-104.76
Total Crop	508.4	493.2	
<u>NON CROP</u>			
Landscaping and Grazing	9.1	14.0	
TOTAL AGRICULTURE	517.5	507.2	

*Low & high - date of low & high daily: surface withdrawals.

- a. HC&S-EMI Low: 10/30/84; High: 10/17/83.
West (West Maui Ditch) Low: 11/1/84; High: 6/19/86.
- b. WAB - Low: October, 1984 total divided by 31 days;
High: October, 1983 total divided by 31 days.
- c. Pioneer Low: January, 1985 divided by 31 days.
High: November, 1987 divided by 30 days.

**Others - the remainder of stream diversion registrations filed by Wailuku Agribusiness (WAB) minus the water used by WAB.

INVENTORY OF EXISTING SOURCES

Agricultural Crops

Inventory lists and location maps for major irrigation systems are included in the following pages. An approximate aquifer boundary line is drawn on the location maps to aid aquifer recharge analysis.

Hawaiian Commercial & Sugar Company (including A&B, Inc. and EMI, Inc.), Wailuku Agribusiness Co., Inc., Maui Pineapple Company, Ltd., and Pioneer Mill Company have constructed extensive surface and ground water irrigation systems to serve the agricultural lands. General descriptions of existing and future plans are included in the Reference Pages R-2 to R-19.

Agricultural Non Crops

Inventory lists of sources for agricultural non crop (landscaping Plants and parks, and grazing) areas follow the inventory lists for crops.

Descriptions by several companies and ranches are included in the Reference Pages R-20 to R-27.

Plans for urban development of agricultural land is included in community plans and generally in the Appendix descriptions. Water demands for urban development of agricultural land is included in the municipal and domestic water totals.

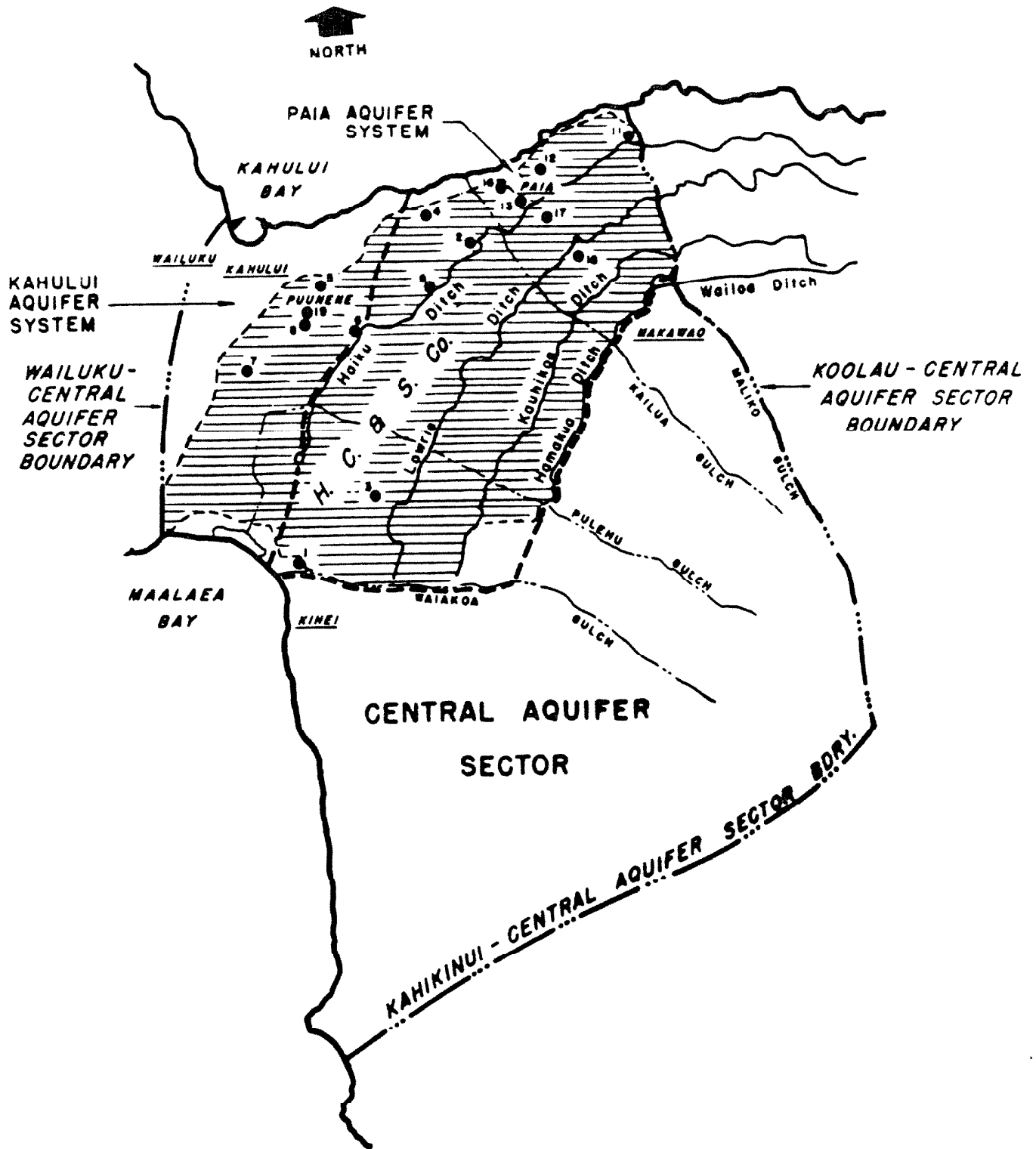
PRIVATE - AGRICULTURAL WATER SYSTEM
 HC&S CO. - A&B, INC.*
 INVENTORY OF EXISTING SOURCES

Aquifer Sector

Surface Water Sources	Koolau	Wailoa Ditch System	
	Koolau	Kauhikoa Ditch System	
	Koolau	Lowrie Ditch System	
	Koolau	Haiku Ditch System	
	Wailuku	Waihee Ditch System	
	<u>DLNR</u> <u>Well No.</u>	<u>Well - Pump *</u>	<u>Number</u> <u>of Pumps</u>
	5520-01	Maliko Pump 11	2
	5522-01	Kuau Pump 12	1
	5423-02	Lower Paia Pump 16	2
	5422-01	Paia Pump 13	2
	5422-02	Paia Pump 17	1
	5424-01	Spreckelsville Pump 4	1
	5323-01	Paia Pump 2	2
Ground Water Sources	5224-02	Puunene Pump 9	1
	5226-01	Puunene Pump 5	1
	5226-02	Puunene Pump 6	2
	5128-02	Waikapu SH Pump F	2
	5321-01	Kaheka Pump 18	2
	5227-04	Puunene Pump 8	3
	5227-05	Puunene Pump 19	2
	4825-01	Puunene Pump 3	2
	4727-01	Puunene Pump 1	1

*Ditch System and State water license area shown in Exhibit AO. All wells are within Central Aquifer Sector and shown in Exhibit AP.

Total well capacity 254 MGD.



● Well

HAWAIIAN COMMERCIAL & SUGAR CO. IRRIGATION WELLS

See Appendix C for Aquifer info.

PRIVATE AGRICULTURAL WATER SYSTEM
WAILUKU AGRIBUSINESS
INVENTORY OF EXISTING SOURCES*

- | | | | |
|-----|--|---|---|
| I. | Surface Water Sources
(from Wailuku Aquifer Sector) | - | Qs = 26.7 MGD |
| | Waihee Valley | - | Waihee Ditch
Spreckels Ditch |
| | Waiehu Valley | - | North Waiehu Ditch
South Waiehu Ditch (HC&S) |
| | Iao Valley | - | Iao - Waikapu Ditch
Maniania Ditch
Kama Ditch |
| | Waikapu Valley | - | South Waikapu Ditch
Everett Ditch |
| II. | Groundwater Sources
(from Wailuku Aquifer Sector) | - | Qg = 0 |
| | Wailuku Shaft
(Map 5 - 53-30-05 - Tunnel) | | |
| | Iao Tunnel (0.7 MGD high level water
included with surface total) | | |

* Surface and ground water sources are shown in Exhibit AQ.

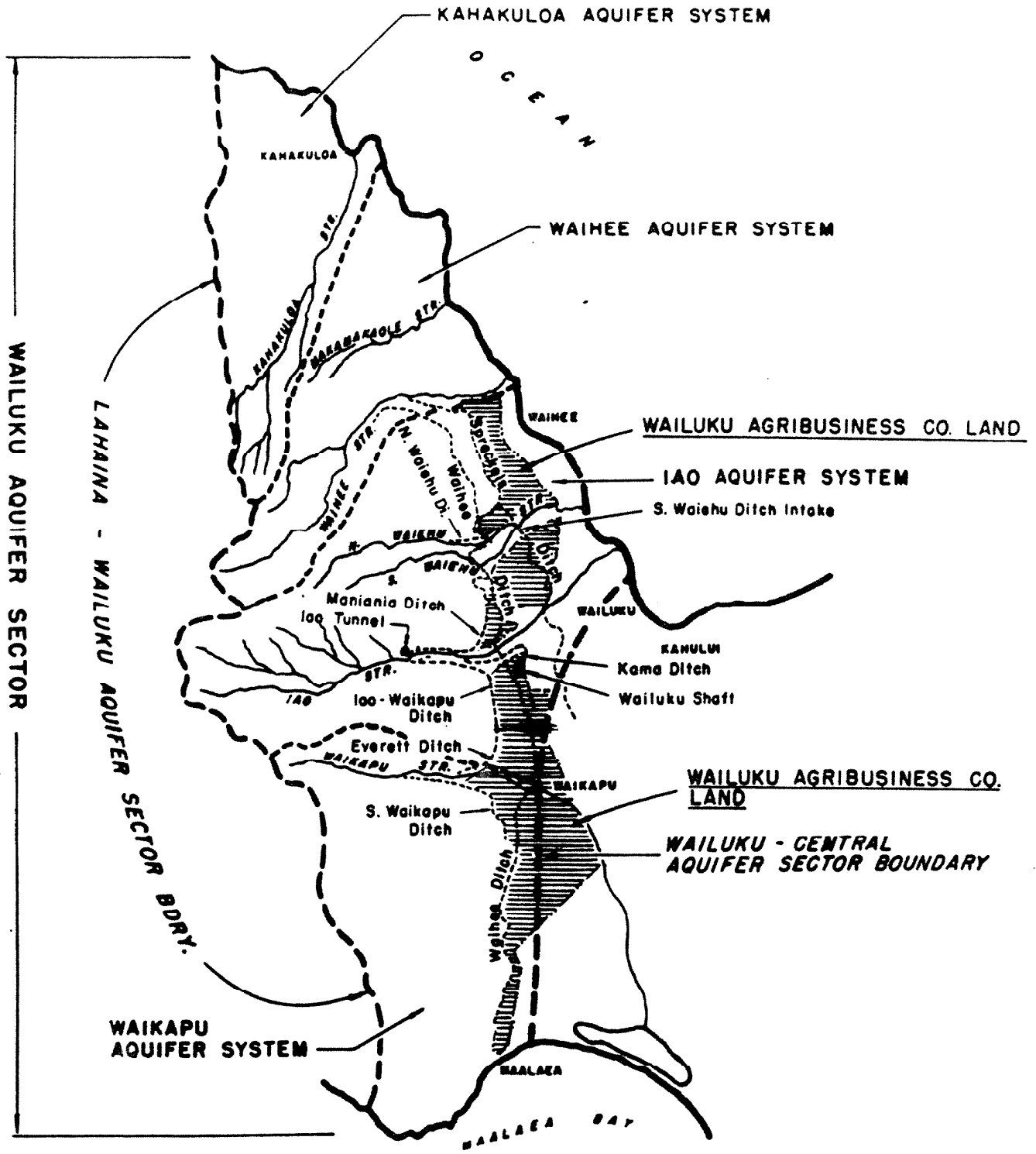
PRIVATE AGRICULTURAL WATER SYSTEM
MAUI PINEAPPLE COMPANY, LTD.
INVENTORY OF EXISTING SOURCES

Honolua Division

1. The agricultural water source is Honokohau Ditch and is shown in Exhibit AL.

Haliimaile Division

1. The private agricultural sources are the Kailiili Intake shown in Exhibit H, and from the EMI system at Haliimaile.



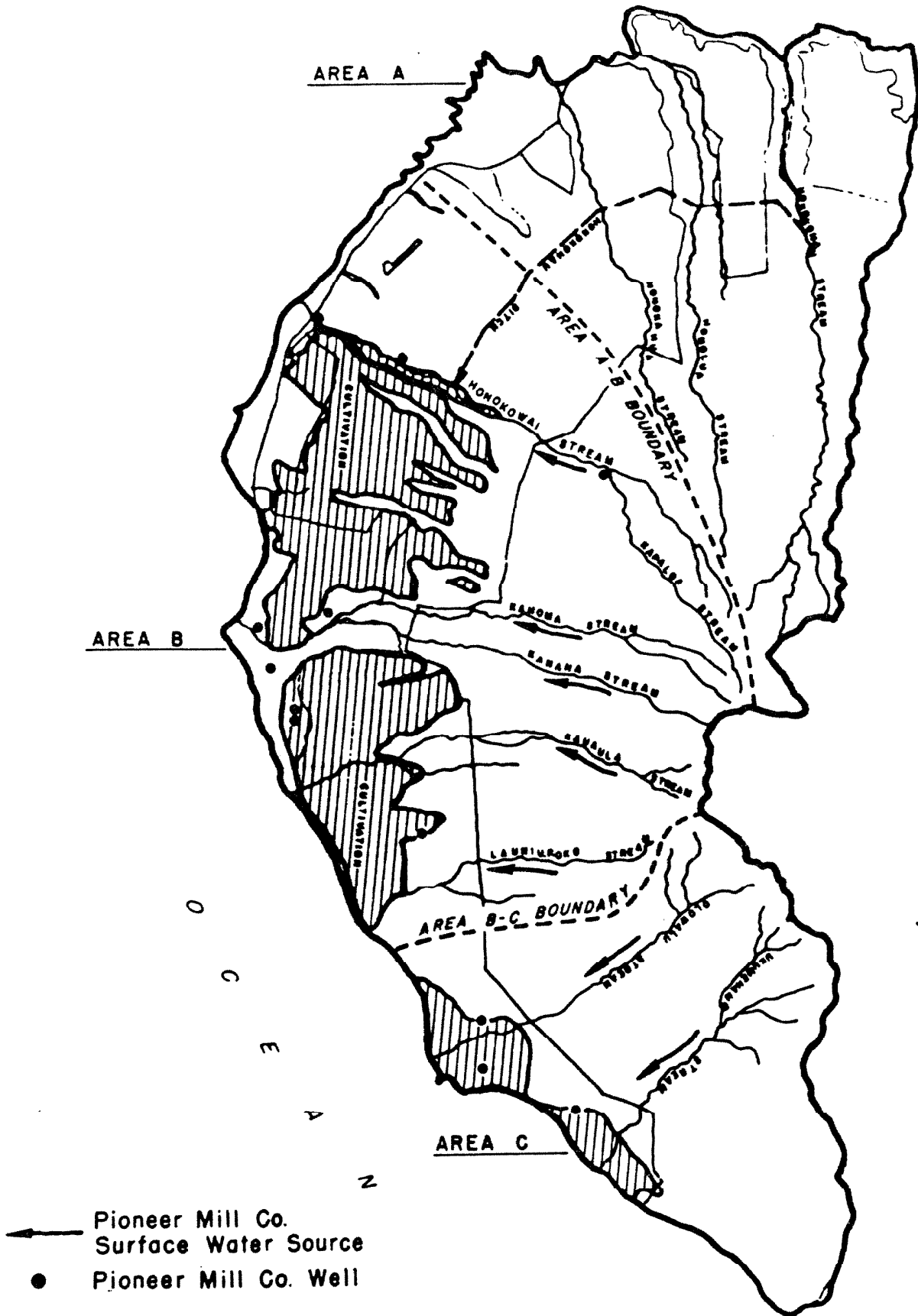
SEE APPENDIX C FOR
AQUIFER INFORMATION.

WAILUKU AGRIBUSINESS CO., INC. BOUNDARY AND IRRIGATION SYSTEM

Private - Agricultural Water System
Pioneer Mill Co., Ltd.
Inventory of Existing Sources*

Surface Water Sources		Honokohau Ditch
		Honokowai Stream
		Kahoma Stream
		Kanaha Stream
		Kauaula Stream
		Launiupoko Stream
		Olowalu Stream
		Ukumehame Stream
Ground Water Sources	DLNR	
	<u>Well No.</u>	<u>Name</u>
	4835-01	Ukumehame - Pump P
	4837-01	Olowalu - Pump O
	4937-01	Olowalu - Pump N
	5138-01	Launiupoko - TUN
	5240-02	Lahaina - Pump A
	5240-03	Lahaina - Pump B
	5240-01	Mill - Pump C
	5340-01	Wahikuli - Pump L
	5340-02	Kahoma - Pump M
	5641-01	Kaanapali - Pump D
	5641-02	Honokowai - Pump F
5640-01	Honokowai - Pump R	
5537-01	Honokowai - TUN	

*Existing sources shown in Exhibit AR.

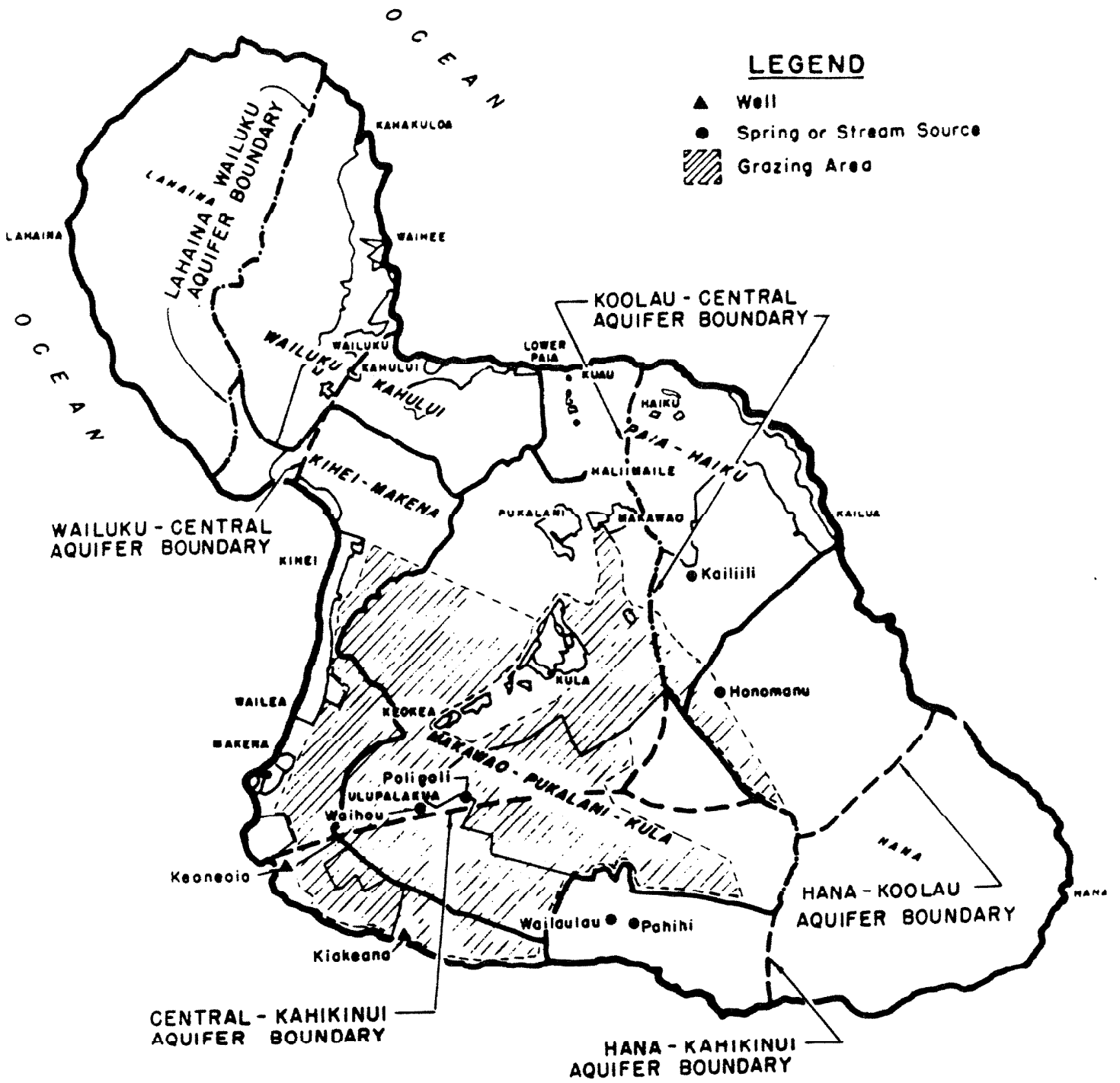


PIONEER MILL COMPANY AGRICULTURAL WATER SYSTEM

See Appendix C for Aquifer info.

PRIVATE AGRICULTURAL NON CROP
GRAZING AREAS WATER SYSTEMS
INVENTORY OF EXISTING SOURCES BY RANCHES

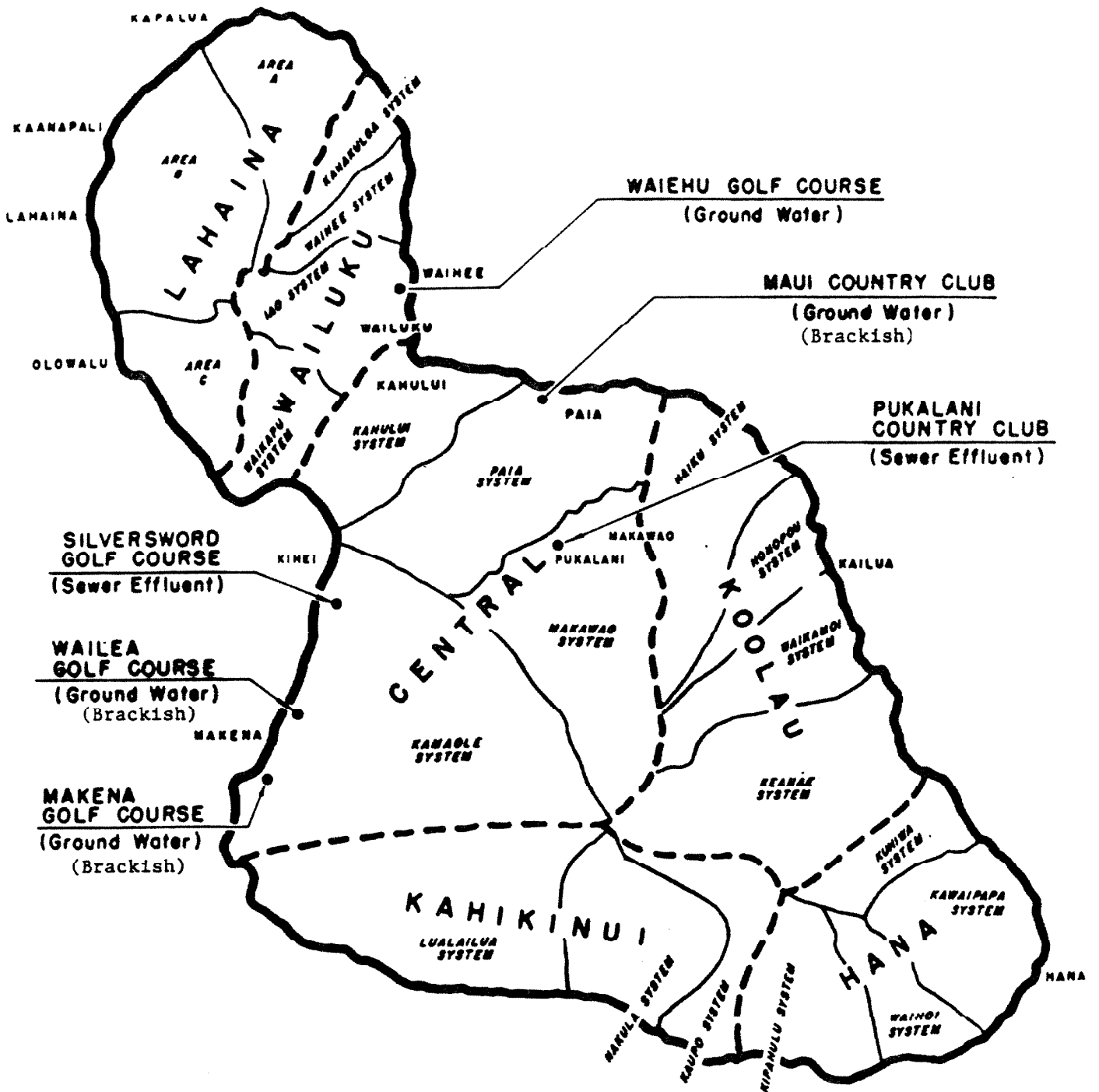
Ranch	Average Daily Demand Unit: GPD	Ground (DLNR #)	Source Surface
Ranches-Northeast (West Mountains)		5731-01 5832-01	(Makamakaole Stream) (Wailena Stream) Kahakaloa Stream
Haleakala Ranch (See Exhibit AS)			Honomanu Stream Opana - Kailiili Pahihi Spring (Waiopai Area) Wailaulau Spring (Waiopai Area)
Kaonoulu Ranch (See Exhibit AS)			Opana - Kailiili
Ulupalakua (See Exhibit AS)	700 1,400 7,000 6,300 7,000		Waikaalu Spring Morton Spring Polipoli Spring Waikaahi Spring Cornwall Spring Waihou Spring
	1,000-50,000	Keoneoio Well	
Kaupo Ranch (See Exhibit AC)	3,600 3,600		Panileihulu (Healani Stream) Kalepa Intake Punahoa Spring Manawainui Spring Waiu Spring
Hana Ranch (See Exhibit AC) (See Exhibit AS)		4701-01	Honomaele Stream Kaeleku
Maui Factors (See Exhibit AS)	100,000	3518-01	(Kahikinui- Kiakeana)



**PRIVATE AGRICULTURAL SOURCES
AND SERVICE AREA - GRAZING
MAKAWAO - KULA - KAHIKINUI**

PRIVATE AGRICULTURAL NON CROP WATER SYSTEMS
 LANDSCAPING PLANTS AND PARKS
 INVENTORY OF EXISTING SOURCES BY DEVELOPMENT

<u>DEVELOPMENT</u>	<u>DLNR NO.</u>	<u>PUMP CAPACITY UNIT: MGD</u>
Kaanapali (See Exhibit AJ)	5540-1	0.8
	5540-3	0.8
	5541-1	0.8
Kapalua (See exhibit AM)	5938-02	1.0
Makena (See exhibit AT)	3826-01	0.43
	3826-02	0.58
	3826-03	0.58
	3826-04	0.58
Maui Country Club (See Exhibit AT)	5423-01	1.3
Parks (County of Maui) (Includes Waiehu Golf Course) (See Exhibit AT)	Total	3.0
Wailea (See Exhibit AT)	3926-03	0.58
	4026-06	1.0
	4026-05	0.32
	4026-04	0.55
	4126-03	0.66
	4126-02	0.72
	4126-01	0.5
	4226-12	1.15



EXISTING GOLF COURSES AND RELATED SOURCES

AGRICULTURAL WATER USE - PRIVATE SYSTEMS

Future Demands

The projected water withdrawal for agricultural use for the year 2010 is 507 million gallons per day and is shown in the table on Page 86.

Crop Systems

Wailuku Agribusiness Company's irrigation water needs and obligations for long-term planning are estimated at 45 MGD, an increase of 18.3 MGD over 1987. The net change for total Wailuku Agribusiness diversions are projected as unchanged. Pioneer Mill Company's irrigation water needs are estimated at 49.2 MGD, a decrease of 16.6 MGD. Other major agricultural companies project smaller changes for irrigation water demands.

Non-Crop Systems

Water demands for grazing areas are projected to be unchanged except in the Kahakuloa area where 0.2 MGD withdrawal is planned. (Refer to Appendix pages R-20 to R-23.)

Parks and school grounds will be irrigated with lower quality groundwater or waste water. Additional well capacities are planned for the Kihei and Lahaina areas. (Refer to Appendix pages R-26 to R-27 for details.)

Wailea and Makena plan six additional brackish wells to increase withdrawal by 2.0 MGD for landscaping plants. (Refer to Appendix R-25 for details.)

Kapalua has plans to increase demand by 1.5 MGD for landscaping plants. Kaanapali plans to increase brackish groundwater withdrawal by 1.0 MGD for landscaping plants. (Refer to pages 70 to 80 for details.)

Development Plans

Crop Systems

Wailuku Agribusiness Company plans no change of stream diversions for their future needs.

Pioneer Mill Company plans reduced groundwater withdrawals as irrigation needs are reduced.

Maui Pineapple Company, Honolua Division, will complete a Honokohau ditch subintake installation at Mahana. Average diversion is planned at 5.5 million gallons per day.

Non-Crop Systems

Brackish water wells are planned for Kaanapali, Wailea, and Makena Resort areas.

Kapalua Resort will increase Honokohau ditch diversions for landscaping plants. Increased diversions for Maui Pineapple Company and Kapalua will reduce ditch delivery to Pioneer Mill Company.

The County Parks Department has the following plans:

- 1) Three wells with a total capacity of 228,000 gallons per day for Kihei area.
- 2) Additional 17,300 gallons per day for Lahaina area.

INDUSTRIAL AND MISCELLANEOUS SYSTEMS

Existing Use

Industrial water users in the Lahaina region are shown in Exhibit AU. These are:

Pioneer Mill Company

Pioneer Mill Company operates a power generating plant located at the sugar processing mill. Condenser water for the turbo-generator is obtained from a well located at the mill. After cooling the turbo-generator condenser, this water is used in the sugar processing plant before finally being used for a third time for cane irrigation.

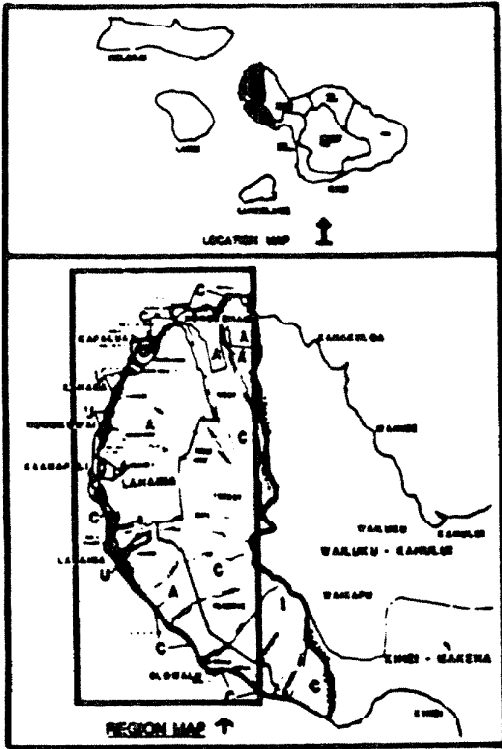
Pioneer Mill Company also operates a hydro-power plant at the base of Kauaula Stream. The unit is rated at 500 KW. This is a non-consumptive use of water (i.e., after passing through the hydro-power plant, the water is ultimately used for agricultural irrigation).

Private Hydro-power Plant

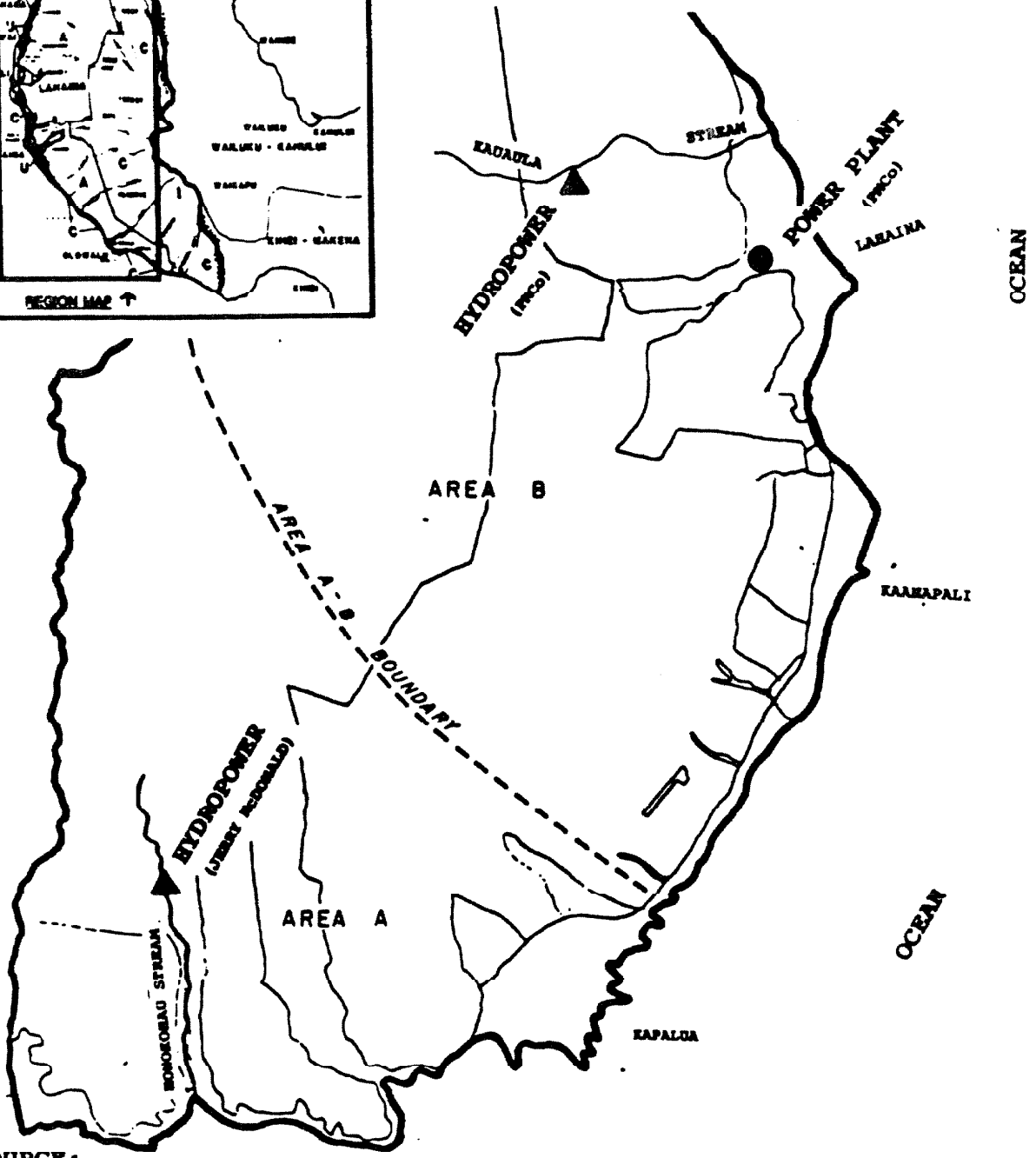
A hydro, owned by Jerry McDonald, is located along the Honokohau stream. Approximately 0.3 MGD is diverted for hydro power.

Industrial and miscellaneous water users in the Central Maui areas are as follows and shown in Exhibit AV:

1. Hawaiian Commercial & Sugar Company:
Puunene Power Plant
Paia Power Plant
Hydroelectric Plants
2. Maui Electric Company:
Kahului Power Plant
Maalaea Power Plant
3. Maui Land & Pineapple Company:
Kahului Cannery



**INDUSTRIAL & MISCELLANEOUS USE
LAHAINA
EXISTING SOURCES**



SOURCE:
 1) LAHAINA COMMUNITY PLAN
 2) PIONEER MILL CO.

Hawaiian Commercial & Sugar Company

HC&S Co. turbo-generators at the Puunene and Paia mills. require saline-free water from the Wailoa Ditch for boiler make-up and other industrial uses. This requirement is approximately 2 to 3 MGD.

Condenser water for the power plants is obtained from wells located by the mill. After the condensing cycle, this water is used in the cane sugar processing plant and finally used for a third time for irrigation. Total withdrawal is included with the HC&S writeup on groundwater.

HC&S operates three hydroelectric plants in the Paia-Haliimaile region. The rated output of the hydros are:

	<u>Rated Output (KWH)</u>
Kaheka Hydro	4,500
Paia Hydro	900
Paia Lowhead Hydro	500

This is a non-consumptive use of water; water is ultimately used for agricultural irrigation.

Maui Electric Company: Kahului Plant

Condenser water for the turbo-generators at Kahului is drawn from ten saltwater wells located next to the plant.

In 1987, approximately 17.1 billion gallons were pumped through the plant. No well water is used at the Maalaea Power Plant.

Maui Land & Pineapple Company: Kahului Cannery

Maui Land & Pineapple Company Cannery has two wells on site. The first, a brine well, draws saltwater from a depth of 280 feet (which is below the aquifer). Approximately 1.4

Maui Land & Pineapple Company: Kahului Cannery (contd)

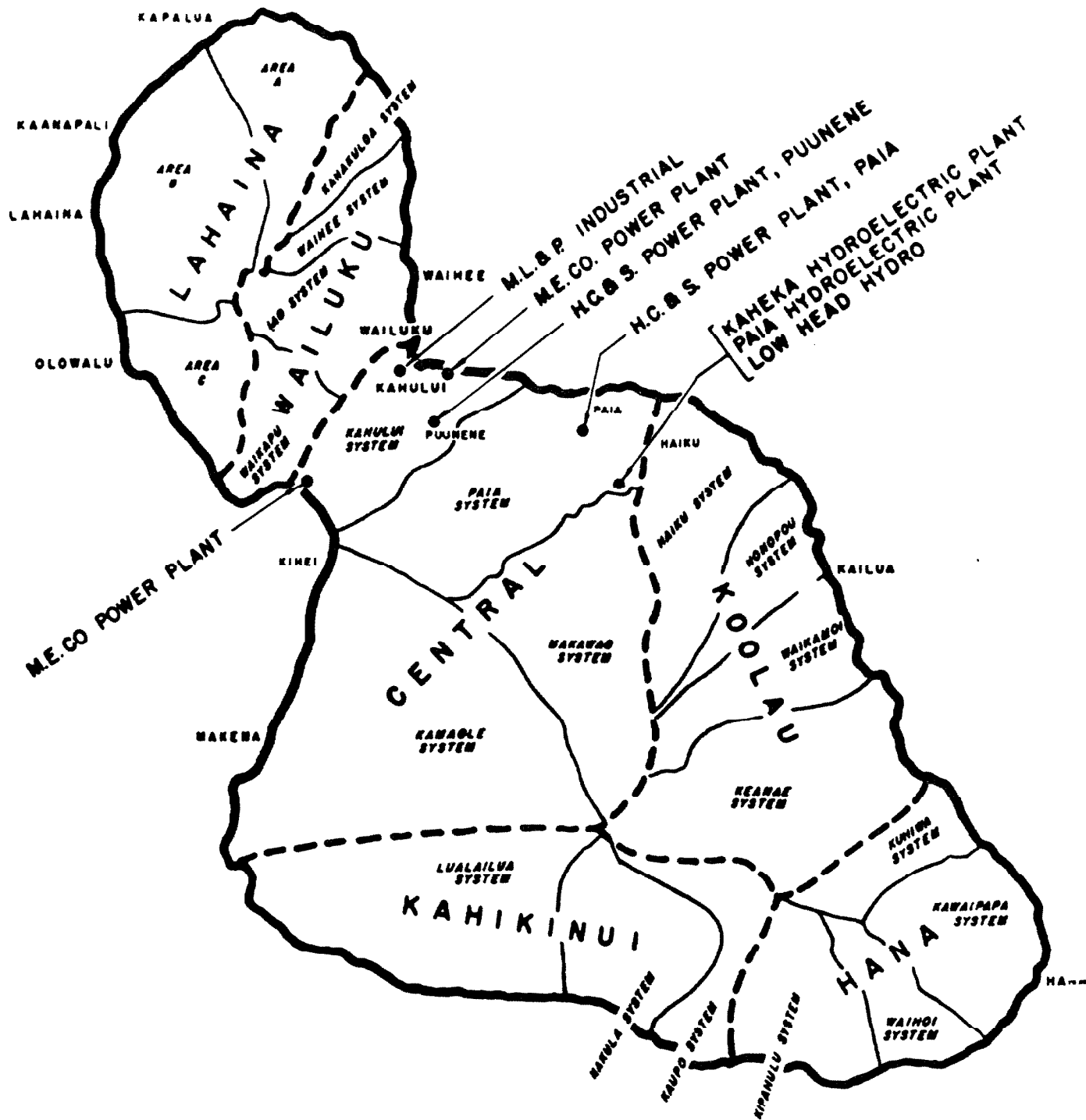
MGD is used as cooling medium for the condensers of the evaporators. The saltwater is then reinjected to the brine depth.

The second well draws low salinity water for washdown purposes. The pump for this well has a capacity of 1.0 MGD.

Yearly withdrawals for the wells (based on five years) are 317 MG for the brine well and 288 MG for the washdown well.

Future Demands:

No major changes are planned at this time.



INDUSTRIAL & MISCELLANEOUS USE
MIDDLE MAUI AREA

SUMMARY OF WATER WITHDRAWAL BY
AQUIFER SECTOR AND AQUIFER SYSTEMS

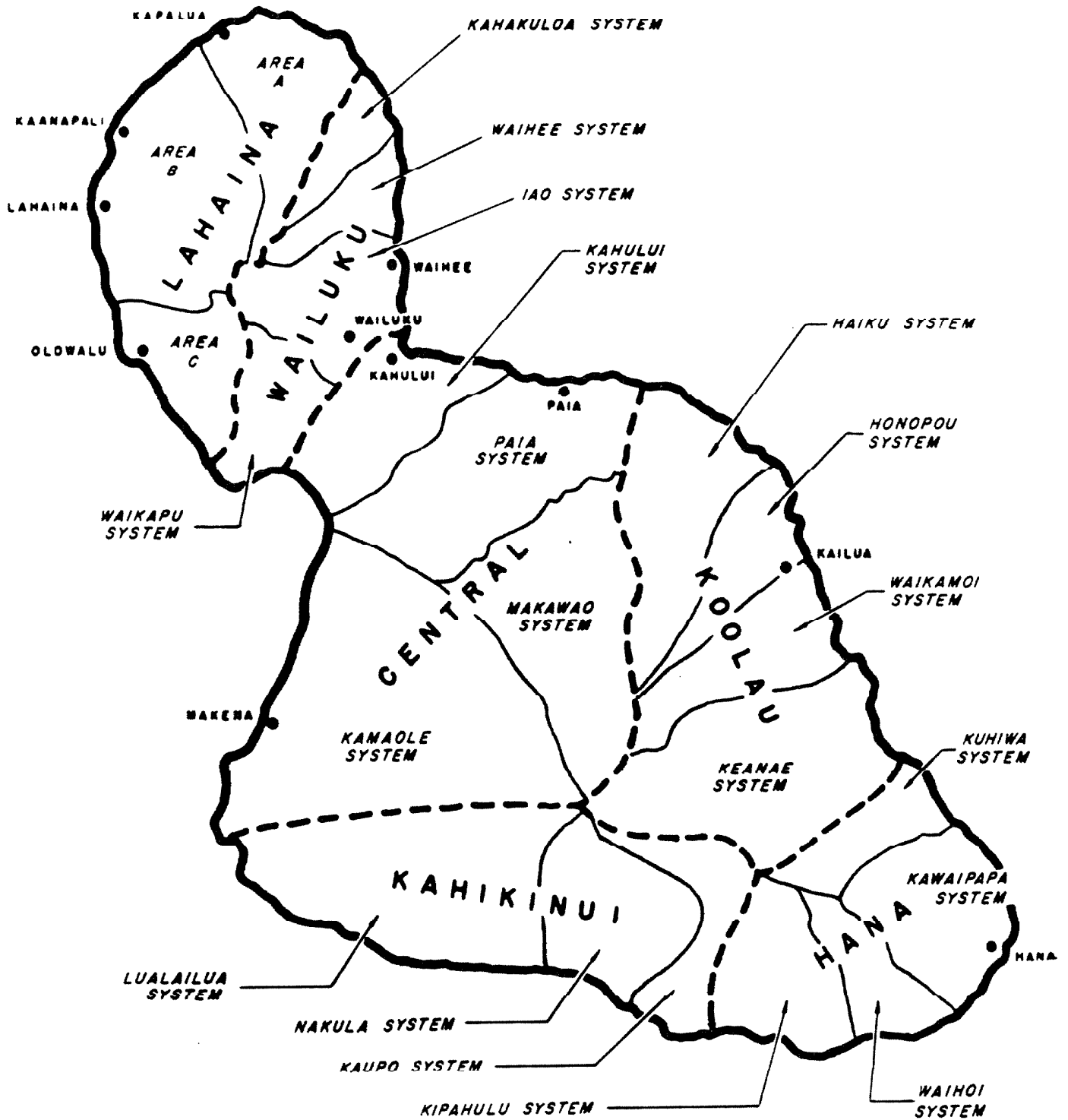
Introduction:

Island of Maui Water Use and Development Plan inventories have been summarized as withdrawals from groundwater and surface water sources. In addition, the groundwater and surface water sources have been summarized by aquifer sectors and systems. Groundwater withdrawals are shown by bar charts.

Exhibit AW shows island of Maui by aquifer classification. A description of aquifer classification by Dr. John Mink is included in the Appendix C.

Lahaina sector is divided into the former USGS areas. This designation was retained for this report to present sustainable yield numbers based on irrigation recharge.

The quantity of water available in an aquifer depends on hydrogeological structure and climatic cycles, as rainfall, vegetation, stream flows, etc. Withdrawal of water from an aquifer can be regulated to sustain safe yields that will not degrade the aquifer quality. The quality of an aquifer is in part maintained or improved by the application of water to an aquifer. This process called recharging is a natural process and also can be accomplished by irrigation of cultivated or planted areas. The summaries of withdrawal for irrigation water by aquifers and by transfer is summarized for recharge consideration.



AQUIFER CLASSIFICATIONS FOR ISLAND OF MAUI

TOTAL AQUIFER SECTOR WITHDRAWAL

Island of Maui

The following table includes total withdrawals for municipal, agricultural, and industrial-miscellaneous uses. The table divides withdrawals by aquifer sectors-systems, by surface water and groundwater for the years 1987 and 2010.

Transfer, the withdrawal of water from one aquifer and applied on another of agricultural water, is summarized for aquifer recharge calculations.

The evaluation of sustainable yield after consideration of agricultural irrigation water application will be presented by the Protection Plan of the Hawaii Water Plan. Appendix D does include a preliminary evaluation by Dr. Mink for the Lahaina Aquifer Sector, area A and B.

ISLAND OF MAUI
TOTAL MUNICIPAL, PRIVATE, DOMESTIC, AGRICULTURAL AND INDUSTRIAL
WATER SYSTEMS
withdrawals and transfers
by AQUIFER SECTORS and SYSTEMS

WITHDRAWAL	YEAR 1987			YEAR 2010		
	SURFACE	GROUND	TOTAL	SURFACE	GROUND	TOTAL
WAILUKU SECTOR						
WAIKAPU SYSTEM	6.6		6.6	6.6		6.6
IAO SYSTEM	24.2	15.6	39.8	24.2	18.5	42.7
WAIHEE SYSTEM	76.5		76.5	76.5	4.2	80.7
KAHAKULOA						
CENTRAL SECTOR						
KAHULUI SYSTEM		38.4	38.4		38.4	38.4
PAIA SYSTEM		130.5	130.5		130.5	130.5
COMBINE SYSTEMS:		2.7	2.7		4.7	4.7
MAKAWAO						
KAMAOLE						
KOOLAU SECTOR						
HAIKU SYSTEM	0.4		0.4	0.4	8.5	8.9
COMBINE SYSTEMS:	169.2		169.2	177.2		177.2
HONOPOU						
WAIKAMOI						
KEANAE						
HANA SECTOR						
KAWAIPAPA	0.1	0.1	0.2		0.4	0.4
COMBINE SYSTEMS:						
KUIHIWA						
WAIHOI						
KIPAHULU						
KAHIKINUI SECTOR	0.1		0.1	0.1		0.1
LAHAINA SECTOR						
USGS-A	24.6	2.7	27.3	25.0	7.0	32.0
USGS-B	22.9	24.2	47.1	22.7	19.1	41.8
USGS-C	8.7	1.0	9.7	8.7	1.0	9.7
TRANSFER-AGRICULTURAL WATER ONLY FROM AQUIFER:						
TO AQUIFER SECTOR-SYSTEM:						
WAILUKU						
CENTRAL						
W A I L U K U						
CENTRAL						
WAILUKU SECTOR				W A I K A P U	I A O	CENTRAL
WAIHEE	0.4		28.3	2.2	7.0	29.5
C E N T R A L						
C E N T R A L						
KOOLAU SECTOR				KAHULUI	PAIA	MAKAWAO
HAIKU			0.2			0.2
COMBINE SYSTEMS:	17.0	147.0		17.0	147.0	
HONOPOU						
WAIKAMOI						
KEANAE						
LAHAINA SECTOR						
LAHAINA SECTOR	A	B	C	A	B	C
A		17.2			15.7	

WITHDRAWAL FOR MUNICIPAL USE

The following table is a summary of withdrawals for municipal uses of both surface water and groundwater by aquifer sectors and systems. Total withdrawals increase from 29.9 MGD in 1987 to 64.2 MGD by year 2010.

Surface and groundwater withdrawals by water systems is shown in Appendix C.

Central Maui water system demands increase from 15.1 MGD in 1987 to 30.5 MGD by year 2010. The development plan shows a range of withdrawals from several aquifer systems. This summary is based on the following withdrawal rates: Iao System - 18 MGD, Waihee System - 4 MGD, Haiku System - 8.5 MGD.

Withdrawals for the Makawao plus Kula water systems increase from 5.4 MGD in 1987 to 13.4 MGD in the year 2010. All withdrawals are from the Koolau sector, a combination of Honopou, Waikamoi, Keanae systems.

The Lahaina Aquifer Sector is divided into the traditional USGS areas A, B, C. The municipal and private domestic systems withdrawals within the Lahaina Sector increase from 9.2 MGD in 1987 to a planned 19.9 MGD by the year 2010.

ISLAND OF MAUI
MUNICIPAL AND PRIVATE DOMESTIC
WATER SYSTEMS
WITHDRAWALS
by AQUIFER SECTORS and SYSTEMS

WITHDRAWAL	YEAR 1987		YEAR 2010	
	SURFACE GROUND	TOTAL	SURFACE GROUND	TOTAL
WAILUKU SECTOR				
WAIKAPU SYSTEM				
IAO SYSTEM	15.1	15.1	18.0	18.0
WAIHEE SYSTEM			4.0	4.0
KAHAKALOA				
CENTRAL SECTOR				
KAHULUI SYSTEM				
PAIA SYSTEM				
COMBINE SYSTEMS:				
MAKAWAO				
KAMAOLE				
KOOLAUPUNAHOU SECTOR				
HAIKU SYSTEM	0.2	0.2	0.2	8.5
COMBINE SYSTEMS:	5.2	5.2	13.2	13.2
HONOPOU				
WAIKAMOI				
KEANAE				
HANA SECTOR				
KAWAIPAPA	0.1	0.1	0.4	0.4
COMBINE SYSTEMS:				
KUHIIWA				
WAIHOI				
KIPAHULU				
KAHIKINUI SECTOR				
LAHAINA SECTOR				
A	1.8	2.7	1.2	7.0
B	1.6	3.0	1.4	10.2
C	0.1	0.1	0.1	0.1
TOTAL	9.0	20.9	16.1	48.1
		29.9		64.2

WITHDRAWAL FOR AGRICULTURAL USE

The following table is a summary of withdrawals for agricultural use of both surface water and groundwater by aquifer sectors and systems for years 1987 and 2010.

Future withdrawals for agricultural purposes are average projections by many company "write-ups" included in the appendix. For the year 2010 total surface water withdrawal for Wailuku Agribusiness and their obligations are identical to the 1987 diversion quantities.

Withdrawal for Lahaina Sector B shows a decrease from 42.5 MGD in 1987 to 30.2 MGD in the year 2010. This reduction reflects the reduction of Pioneer Mill Company agricultural land to areas for Hawaii Financial Development Corporation housing project and also the Kaanapali development plans.

ISLAND OF MAUI
TOTAL AGRICULTURAL PRIVATE
WATER SYSTEMS
withdrawals and transfers
by AQUIFER SECTORS and SYSTEMS
unit:MGD

WITHDRAWAL	YEAR 1987		YEAR 2010			
	SURFACE	GROUND	TOTAL	SURFACE	GROUND	TOTAL
WAILUKU SECTOR						
WAIKAPU SYSTEM	6.6		6.6	6.6		6.6
IAO SYSTEM	24.2	0.5	24.7	24.2	0.5	24.7
WAIHEE SYSTEM	76.5		76.5	76.5	0.2	76.7
KAHAKALOA						
CENTRAL SECTOR						
KAHULUI SYSTEM		37.6	37.6		37.6	37.6
PAIA SYSTEM		130.5	130.5		130.5	130.5
COMBINE SYSTEMS:		2.7	2.7		4.7	4.7
MAKAWAO						
KAMAOLE						
KOOLAU SECTOR						
HAIKU SYSTEM	0.2		0.2	0.2		0.2
COMBINE SYSTEMS:	164.0		164.0	164.0		164.0
HONOPOU						
WAIKAMOI						
KEANAE						
HANA SECTOR						
KAWAIPAPA						
COMBINE SYSTEMS:						
KUHIWA						
WAIHOI						
KIPAHULU						
KAHIKINUI	0.1		0.1	0.1		0.1
LAHAINA SECTOR						
A	22.8		22.8	23.8		23.8
B	21.3	21.2	42.5	21.3	8.9	30.2
C	8.6	1.0	9.6	8.6	1.0	9.6
TRANSFER-AGRICULTURAL WATER FROM AQUIFER						
			TO AQUIFER SECTOR	-SYSTEM		
WAILUKU SECTOR	WAILUKU		CENTRAL	W A I L U K U		CENTRAL
WAIHEE	WAIKAPU		KAHULUI	WAIKAPU	IAO	KAHULUI
	0.4		28.3	2.2	7.0	29.5
KOOLAU SECTOR			C E N T R A L	C E N T R A L		
HAIKU	KAHULUI	PAIA	MAKAWAO	KAHULUI	PAIA	MAKAWAO
COMBINE SYSTEMS:			0.2			0.2
HONOPOU	17.0	147.0		17.0	147.0	
WAIKAMOI						
KEANAE						
LAHAINA SECTOR			LAHAINA SECTOR	LAHAINA SECTOR		
A	A	B	C	A	B	C
		17.2			15.7	

WITHDRAWALS FOR MISCELLANEOUS USES

The following table is a summary of withdrawals for industrial and miscellaneous uses of both surface water and groundwater by aquifer sector and systems for years 1987 and 2010.

ISLAND OF MAUI

WITHDRAWALS FOR INDUSTRIAL AND MISCELLANEOUS USES

BY AQUIFER SECTORS AND SYSTEMS

UNIT: MGD

<u>WITHDRAWAL</u>	<u>YEAR 1987</u>		<u>YEAR 2010</u>	
	<u>Ground</u>	<u>Total</u>	<u>Ground</u>	<u>Total</u>
<u>Central Sector</u>				
Kahului System	0.8	0.8	0.8	0.8
<u>Koolau Sector</u>	<u>Surface</u>		<u>Surface</u>	
Combination Systems	2.5	2.5	2.5	2.5

The withdrawals for hydroplants and power plants are accounted for in the agricultural totals. The Maui Electric plant and Maui Pineapple Co. cannery withdraw saltwater and, therefore, are not tallied in this summary.

GROUNDWATER WITHDRAWAL BY AQUIFER SECTOR-SYSTEM

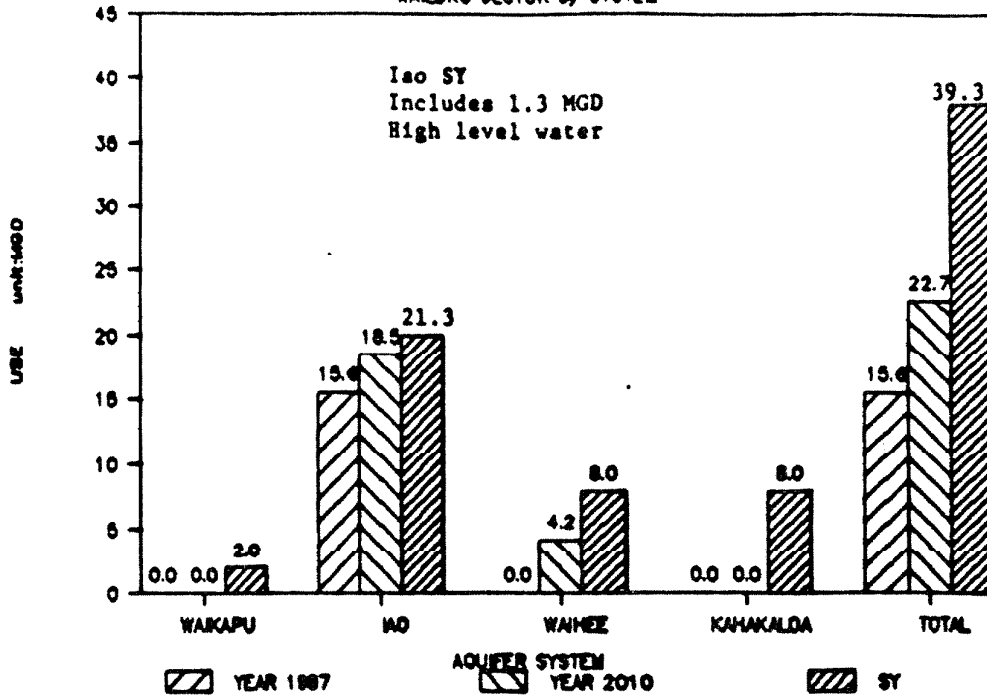
The following bar charts are summaries of total groundwater withdrawal compared to total groundwater sustainable yield and summaries of potable groundwater withdrawal compared to potable groundwater sustainable yield. The summaries are for the years 1987 and 2010.

Lahaina sector is shown as total groundwater withdrawal for years 1987 and 2010 compared to the basic sustainable yield and sustainable yield calculated with agricultural recharge water.

Central sector-system sustainable yields have not been calculated for agricultural recharge. Koolau sector-system sustainable yields have not been calculated for surface withdrawals and transfers.

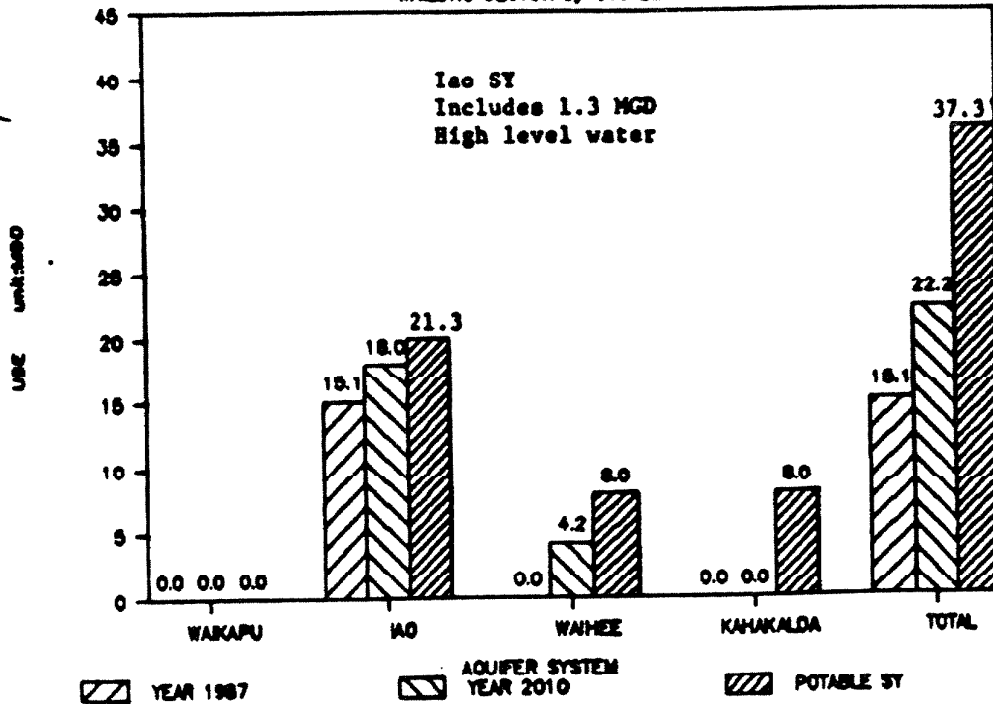
GROUNDWATER WITHDRAWAL

WAILUKU SECTOR by SYSTEM



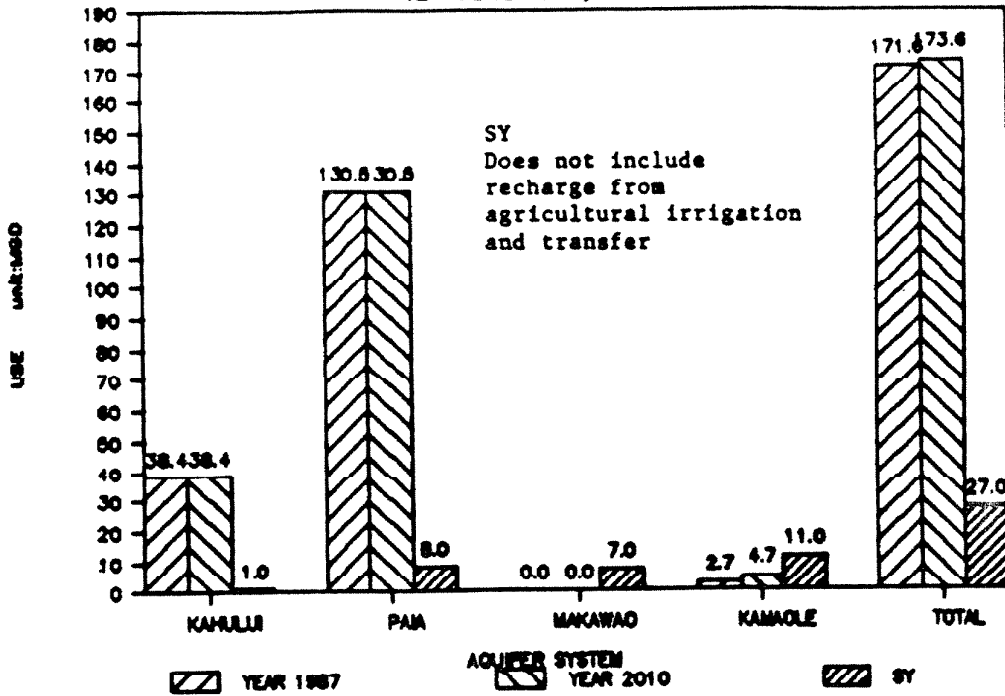
POTABLE GROUNDWATER WITHDRAWAL

WAILUKU SECTOR by SYSTEM



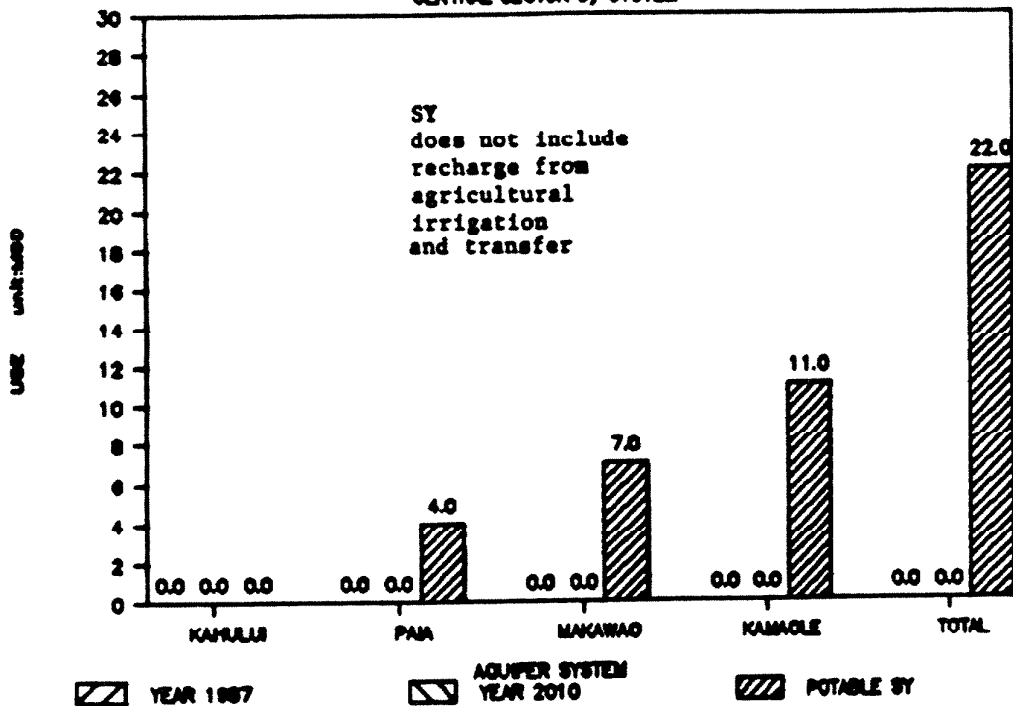
GROUNDWATER WITHDRAWAL

CENTRAL SECTOR by SYSTEM



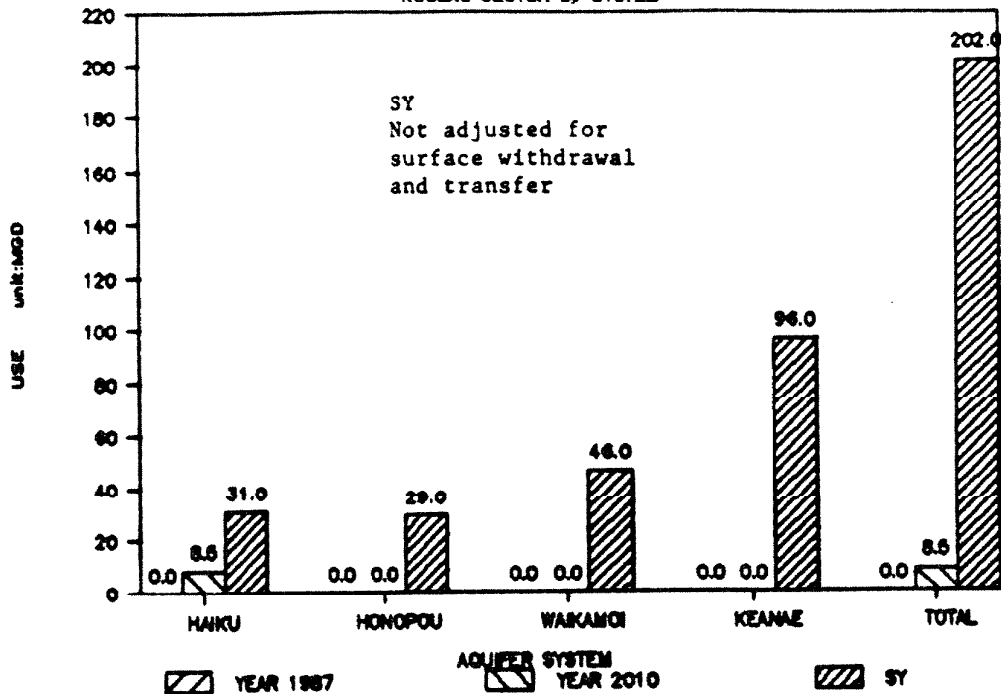
POTABLE GROUNDWATER WITHDRAWAL

CENTRAL SECTOR by SYSTEM



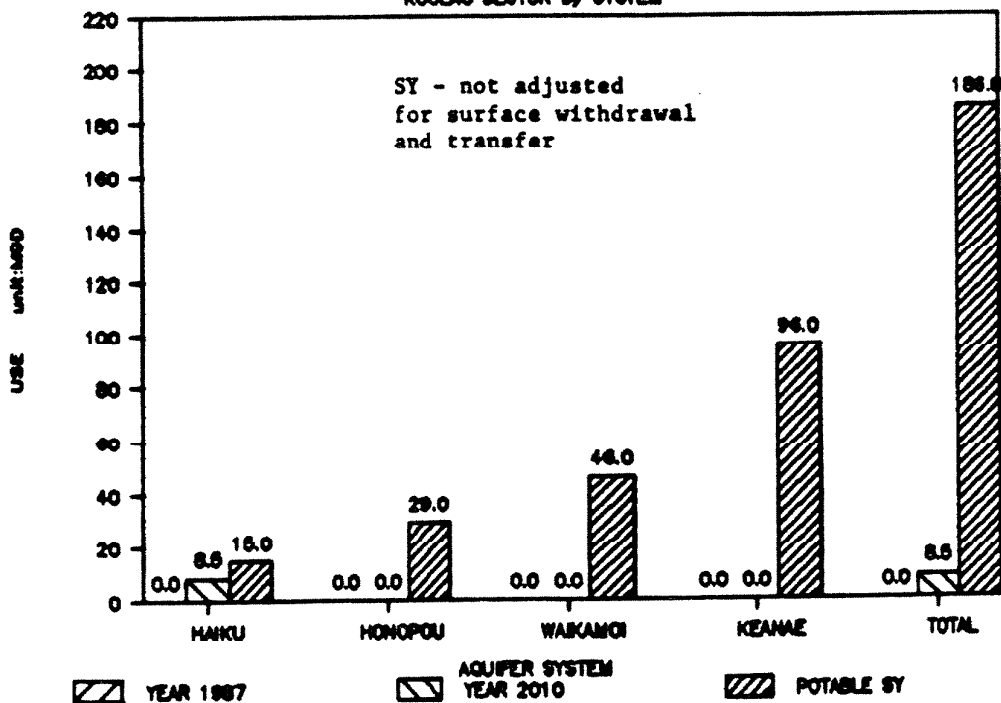
GROUNDWATER WITHDRAWAL

KOOLAU SECTOR by SYSTEM



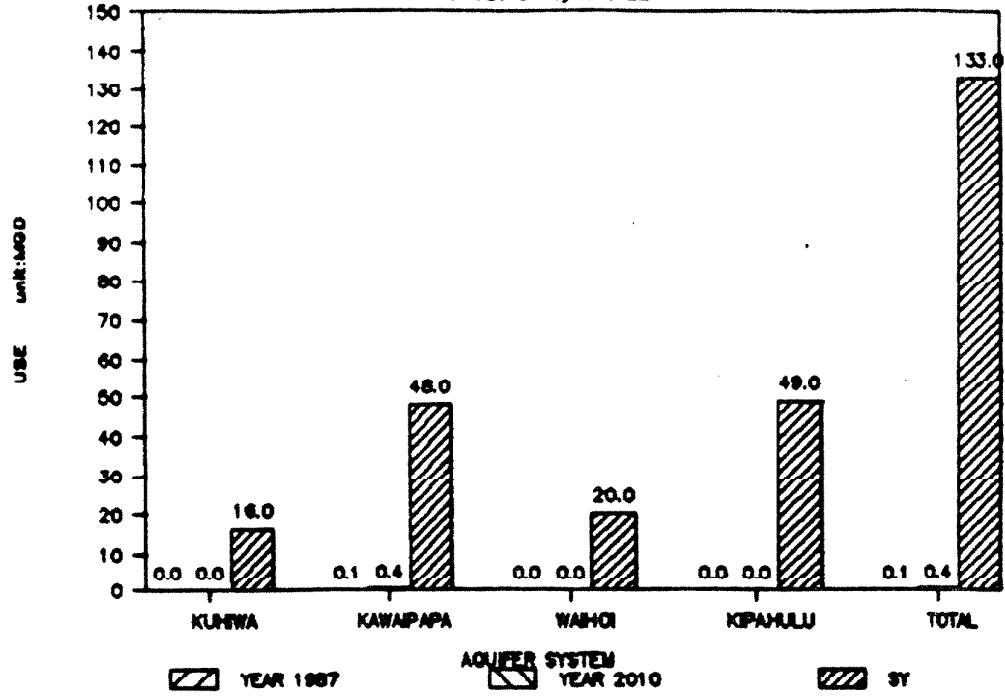
POTABLE GROUNDWATER WITHDRAWAL

KOOLAU SECTOR by SYSTEM



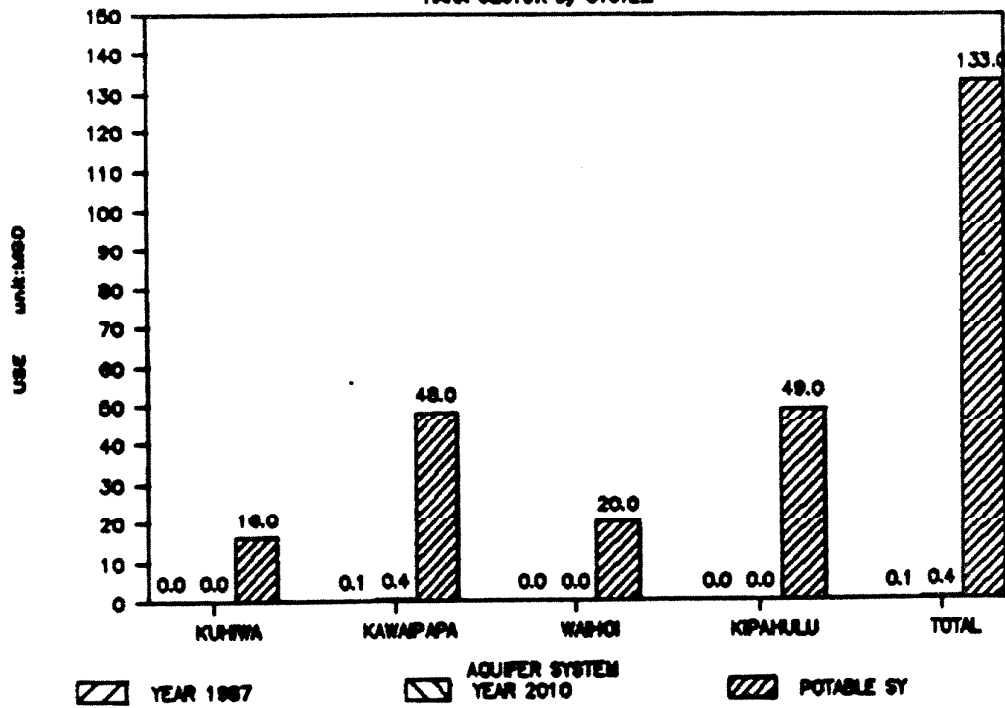
GROUNDWATER WITHDRAWAL

HANA SECTOR by SYSTEM



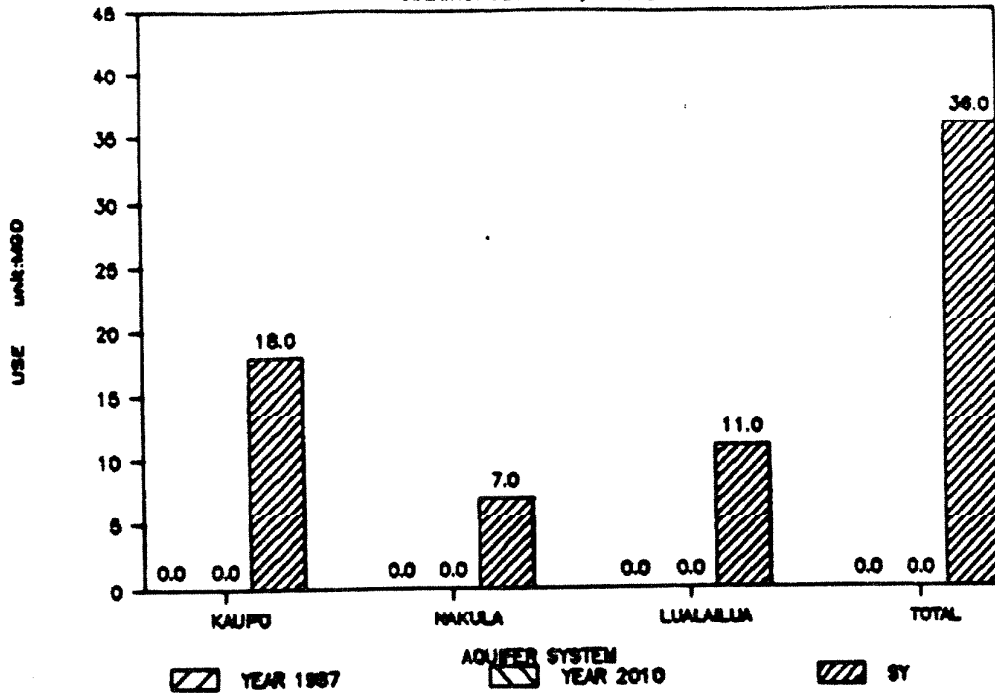
POTABLE GROUNDWATER WITHDRAWAL

HANA SECTOR by SYSTEM



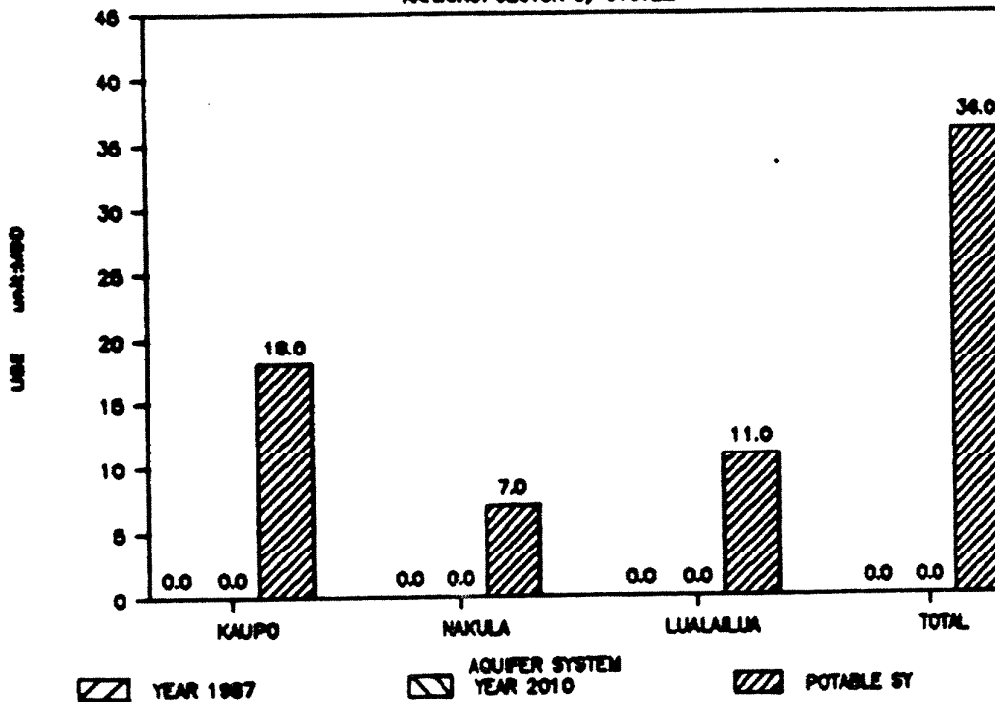
GROUNDWATER WITHDRAWAL

KAHUKUHI SECTOR by SYSTEM



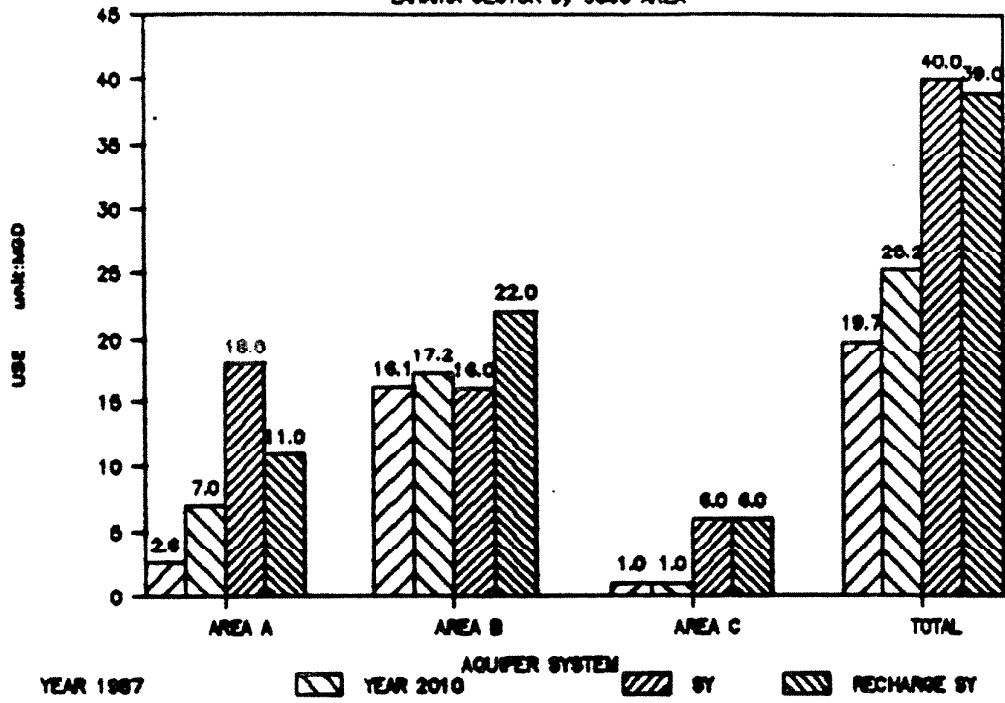
POTABLE GROUNDWATER WITHDRAWAL

KAHUKUHI SECTOR by SYSTEM



GROUNDWATER WITHDRAWAL

LAHAINA SECTOR by USGS AREA



Future Study Areas

There are many study areas that need to be studied or expanded in the Water Use & Development Plan. The following are some of the suggested study areas.

There is need for information to increase the "confidence level" of the sustainable yields of those aquifer systems that may become potable water sources within the next twenty years.

Completion of the certification process of stream diversion declarations will allow updates of withdrawals by aquifer systems.

Information on for desalinization pilot plants and other operational plants should be current to allow reasonable cost analysis.

Water demand estimates should be updated to reflect community plan changes. Ultimate water demands by community plan would be useful as a long-range planning tool.

R E F E R E N C E S

I S L A N D O F M A U I

HAWAIIAN COMMERCIAL & SUGAR COMPANY (HC&S)*
AGRICULTURAL WATER USE

The Hawaiian Commercial & Sugar Company (HC&S) cultivates sugarcane on over 35,800 acres in Central Maui. Our total annual water needs, which are satisfied by a combination of surface and ground waters, approximate 130 billion gallons. On the average, the plantation's irrigation needs are met 55% by surface water and 45% by ground water.

An adequate supply of irrigation water is an ever-present concern of the plantation due to the seasonal fluctuations in surface supplies over the high cost and limited use of pumped ground water. Over the years, HC&S has expended substantial effort and substantial sums of money to insure that available water resources are used as efficiently as possible. All of HC&S' cane land is now equipped with drip irrigation except for 1,600 acres which utilize the excess mill water for irrigation, a project which took eleven years and over \$35 million to complete. Prior to the installation of drip, the plantation implemented a water "development" program which focused on "developing" water through water conservation. All the plantation's major supply and distribution ditches were concrete-lined, selected reservoirs were lined, reservoir capacity increased, irrigation layouts improved, flume outlets improved, and experiments with overhead sprinklers undertaken.

*This section from A&B, Inc.

Efficient water management continues to be a critical issue for HC&S today, a key item in the plantation's strategy for survival.

Surface Water

Surface waters are imported to the plantation from East Maui and West Maui streams through extensive and complex plantation ditch systems.

HC&S' East Maui Irrigation (EMI) system is a network of four major ditches which operate in parallel to collect water from some 100 East Maui streams located between Nahiku and Haiku. The EMI system consists of 74 miles of ditch and tunnel and collects surface runoff from a watershed area of 57,000 acres, 38,000 acres of which are state-owned and 19,000 acres owned by EMI. EMI for over the past 100 years has operated continuously under agreements with the government to collect waters off of the government-owned lands.

EMI's average deliveries are approximately 60 billion gallons a year, or an average of 164 MGD. Actual daily flows, however, vary greatly throughout the year depending on rainfall conditions. During periods of high rainfall, the capacity of the EMI system (450 MGD) is rapidly filled and most of the rainfall flows to the ocean. During periods of low rainfall, HC&S is severely short of water. Flows as low as 10 MGD have been experienced. Our records indicate that there is insufficient water to meet HC&S' irrigation needs 24% of the time, or roughly 90 days a year.

The water provided by the East Maui watershed is absolutely essential to the viability of HC&S. HC&S has 10,000 acres of cane land dependent entirely on East Maui ditch flows for irrigation. In addition, the EMI system provides essential water to the County of Maui for the domestic and agricultural needs of their Upcountry Maui consumers, some 21,000 residents and farmers, and to some private pineapple growers.

The West Maui ditch system is owned and utilized by HC&S in conjunction with Wailuku Agribusiness Company, Inc. This Waihee system provides HC&S with an average of 25 MGD for its western fields. This enables HC&S to utilize more of its East Maui waters for those 10,000 acres totally dependent on the EMI ditch system (shown in Page R-7).

Ground Water

The plantation utilizes 16 ground water wells to supplement its rainfall-dependent surface water sources (shown in Page R-8). These wells are capable of supplying a total of 254 MGD. However, in addition to being very expensive to pump, this water is limited in use due to the low elevation locations of the wells and the salt content of the water. During low rainfall periods, HC&S will pump these costly wells in order to keep the cane alive. Actual use, therefore, varies from year-to-year depending on rainfall conditions.

Other Water Facilities

Other plantation water facilities include 47 reservoirs scattered throughout the plantation with a total storage capacity of 1.065 billion. There are also three hydro-electric plants incorporated into the EMI ditch system which utilize the energy of the water, when available, as it drops from one ditch to another. This power is utilized by our mills and is also sold to Maui Electric.. Priority use of the water, however, is for the irrigation of HC&S' cane lands.

Conclusion

Despite the capability of the plantation's water systems and water infrastructure to handle large quantities of water, it is important to realize that water shortages are common at HC&S. HC&S is continually looking at means of utilizing water more efficiently and stabilizing its water supplies.

PRIVATE - AGRICULTURAL WATER SYSTEM
 HC&S CO. - A&B, INC.*
 INVENTORY OF EXISTING SOURCES

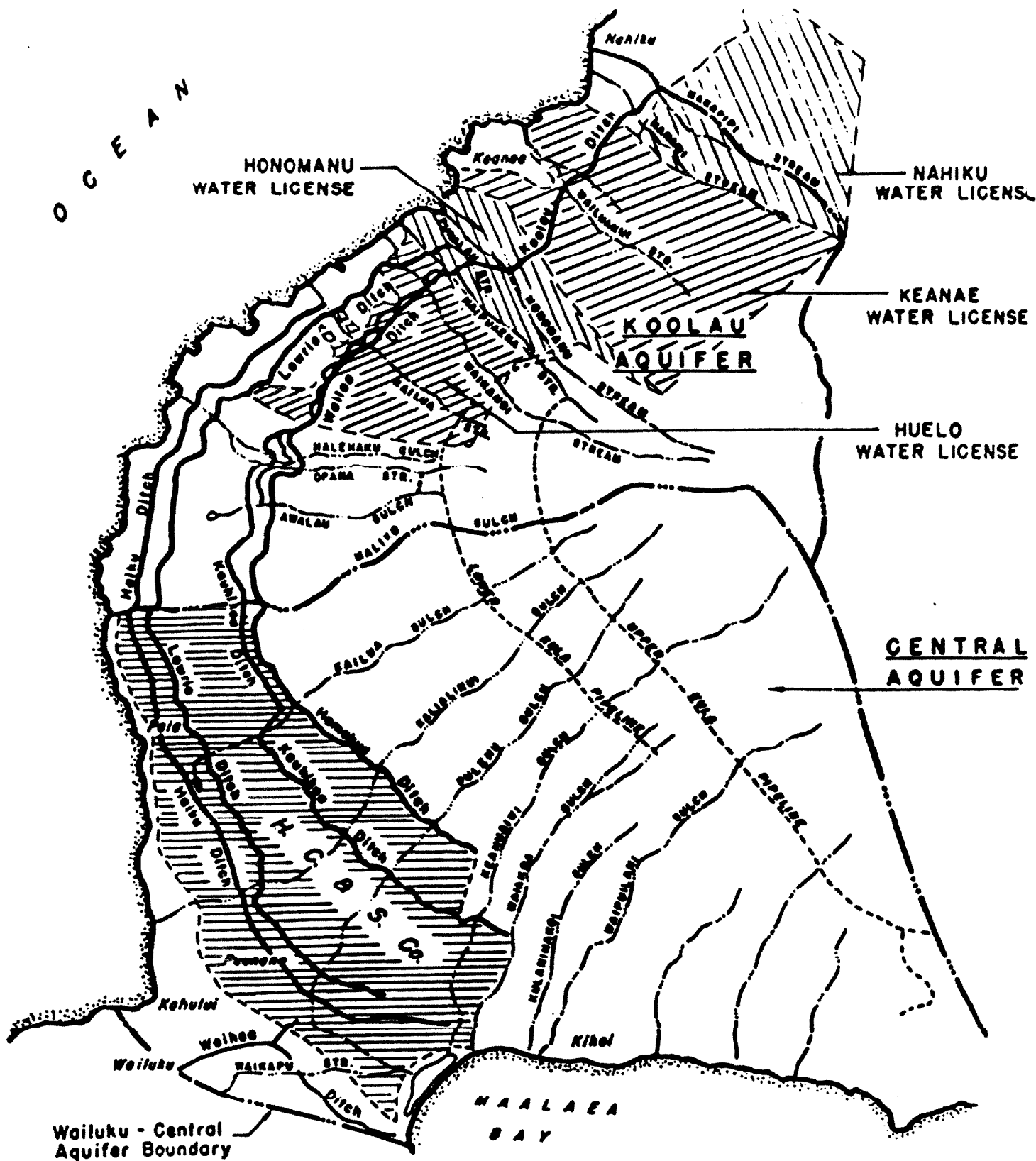
Aquifer Sector

Surface Water Sources	Koolau	Wailoa Ditch System
	Koolau	Kauhikoa Ditch System
	Koolau	Lowrie Ditch System
	Koolau	Haiku Ditch System
	Wailuku	Waihee Ditch System

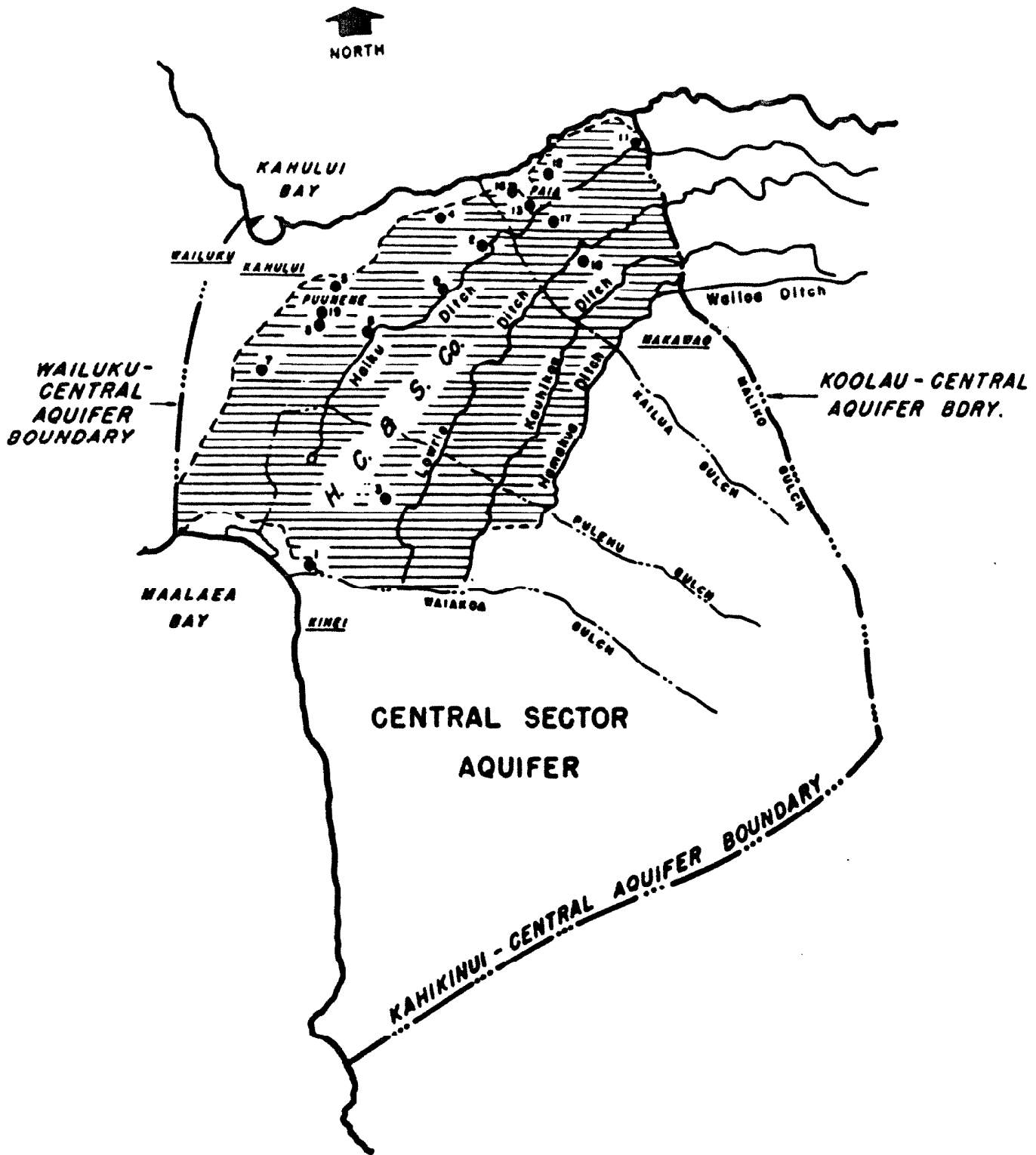
	<u>DLNR Well No.</u>	<u>Well - Pump *</u>	<u>Number of Pumps</u>
	5520-01	Maliko Pump 11	2
	5522-01	Kuau Pump 12	1
	5423-02	Lower Paia Pump 16	2
	5422-01	Paia Pump 13	2
	5422-02	Paia Pump 17	1
	5424-01	Spreckelsville Pump 4	1
	5323-01	Paia Pump 2	2
	5224-02	Puunene Pump 9	1
Ground Water Sources	5226-01	Puunene Pump 5	1
	5226-02	Puunene Pump 6	2
	5128-02	Waikapu SH Pump F	2
	5321-01	Kaheka Pump 18	2
	5227-04	Puunene Pump 8	3
	5227-05	Puunene Pump 19	2
	4825-01	Puunene Pump 3	2
	4727-01	Puunene Pump 1	1

*Surface water sources shown in Page R-7 and ground water sources shown in Page R-8.

*All wells within Central Sector Aquifer.



**HAWAIIAN COMMERCIAL & SUGAR CO.
BOUNDARY AND IRRIGATION SYSTEM
AND STATE WATER LICENSE**



● Well

**HAWAIIAN COMMERCIAL & SUGAR CO.
IRRIGATION WELLS**

WAILUKU AGRIBUSINESS CO., INC. WATER USE*

Until 1979, Wailuku Sugar Company cultivated sugarcane on approximately 4,700 field acres** and utilized approximately 400 acres in pasture, a total water service area of approximately 5,100 acres with annual water demand of 15,000 to 18,000 million gallons per year. In 1979, Wailuku Sugar began the transition to diversified agriculture and began converting approximately 1,800 former (sugar) field acres to macadamia north of Iao Valley. More recently, Wailuku Agribusiness (renamed to better represent its diversified nature) began converting approximately 2,100 former (sugar) field acres to pineapple south of Iao Valley. Wailuku Agribusiness is currently analyzing and planning the use of approximately 1,000 field acres for conversion to diversified agricultural uses including macadamia, pineapple, and other crops. An additional 500 acres of former and current pasture land may have potential for conversion to agricultural uses.

Due to the transitional nature and present state of conversion of uses, WACI's 1987 water usage is not representative of normalized demand. Current macadamia plantings will not reach maturity and maximum water usage for many years, as late as 2000. Also it is critical to recognize that even normalized annual demand is not representative of actual peak demands dictated by crop cycle - this is especially true of pineapple for example.

* This section from Wailuku Agribusiness Co., Inc.

** Field acres are net productive areas, actual "land" acres are greater.

Therefore, for long-term planning purposes, WACI's normalized (but not peak) demand for its planned 4,800 field acres and its water supply obligations to other users is estimated at 45 million gallons per day. This level of demand could vary substantially depending on actual water demands for the 1,000 field acres planned for further diversification based on the actual mix of crops developed. Timing of full production and normalized demands will fluctuate depending on actual timing of development and peak demands will vary with actual uses developed.

Approximately 500 to 600 acres of current crop land are designated for residential development in the Wailuku-Kahului Community Plan. The timing and conversion of these lands to urban uses are not predictable with any precision and will not necessarily result in any significant reduction of water usage due to the anticipated overall deficit at planned, normalized full-production for the remaining cultivated areas.

Like all Hawaii agricultural operations, the last few years have been a period of cost containment and improved efficiency. Due to high pumping costs, WACI is highly dependent on rainfall and stream flows for its irrigation needs. Thus, operations are highly susceptible to seasonal fluctuations. Even though the plantation is serviced efficiently with drip irrigation, it operates in a "deficit" situation much of the year.

A. Surface Waters - WACI diverts surface waters from four separate streams. Supply varies widely by weather conditions. In 1987, the "average" daily flows from all surfaces was 26.7 MGD.

WACI's largest and most important source of water is the Waihee system, which is operated and shared with HC&S. Water is collected from both the Waihee and Spreckels intakes. "Average" daily flows for WACI's share in 1987 was 10.8 MGD. These flows are further reduced by other users who exercise rights to ditch withdrawals.

In addition, WACI draws water from three streams through its own system. These streams are the North Waiehu, Iao, and Waikapu. The 1987 "average" flows from these three sources was 15.9 MGD.

B. Ground Water - The Wailuku Shaft is a "Maui" type skimming tunnel located about one-fourth mile above the manager's house. The shaft has an installed capacity of approximately 21 MGD from three 7 MGD pumps. Because of high pumping costs, this shaft is currently pumped only as necessary.

The County of Maui operates a ground water system for domestic use in Iao Valley. Any water not used by the county is delivered to the WACI surface water collection system in Iao Valley.

A cautionary note: "average" annual flows are misleading. Daily flows over the last 30 years have ranged from a high of 85 MGD to a low of 15 MGD. WACI has always run on a tight water "budget" with little storage capacity - ability to capture high flows for later use. Therefore, effective available amounts are much less than indicated by "average" measurements. WACI is making continual efforts to preserve its water sources, and to upgrade the efficiency of its distribution and irrigation system. See Exhibit AQ.

WAILUKU - KAHULUI
PRIVATE AGRICULTURAL WATER SYSTEM
WAILUKU AGRIBUSINESS COMPANY

I.	Surface Water Sources (from Wailuku Aquifer Sector)	-	Qs = 26.7 MGD
	Waihee Valley	-	Waihee Ditch Spreckels Ditch
	Waiehu Valley	-	North Waiehu Ditch South Waiehu Ditch (HC&S)
	Iao Valley	-	Iao - Waikapu Ditch Maniania Ditch Kama Ditch
	Waikapu Valley	-	South Waikapu Ditch Everett Ditch
II.	Ground Water Sources (from Wailuku Aquifer Sector)	-	Qg = 0
	Wailuku Shaft (Map 5 - 53-30-05 - Tunnel)		
	Iao Tunnel*		

Surface and ground water sources are shown in Exhibit AQ.

*Average discharge, Central Maui Source Development Joint venture Report (Preliminary draft) 9/1/89, Page 31.
0.7 MGD included with surface withdrawals.

MAUI PINEAPPLE COMPANY, LTD.*

HONOLUA DIVISION

WATER USE & DEVELOPMENT PLAN FOR COUNTY OF MAUI

The following is a description of Maui Pineapple Co., Ltd. (MPCo., Ltd.) Honolua Division's agricultural water use. Source (Honokohau Ditch System) for cultivated areas are shown in Exhibit AL.

MPCo., Ltd. owns approximately 26,000 acres on West Maui. A large portion of this land lies in the water shed area in the upper area of the West Maui Mountains where rainfall averages between 100 and 400 inches a year. Maui Land and Pineapple Company, Inc. (MLPCo., Inc.) has two major subsidiaries, Maui Pineapple Company, Ltd. and Kapalua Land Company, Ltd.

MPCo., Ltd. grows pineapple on approximately 3,800 net acres from Honokohau Plateau to Honokowai Gulch. MPCo., Ltd. also owns and operates the Honokohau Ditch. This seven mile ditch system begins at the 870 foot level in Honokohau Valley and consists of long tunnels, siphons across narrow valleys, and is fed by three intakes - two in Honokohau Valley and one in Honolua Valley. The ditch ends at Mahinahina at the 720 foot elevation. This water system can carry up to 60 MGD, averages 25 MGD, but occasionally drops to less than 4 MGD at Mahinahina.

*This section was prepared by Maui Pineapple Co., Ltd.

By 1990, the existing non-irrigated fields will have been converted to drip irrigation. This will increase the water demand from the ditch for pineapple operations to 5.5 MGD during dry periods. Since 1978, MPCo., Ltd. has invested nearly three million dollars in irrigation projects at Honolua as a way to try to keep this land in profitable pineapple production.

Additional users of water from this ditch system are Kapalua Water Company, Ltd., Kapalua Land Company, Ltd., County of Maui, a private hydro system, and Pioneer Mill Company. The residual ditch flow appears to be between 11 and 12 MGD.

During dry periods, this amount will be used entirely by MPCo., Ltd. (5.5 MGD), Kapalua Land Company (4.5 MGD), Kapalua Water Company (2.0) and County of Maui (1.5 MGD).

I) *INTAKES

- A. No. 1-Honokohau Stream 840* Elevation
- B. No. 2-Kaluanui Stream 800' Elevation--Honokohau Ditch
- C. No. 3-Honolua Stream 790' Elevation

II) *DISCHARGES

	<u>Average Daily</u> <u>Flow MGD</u>
A.**Honokohau Valley	
1. Number 16 Adit	
a. Hydro (Jerry McDonald)	.3
b. County of Maui	.1
c. MPCo., Ltd.: pineapple	.8
B. Honolua Valley	
1. MPCo., Ltd.: pineapple	.7
C. Mahana (to be completed in 1989)	
1. MPCo., Ltd.: pineapple	1.0
2. MLPCo., Inc.: Kapalua	2.0
D. Field 42	
1. MPCo., Ltd.: pineapple	1.0
2. MLPCo., Inc.: Kapalua	4.5
E. Alaeloa	
1. County of Maui	1.5
F. Mahinahina Field 15 Bridge	
1. MPCo., Ltd.: pineapple	1.0
G. Mahinahina Weir	
1. MPCo., Ltd.: pineapple	1.0
	<hr/>
TOTAL WATER USAGE	13.9 MGD
H. Mahinahina Weir	
1. Pioneer Mill Company: sugarcane - balance of water	

*By Maui Pineapple Co., Ltd.

**Below ditch perennial stream: 0.63 MGD

MAUI PINEAPPLE CO., LTD.*

HALIIMAILE DIVISION

The Maui Pineapple Co., Ltd. (MPCo), Haliimaile Division, owns or leases over 9,800 acres around the slope of Haleakala and cultivates pineapple on over 5,900 acres.

The water needs for 1987 for the Haliimaile Division were from the following sources:

<u>Source</u>	<u>Quantity - MG/Year</u>
County	29.205
Kailiili (private)	21.279
Wailoa (EMI)	<u>30.616</u>
Total	81.100

Water needs may increase an additional 40% during dry years. The EMI source could be up to 40 MG per year. Kailiili source has historic beginnings with Maui Agricultural Company, now part of HC&S Co., and is jointly used by ML&P Co., Ltd., Kaonoulu Ranch, and the County of Maui. Exhibit H is the location map of the Kailiili source.

*This section was prepared by Maui Pineapple Co., Ltd.

AGRICULTURAL WATER USE*

PIONEER MILL COMPANY, LIMITED

The following is a description of Pioneer Mill Company's Agricultural water use as prepared by Pioneer Mill Co., Ltd. Please note that surface water sources for cultivated areas are shown in Exhibit AR.

Pioneer Mill Company, Limited (PMCo) farms approximately 7,000 acres of land in West Maui. The entire plantation is irrigated with a combination of surface and ground waters, and approximately 95% of this irrigation is done through drip tubing to conserve water. An adequate supply of agricultural water is an ongoing concern at Pioneer Mill Company, Limited, both in terms of seasonal fluctuations in surface supplies and the relatively high cost of pumping groundwater to supplement surface water in upper fields.

In 1986, PMCo undertook several major cost containment efforts directed in part at controlling the energy costs of water pumping throughout the plantation. Total operations were reduced in size for use of surface water and to minimize the necessity of frequent groundwater pumping. Efficient water management continues to be a critical element of PMCo's future stability and the system of pumps, pipes, ditches and intakes that are in the ground today are some of the company's most valued assets.

*This section was prepared by Pioneer Mill Co.

Surface Waters

PMCo diverts surface water from seven separate stream basins in West Maui including Honokowai, Kahoma, Kauaula, Kanaha, Launiupoko, Olowalu and Ukumehame plus the residual Honokohau Ditch with an average surface water flow of approximately 45.2 MGD. Supply varies widely by weather conditions in the interior of West Maui. During seasonal periods of low stream flows, several of the major intakes dry up and require substantial groundwater pumping to supplement the surface flows.

PMCo's largest and most important source of surface water is the Honokohau Ditch which is owned and operated by Maui Pineapple Company, Ltd. Water is collected from intakes in Honokohau and other valleys and delivered at the northern edge of PMCo's sugarcane lands at a relatively high elevation (750' elev.). Like other surface systems, Honokohau Ditch is subject to seasonal fluctuations that range from 0-60 MGD. The ditch is also affected by upstream water users who exercise priority rights to water withdrawals. Kapalua Resort, Maui Pineapple Co., Ltd. and the County of Maui all currently utilize Honokohau waters. They have their own plans for expanded withdrawals in the near future. These withdrawals will reduce the base flow that will be available to PMCo. and will require either an increased use of pumped water or a reduction in cultivated acreage. All flows related to Honokohau Ditch reported by PMCo in this report are estimates only as long-term averages may not be meaningful given recent and anticipated future changes in withdrawals by upstream users.

Ground Water

In order to supplement surface flows, PMCo has installed a series of 13 low elevation groundwater wells located mostly on the lower fringes of the plantation between Honokowai and Ukumehame. These pumps are operated on an as-needed basis for farm and mill operations and produce waters from the coastal portion of the aquifer which are slightly brackish and generally not of domestic quality. Pumping records over the last 30 years vary dramatically due to weather and other operation conditions. Current ground water pumping is not expected to exceed 20 MGD on a long term annual average.

Annual average water use for PMCo. is seasonally variable and subject to annual rainfall. For working purposes, PMCo. utilizes a total of approximately 65 MGD to grow and process sugarcane on 7,000 acres. This usage fluctuates greatly on a daily basis with peak daily usage approaching 85 MGD.

AGRICULTURE - WATER USE - NON CROP

Grazing Lands

In the northwest portion of the Wailuku-Kahului Community Plan approximately 3,000 acres of agricultural land is used for grazing. Water for this northwest region is supplied mainly from three major streams: Makamakaole, Wailena, and Kahakaloa. In addition, at least two wells were identified.

Ranches around the slopes of Haleakala Mountain rely on a combination of springs, streams, and municipal water to sustain animal herds. Major ranch lands in the Makawao-Kula region total at least 87,500 acres. Approximately 18,000 acres are within the Kihei-Makena Community Plan but are generally served by sources from the Makawao-Kula region. Approximate grazing areas and source locations are shown in Exhibit AS.

Plans for ranch lands are changing from status quo to major urban development plans at the Kihei edge of the ranches to cultivated agricultural lands and other possibly more water intensive uses.

AGRICULTURAL WATER USE - CONSERVATION LAND USE

Grazing is permitted in conservation designated land. Approximately 2,300 acres of conservation land in the Wailuku-Kahului Community Plan and at least 5,800 acres of conservation land in the Kihei-Makena Community Plan are used for grazing. The following ranch summaries include Conservation designated land.

Haleakala Ranch *

Haleakala Ranch owns 32,538 acres and leases another 2,713 acres. The division by community plans is as follows: Makawao-Pukalani-Kula, 28,159 acres; Kihei-Makena, 3,503 acres; and Hana, 3,590 acres.

The major portion of water for ranch operations is served from the municipal system. In addition, private water sources are as follows:

1. Honomanu Stream
2. Opana - a private system shared with Maui Pine
3. Waiopai - spring sources serving about 400 cows

The municipal flows for 1987 and 1988 were:

	Total Yearly Use MG	
	1987	1988
Haleakala Ranch	9.6	9.2

Above the municipal service area, water is served from the Honomanu source at approximately 6,400 feet elevation. Pumping facilities to upper lands have been installed and have been used in the past.

The Opana-Kailiili System (elevation 2,400 feet) is used mainly for the dairy operations (see also Exhibit H).

In the Waiopai area, the Pahihi Spring (elevation 2,900 feet) and Wailaulau Spring (elevation 2,500 feet) are major sources. A pond-pump arrangement also serves the range lands.

*Information from Haleakala Ranch.

Land development plans are described in the Kihei-Makena Community Plan. These include Project District 5 (187.8 acres), Project District 6 (R&T Park - 300 acres), Silversword Golf Course, public zoned area of approximately 125 acres, and a low and moderate income housing project. In addition, an approximately 1,000 acre jojoba farm is planned.

Kaonoulu Ranch*

Kaonoulu Ranch spreads around the western slope of Haleakala. The ranch owns 8,739 acres and leases another 6,012 acres. The major area of approximately 13,685 acres is within the Makawao-Pukalani-Kula Community Plan. The remainder is within the Kihei-Makena Community Plan.

The entire ranch is on the County water system except for for a small area served from the Kailiili water system (see also Exhibit H).

Ulupalakua Ranch**

Ulupalakua Ranch owns 22,000 acres and leases another 6,860 acres. Approximately 19,547 acres are within the Makawao-Pukalani-Kula Community Plan. The ranch also spreads into the Kihei-Makena Community Plan and the Hana Community Plan.

Current land use consists of an estimated 40 acres of irrigated crops, 50 acres of forest tree plantings and 100 acres of business and residential development with the remainder in pasture.

* Information from Kaonoulu Ranch.

** Information from Ulupalakua Ranch.

Projected land uses at Ulupalakua Ranch through the year 2010 revolve around continued agricultural diversification. Future uses will include livestock and game operations, produce farming, and expansion of the vineyard and forest plantings. Selected areas may also be managed to provide recreational and cultural activities for island residents and visitors.

In 1989, most of the domestic water supply and most of the livestock water supply for Ulupalakua ranch were imported from northeast Maui by the Kula pipeline. Local water sources include small springs and seeps located at altitudes from 4,000 to over 5,000 feet, and a ten foot deep, six foot diameter well near the western edge of La Perouse Bay. The flow of the springs and seeps varies seasonally from over ten gallons per minute to less than one, and the chloride content of the water of the near-shore well is high. Nevertheless, these sources provide valuable and necessary additions to Ulupalakua Ranch's agricultural supply. The following is a brief summary of sources.

<u>Name</u>	<u>Ulupalakua Ranch Elevation</u>	<u>GPM</u>
*Waikaalu Spring	5,400	0.5
*Morton Spring	4,850	1.0
Polipoli Spring	6,200	4.9
*Waikaahi Spring	4,600	10.4
*Cornwall Spring	4,850	4.9
*Waihou Spring	4,760	
Keoneoio Well	20	12-35

*Shown as Waihou on Exhibit AS.

AGRICULTURAL WATER USE - NON-CROP

Golf Courses and Landscaping Plants

Golf courses use non-potable water for irrigation of landscaping plants. Presently, two golf courses are within in the Wailuku-Kahului Community Plan (W-K), three courses are located in the Kihei-Makena Community Plan (K-M), and one course is in the Makawao-Pukalani-Kula Community Plan (M-P-K). These golf courses, their approximate area, and approximate daily water use are:

	<u>Community Plan</u>	<u>Acres</u>	<u>Daily Water MGD</u>
Waiehu Golf Course	W-K	178	0.33
Maui Country Club	W-K	66	0.45
Makena Resort	K-M	200	1.00
Silversword Golf Course	K-M	230	(sewer effluent)
Wailea Resort	K-M	359	1.60
Pukalani Terrace Country Club	M-P-K	117	(sewer effluent)

Total

Irrigation of landscaping plants is approximately 0.78 MGD for Waiehu Golf Course and Maui Country Club. Silversword Golf Course and Pukalani Terrace Country Club (PTCC) use sewer effluent.

Wailea and Makena Golf Courses integrate into resort complexes. The following is a brief description of their water source development plans:

Wailea Resort

Wailea water source development for non-crop irrigation consists of eight wells and is shown in Exhibit AT. Total day flow is 1.6 MGD. Total area of Wailea Resort is about 1,400 acres; golf course and landscaped areas are estimated at 359 acres. Two more wells are planned along the northern area of the resort.

Makena Resort*

Seibu Hawaii, Inc.'s Makena Resort properties total approximately 1,800 acres with 1,000 acres included for resort development in the Kihei-Makena Community Plan. About 500 of the 1,000 acres are already zoned on the County zoning map.

Domestic water needs are served from the municipal system and transmitted from Central Maui.

Non-potable water for general landscaping plants and the golf course, approximately 200 acres, is withdrawn from four private Seibu wells in Makena (shown in Exhibit AT). Daily average withdrawal is 1.0 MGD.

Future plans include the development of another 200 acres for golf course. Four more existing wells will be put into projection to provide about 1.0 MGD for the existing and the future golf course. Submittals for governmental permits are being finalized, and construction of the new golf course is scheduled to start toward the end of 1989.

*This section from Seibu Hawaii, Inc.

Parks and School Grounds**

Existing Uses - Central Maui

Parks and school ground landscaping plants are irrigated with municipal water or well water. Presently for the Central Maui Community Plans, water consumption is as follows:

<u>Community Plan</u>	<u>Irrigation Water Usage</u>	
	<u>Municipal Water</u> MGD	<u>Individual Wells</u> MGD
Wailuku-Kahului	0.096	0.566
Kihei-Makena	0.133	---
Makawao-Pukalani-Kula	0.003	
Paia-Haiku	<u>0.018</u>	
Total	0.250	<u>0.566</u>

Because of the high cost of municipal water, irrigation of parks and school grounds are being converted to lower quality ground water and waste water. Parks and school grounds presently irrigated by wells and the approximate area serviced in the Wailuku-Kahului (W-K) Community Plan are as follows:

<u>Park/School</u>	<u>Area (Acres)</u>
War Memorial Park	38
War Memorial Stadium	--
Lihikai School	5
Kahului School Park	7
Kahului Community Center Tennis and Ball Field	15
Maui High School	<u>12</u>
Total	77

Future Projections - Central Maui
Planned well installations in the Kihei-Makena region are:

<u>Park/School</u>	<u>Area (Acres)</u>	<u>Planned Well Capacity (MGD)</u>
Kihei Recreation Center	4	0.042
Kamaole III	11	0.036
Kalama Park	<u>25</u>	<u>0.150</u>
Total	40	0.228

** Source: Maui County Parks Dept., private communication, August 10, 1988.

Existing and Future Projections - Lahaina

In the Lahaina region, the following are existing and future irrigation wells for County parks:

A. West Maui Regional Park

1. An existing well now serves 14 acres of ball fields.
2. An additional irrigation well will be required within the next ten years to serve an additional ten acres of play fields.

B. Lahaina Civic Center

1. Plans are being prepared to construct and install an irrigation well and pump to serve to approximately ten acres of grass area.

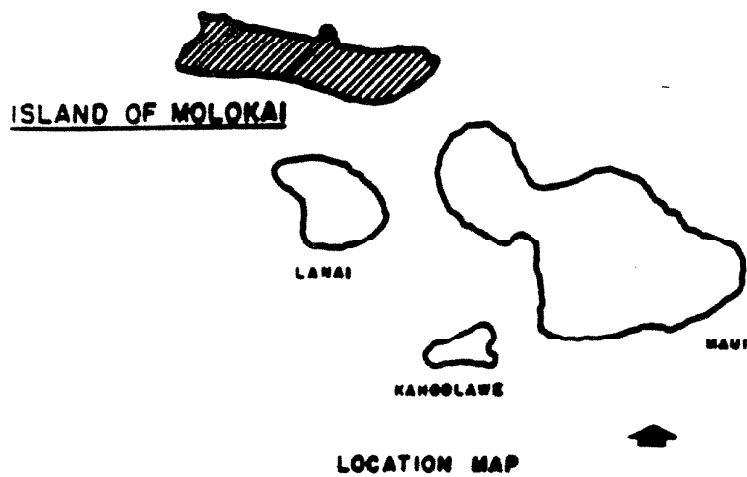
C. The approximate irrigation water rate in gallons per day (GPD) is as follows:

	<u>Water Rate in GPD</u>		
	<u>1988</u>	<u>Future</u>	
		<u>Add</u>	<u>Total</u>
West Maui Regional Park	7,100	5,100	12,200
Lahaina Civic Center	<u>---</u>	<u>5,100</u>	<u>5,100</u>
Total	7,100	10,200	17,300

C O U N T Y O F M A U I
W A T E R U S E A N D
D E V E L O P M E N T P L A N

I S L A N D O F M O L O K A I

The Molokai section of the Water Use and Development Plan was amended in July 1990. Bracketed portions are deletions, while underlined portions are additions.



**TABLE OF CONTENTS
ISLAND OF MOLOKAI**

	Page
WATER USE & DEVELOPMENT PLAN - Introduction	1
MUNICIPAL & MAJOR PRIVATE DOMESTIC WATER SYSTEMS General	2-3
Municipal Water Systems	
<u>KAUNAKAKAI-KAWELA</u>	4
Existing Uses & Sources	
Future Demands	
<u>KALAE</u>	5
Existing Uses & Sources	
Future Demands	
Development Plans	
<u>UALAPUE</u>	6
Existing Uses & Sources	
Future Demands	
Development Plans	
<u>HALAWA</u>	7
Existing Uses & Sources	
Future Demands	
Development Plans	
Map of Service Area	8
Summary of Municipal Future Demand	9
Major Private Domestic Water Systems	
<u>MOLOKAI RANCH</u>	10-13
Existing Uses & Sources	
Future Demands	
Development Plan	
<u>KUKUI (MOLOKAI), INC.</u>	14-15
Existing Uses & Sources	
Future Demands	
Development Plans	
<u>DEPARTMENT OF HAWAIIAN HOME LANDS</u>	16-18
Existing Uses & Sources	
Future Demands	
Development Plans	

<u>OTHER WEST & CENTRAL MOLOKAI PROJECTS</u>	19-22
<u>EAST MOLOKAI PRIVATE WATER SYSTEMS</u>	23
AGRICULTURAL WATER SYSTEMS	
<u>MOLOKAI IRRIGATION SYSTEM</u>	24-27
Existing Uses & Sources	
Future Demands	
Development Plans	
<u>OTHER AGRICULTURAL AREAS/SYSTEMS</u>	28
WITHDRAWAL BY AQUIFER SECTOR - AQUIFER SYSTEMS	
<u>INTRODUCTION</u>	29-30
TABLE: Total Withdrawal for Island of Molokai	31
TABLE: Withdrawal for Municipal and Private Domestic Use	32
TABLE: Withdrawal for Agricultural Use	33
<u>GROUNDWATER WITHDRAWAL BY AQUIFER SECTOR-SYSTEM</u>	34-38
FUTURE STUDY AREAS	39
REFERENCE	40

E X H I B I T S

EXHIBIT		PAGE
A	Municipal Water Systems Island of Molokai	8
B	Molokai Ranch Water Systems	13
C	Kukui (Molokai), Inc. Water System	15
D	Department of Hawaiian Home Lands Water System	18
<u>D-1</u>	<u>Alpha USA Inc. Water Service Area</u>	19a
E	Kawela Plantation System	22
F	Molokai Irrigation System	27
G	Aquifer Classifications for Island of Molokai	30

WATER USE & DEVELOPMENT PLAN FOR THE ISLAND OF MOLOKAI

This report includes the following:

1. Municipal and Major Private Domestic Water Systems
 - A. A brief description of the present water usage and sources of the supply.
 - B. Future water demand projections.
 - C. Development plans.

2. Agricultural Water Systems
 - A. Inventories of present water usage and sources of the supply.
 - B. Future water demand projections.
 - C. Development plans.

3. Industrial and Miscellaneous Water Systems

4. Aquifer Description

5. Summary of Water Withdrawals from Ground and Surface Sources

6. Future Study Areas

7. References

MUNICIPAL AND PRIVATE DOMESTIC WATER SYSTEMS

GENERAL

The County of Maui operates four water systems on the Island of Molokai. The systems are:

1. Kaunakakai-Kawela
2. Ualapue
3. Kalae
4. Halawa

See Exhibit A for the service areas and location of sources for municipal systems.

The major private domestic water systems and purveyors are:

<u>Purveyor</u>	<u>Area or System</u>
Molokai Ranch	1. Maunaloa
	2. Kualapuu
	3. Kipu and Manawainui
Kukui (Molokai), Inc.	Kaluakoi
Dept. of Hawaiian Home Lands	1. Hoolehua
	2. Kalae
	3. Kalamaula
State of Hawaii	Molokai Irrigation System (MIS)

See Exhibit B, C, D, F for the approximate service areas and location of sources by major private systems.

General information is detailed in the 1982 report, entitled Molokai Water Systems Plan, by Tom Nance of Belt, Collins and Associates*.

*Reference 1.

As a result of public input concerning the development plans for West and Central Molokai, this report refers only to the inventory of existing uses and projected future water demand. Further studies, including identification and analyses of various alternatives, must be conducted to complete the development plan for Molokai.

Discussions between the major landholders, water users, and affected State, County agencies and community groups, are suggested. Mutually compatible plans are needed for development of water resources, consistent with Native Hawaiian rights. Issues in the community plan relative to West End hotel development and projected population also need to be addressed, as they affect projected water use.]

DHHL projects that the Kaluakoi aquifer will service its future water demands and has no plans to develop additional sources. Kukui (Molokai) Inc., Molokai Ranch and Alpha USA currently have no plans to develop additional potable sources. The County tentatively plans to develop an additional well in the Kualapuu aquifer in the area behind Kaunakakai, to meet the increased future demand in Kaunakakai and to provide adequate backup.

Due to the distance between the potential ground water sources and the probable users on the arid west end of Molokai, the Department of Water Supply initiated a study with Molokai Ranch and Kukui (Molokai) Inc. to identify potential cooperation in future water system developments. A preliminary study has identified one conceptual potential pipeline project extending from central Molokai to the west end. This preliminary concept is called the Molokai Integrated System.

The only currently developed source of potable water in central Molokai is the Kualapuu aquifer which lies under lands owned by Molokai Ranch and lands owned by DHHL. The current projected water needs by the major water users in central and west Molokai exceed the estimated sustainable yield of the Kualapuu aquifer. The sustainable yield is the estimated amount of water that can be safely withdrawn so the the integrity of the aquifer is not compromised.

Therefore, it is recommended that all the prospective major water users in central and west Molokai attempt to work cooperatively together by entering into a negotiations agreement. This would include the County of Maui, DHHL, Kukui (Molokai) Inc., Molokai Ranch, Alpha USA, and a representative selected by the homestead community on Molokai.

The intended purposes of the agreement would include, but not be limited to, a) establishing procedures by which the parties may negotiate the details of the conceptually proposed pipeline, i.e., development strategies, maintenance, ownership, etc.; b) evaluating alternative water source development outside of the Kualapuu aquifer; and c) reaching a mutual understanding among all the parties as to the priority rights to usage of the water from the Kualapuu aquifer based on the interpretation of the various state and federal laws as applicable to Native Hawaiian and other users.

Municipal Water Systems

KAUNAKAKAI-KAWELA WATER SYSTEM

The water service area includes the Kaunakakai region and stretches along the coastline to Kawela.

Existing Uses and Sources. The Department of Water Supply reports the amount withdrawn from the Kawela well and the State's Molokai Irrigation System (MIS) for the fiscal year ended June 30, 1988 was 251.5 million gallons (0.69 million gallons per day). There are 982 water meters within the service area.

The source withdrawals were as follows:

	1988	
	<u>Year (actual)</u>	<u>Daily Average</u>
Kawela Well 2-0.4 MGD Pumps (DLNR - 0457-01)	117.8 MG	0.32 MGD
Tap from MIS	<u>133.7 MG</u>	<u>0.37 MGD</u>
TOTAL	251.5 MG	0.69 MGD

See Exhibit A for the service area and location of the sources.

Future Water Projection. The Department of Water Supply's projection for Kaunakakai-Kawela water system for the year 2010 is 1.6 MGD.

Development Plans. In 1987 the State Department of Land and Natural Resources (DLNR) drilled and tested a new well in the Kualapuu aquifer called the Kualapuu-Mauka Well, 0801-03.[*] The pump and piping installation is now in progress and should be completed in 1990.

This will be the primary source for Kaunakakai. A second well, also in the Kualapuu aquifer, will be drilled as a backup well.

[*Reference 2, page 4.]

KALAE WATER SYSTEM

The water service area includes Kalae located in the north central region of Molokai.

Existing Uses and Sources. The Department of Water Supply purchased water from Hawaiian Home Lands and R. W. Meyer, Ltd. to service the Kalae area. There were 77 water meters serving the area for the fiscal year ended June 30, 1988. Ten million six hundred thousand gallons or 0.03 million gallons per day were withdrawn from two sources.

The source withdrawals were as follows:

	<u>1988</u>	
	<u>Year</u>	<u>Daily Average</u>
Hawaiian Home Lands	0.766 MG	0.002 MGD
R. W. Meyer, Ltd.*	<u>9.856 MG</u>	<u>0.027 MGD</u>
TOTAL	10.622 MG	0.029 MGD

See Exhibit A for the service areas and location of the sources.

Future Water Projection. The future projections by the Department of Water Supply for the Kalae water system is nominal growth.

Development Plan. No new source improvements are anticipated at the present. Eventually, a water system to pump water from the Kaunakakai system, must be provided.

*Estimated from consumption.

UALAPUE WATER SYSTEM

The water service area is along the southeastern region of Molokai approximately from Kamalo to Waialua-Moanui.

Existing Uses and Sources. The Department of Water Supply reports 64.3 million gallons or 0.18 million gallons per day was withdrawn from Ualapue well for the fiscal year ended June 30, 1988. Two hundred eighty-five water meters served this area.

The source withdrawal was as follows:

	<u>1988</u>	
	<u>Year</u> <u>(Actual)</u>	<u>Daily Average</u>
Ualapue well 2-500 GPM Pump (DLNR - 0449-01)	64.3 MG	0.18 MGD

See Exhibit A for the service areas and location of the sources.

Future Water Projections. For the year 2010 the Department of Water Supply projection for water demand for the Ualapue water system is 0.2 MGD.

Development Plan. The present source is adequate to serve the projected demand.

HALAWA WATER SYSTEM

The service area includes Halawa located at the north-eastern area of Molokai.

Existing Uses and Sources. The Department of Water Supply reports an estimated 0.87 million gallon diversion from the Halawa Stream, for fiscal year ended June 30, 1988. Six (6) meters serve this area.

See Exhibit A for the service areas and location of the source.

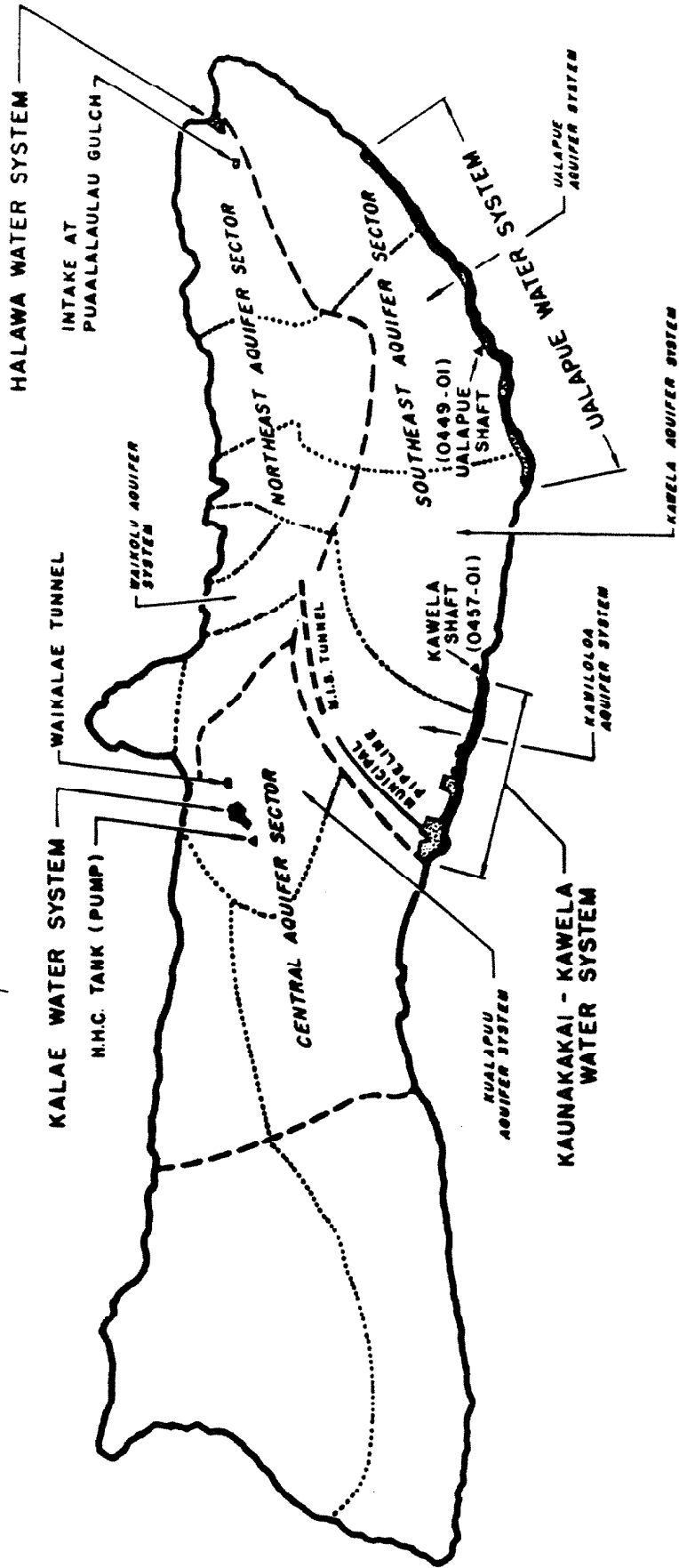
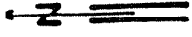
The source withdrawal was as follows:

	<u>1988</u>	
	<u>Annual</u>	<u>Daily Average</u>
Halawa Stream*	0.87 MG	0.002 MGD

Future Water Projections. The Department of Water Supply projection for the year 2010 for Halawa water system is less than 10,000 gpd.

Development Plan. The present source is adequate to serve the projected demand. However, provisions may be needed to meet Department of Health requirements for surface water systems.

*Withdrawal based on 0.726 MG consumption plus 20% losses.



EXISTING MUNICIPAL WATER SYSTEM ISLAND OF MOLOKAI

Municipal Water Systems
Projected Future Withdrawal

<u>Service Area</u>	<u>Source Withdrawals</u>	
	Unit: MGD	
	<u>1988</u>	<u>2010</u>
Kaunakakai-Kawela	0.69	1.60
Kalae	0.03	0.03
Ualapue	0.18	0.2 (Est.)
Halawa	0.00*	<0.01

*Less than 3000 gpd.

Major Private Water Systems

MOLOKAI RANCH*

The Molokai Ranch Company private water systems and service areas of 1) Maunaloa, 2) Kualapuu, and 3) Kipu and Manawainui are summarized below.

See Exhibit B for the location of sources and service areas.

1. Maunaloa

Existing System.

[**]Six stream diversions and one tunnel in the upper Kawela, Kamoku, and Lualoхи basins supply the Molokai Ranch's system, which feeds Maunaloa Village and Kualapuu. The yield from these sources varies substantially from season to season, with the minimum flow estimated to be about 110,000 GPD...

Ten million gallons (MG) of storage exist within the system. A connection at Puu Nana to the Kaluakoi system allows supplemental source for the ranch system...

Current consumption for the Maunaloa system is about 120,000 GPD.[***]

Future Water Projections.[***]

Current consumption is approximately .12 MGD. Assuming that the proposed County housing project would be completed by 1995 and a projected growth rate of 3% thereafter, the year 2000 projected demand is .21 MGD; year 2010 projected demand is .28 MGD.

*Reference 1.

[**Reference 2, pages 5, 6.]

[***Reference 2, page 11.]

Development Plan.

The development plans are in the preliminary stage. Further discussions and coordination with major land owners affected, State and County agencies, and the community, are needed to ensure water resources on Molokai are properly protected and address the needs of all concerned.

2. Kualapuu

Existing System.

["]The primary source is the Molokai Ranch's mountain collection system. A line from Kaluakoi's well number 17 is available as a standby source when demand exceeds Molokai Ranch's source capability. Molokai Ranch operates the system with a charge to the residential community in Kualapuu.

Current consumption for the Kualapuu system is approximately 120,000 GPD.[**]

Future Water Projections.

["]Current demand is about .12 MGD. A 40-unit residential subdivision mauka of the Del Monte office is planned by Molokai Ranch. Assuming that this development occurs by 1995, and projecting a 3% growth rate thereafter, the year 2000 projected demand is .18 MGD; year 2010 projected demand is .25 MGD.[***]

Development Plan.

The development plans are in the preliminary stages. Further discussions and coordination with major land owners affected, State and County agencies and the

[*Reference 2, pages 5, 6.]

[**Reference 2, page 12.]

2. Kialapua (contd)

Development Plan (contd)

community are needed to ensure that water resources on Molokai are properly protected and address the needs of all concerned.

3. Kipu and Manawainui

Existing System.

["]Manawainui receives water from the Molokai Ranch's mountain collection system...Kipu is supplied water from the **DHHL Source (Molokai Ranch buys it from DHHL and distributes it to the Ranch's Kipu customers).

Current consumption is about 20,000 GPD in Kipu and about 15,000 GPD in Manawainui.[""]

Future Water Projections.

Kipu

["]Current demand is about 20,000 GPD. Eighty new lots are planned at Puu Kokea by Molokai Ranch. Assuming that this development occurs by 1995, and projecting a 3% growth thereafter, the year 2000 projected demand is .07 MGD, the year 2010 projected demand is 0.094 MGD.["****]

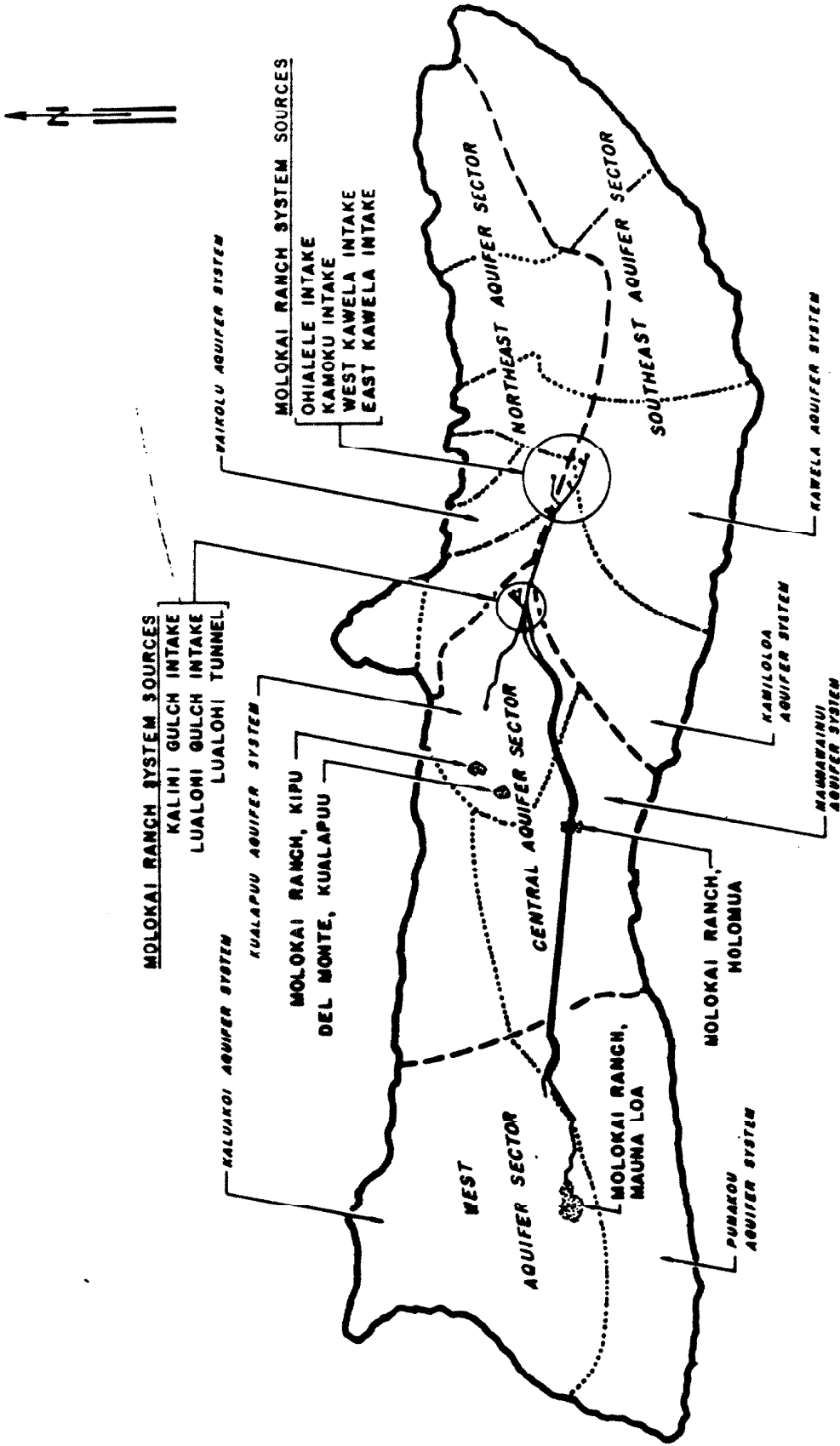
Manawainui

["]Current demand is about 15,000 GPD. A major industrial development is planned in the future by Molokai Ranch (50 acres at 4000 GPD per acre). Assuming this development occurs by 1995, and projecting a 3% growth thereafter, the year 2000 projected demand .23 MGD; the year 2010 projected demand is 0.31 MGD.["****]

[*Reference 2, page 7.]

**Dept. of Hawaiian Home Lands

[***Reference, page 12]



MOLOKAI RANCH SYSTEM SERVICE AREA

Exhibit B

**MOLOKAI RANCH CO.
EXISTING WATER SYSTEM AND SERVICE AREA
ISLAND OF MOLOKAI**

KUKUI (MOLOKAI), INC.

Kaluakoi Corporation has been purchased by Kukui (Molokai), Inc., which owns approximately 5,000 acres of the estimated 6,700 acres comprising the Kaluakoi Resort area. Therefore Kaluakoi water system is discussed under the ownership of Kukui (Molokai), Inc.

Existing Uses and Sources. [*]

The source for the Kaluakoi water system is well 00-1-01 (also known as well number 17) located east of Kualapuu. Water is pumped into the Molokai Irrigation System pipeline, then removed at Mahana. From Mahana, water is pumped to two reservoirs at Puu Nana, then gravity flowed to Kaluakoi Resort area.

See Exhibit C for the existing sources and service areas.

By rental agreement with the State Department of Land and Natural Resources, withdrawal at Mahana is limited to 2 MGD.

Current consumption for Kaluakoi averages about 0.6 MGD; about two-thirds is used to irrigate one golf course.

Future Water Projections.

Based on development projections of the area in accordance with the community plan, the owner anticipates an approximate water demand of 3 million gallons per day.

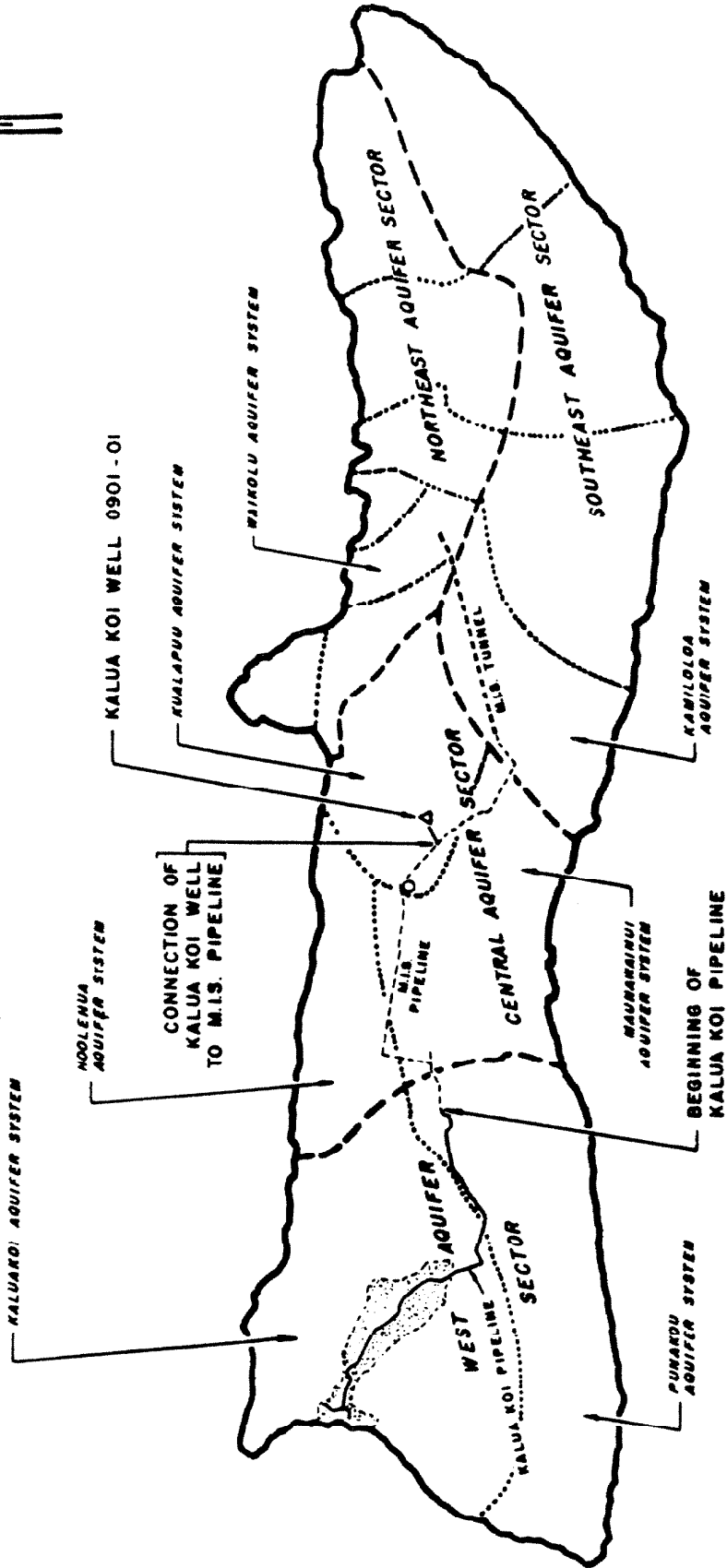
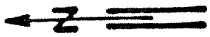
[*Reference 2, pages 7, 8, & 12.]

[**Reference 2, page 12.]

Development Plan.

The development plans are in the preliminary stages. However, as Kukui (Molokai), Inc. is required by contract to be off the Molokai Irrigation System, a major new pipeline extending from its Well # 17 to the west end is required. This pipeline, if designed to provide additional capacity for other users, can provide the basis for a conceptually proposed integrated Molokai water system.

Further discussions and coordination with major land owners affected, State and County agencies, and the community, are needed to ensure water resources on Molokai are properly protected and address the needs of all concerned.



**EXISTING
KUKUI (MOLOKAI) INC.
WATER SYSTEM AND SERVICE AREA
ISLAND OF MOLOKAI**

EXHIBIT C

KALUA KOI SYSTEM
SERVICE AREA

See Exhibit D for location of sources and service areas.

(*Appendix, Reference 2, pages 8 and 9.)

DEPARTMENT OF HAWAIIAN HOME LANDS DHHL

The Hawaiian Home Lands areas on Molokai are as follows:

<u>Location</u>	<u>Area (in acres)</u>
Hoolehua-Palaau	13,076.26
Kalamaula	5,116.00
Kalaupapa	1,247.00
Kapaakea-Kamiloloa- Makakupaia	5,183.34
Palaau Apana 1	548.70
Palaau Apana 3	<u>226.42</u>
TOTAL	25,397.72

Existing Water System and Demand. The service areas for DHHL are Hoolehua, Kalae, and Kalamaula. The Kalae area is serviced from the DHHL potable system. For the Hoolehua area, agricultural water is provided from the Molokai Irrigation System and potable water from the DHHL system. For the Kalamaula area, potable water is provided by the DHHL system, however, there is no system to deliver agricultural water to the area. ["]The primary sources for the DHHL potable water system, are two deep wells at elevation 1005 feet along the pipeline from Kauluwai to Kalamaula. Two existing surface sources, Waihanau Stream and Kamiloloa Gulch, were planned to also supply the system; however, treatment units installed to upgrade this water to Safe Drinking Water Act standards malfunctioned and have been abandoned. To date the DHHL continues to supply its system exclusively from groundwater sources. The DHHL wells have a capacity to pump about 1.7 MGD, versus a current demand of .3 to .4 MGD.["*]

Hawaiian Home Lands cont'd
Existing Sources

Surface water

Waihanau Stream Diversion

Groundwater

DLNR Well No.

0801 - 01

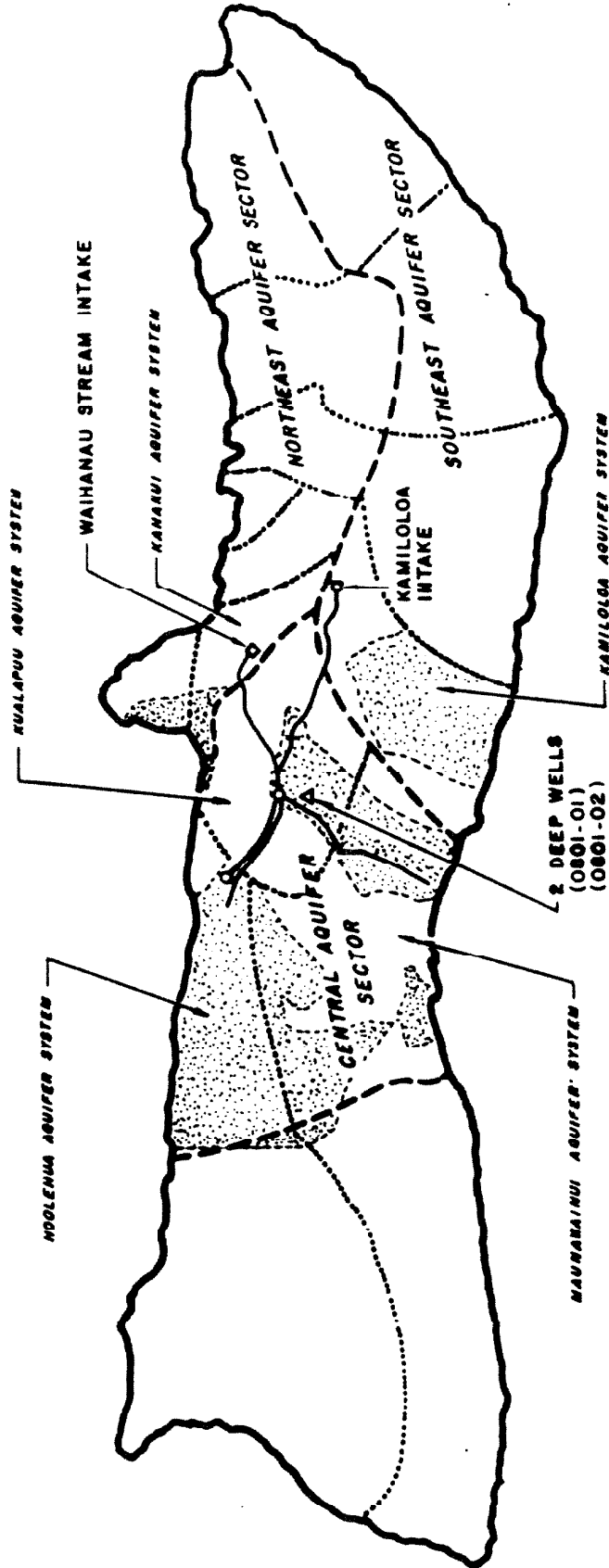
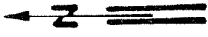
0801 - 02

Future Water Projections

Future water projections from the Department of Hawaiian Home Lands as provided in the State Projects Plan are listed below.

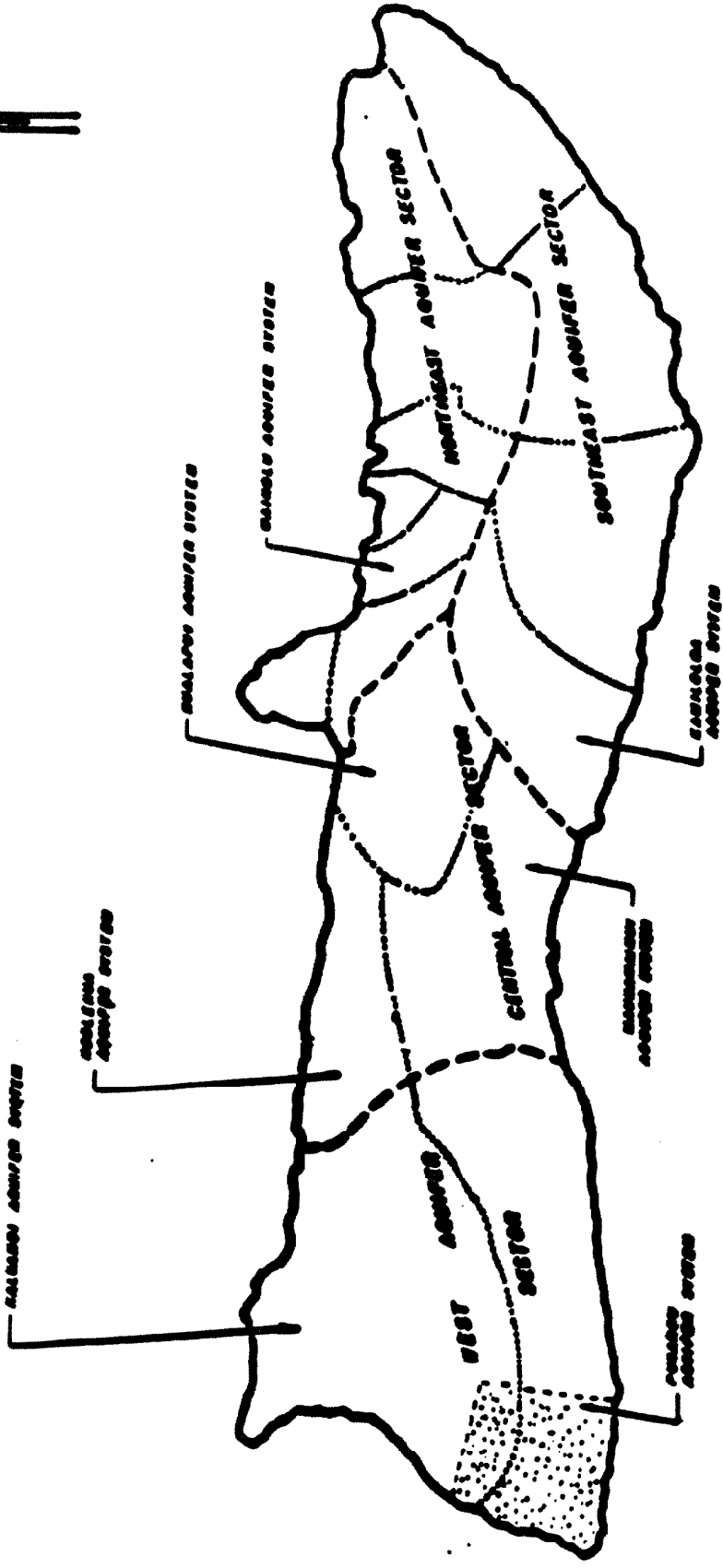
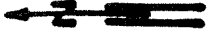
Water demands for year 2010 for domestic needs are estimated at a minimum of 1.5 million gallons per day. DHHL has indicated that if another source of water is not available to supply the irrigation needs for Kalamaula, its projected needs from the Kualapuu aquifer will increase from a minimum of 1.5 MGD to a minimum of 3.0 MGD. [and for]DHHL's agricultural needs for the year 2010 are estimated at 7.3 million gallons per day.


Based on the federal origin of Hawaiian Home Lands program (Congressional Act of July 9, 1921, c 42.42 Sta 108, as amended) and the State's fiduciary obligation to native Hawaiians under Section 4 of the Admissions Act (Congressional Act of March 18, 1989, Pub L. 86-3, 73 Stat 4), the DHHL has the right consistent with Section 221 as amended. This right to water, guaranteed under the State Constitution (Art. XI, Sec. 7), is acknowledged in Section 174C-101 of the State Water Code.



 HAWAIIAN HOMES LAND

HAWAIIAN HOMES LANDS (STATE) EXISTING SOURCES AND SERVICE AREAS ISLAND OF MOLOKAI



 PROPOSED WATER SERVICE AREA

PROSPECTIVE ALPHA U.S.A., INC.
WATER SERVICE AREA
ISLAND OF MOLOKAI

Exhibit D-1

OTHER WEST AND CENTRAL MOLOKAI PROJECTS AND
RELATED WATER DEMANDS

["]Several potential projects that could impact the demand for water in central Molokai are:

- 1) Proposed Highlands Golf Course (Kualapuu) and surrounding development. The developer has received permits from the State DLNR to drill two test wells. It is advisable that potable water not be used for golf course irrigation.
- 2) Alpha Corp's land holdings on the West End consists of approximately 6,357 acres, adjacent to Kaluakoi. See (Exhibit D-1). The land is designated for agricultural use on the Molokai Community Plan and the developer is beginning the planning process. Alpha USA, Inc. has no water consumption currently, and based on the present zoning in the Molokai Community Plan, Alpha USA, Inc. projects that its water needs may be approximately 2.0 MGD. [Water requirements have not yet been determined. Similar fashion as Kaluakoi, an additional [1-]2 MGD may be required."*] The development plans are in the preliminary stages. Further discussions and coordination with major landowners, State and County agencies and the community are needed to insure water resources on Molokai are properly protected.

3) Hawaiian Research, Ltd.

Existing Use

The following information is based on the registration sheets filed with DLNR.

Total withdrawal for 1987 was 300 million gallons. Approximately 140 acres were farmed. The major crop was seed corn.

WELL INFORMATION

<u>DLNR NOS.</u>	<u>Withdrawal</u>		<u>SECTOR</u>	<u>Aquifer</u>	<u>SYSTEM</u>
	<u>Unit: x 10</u>	<u>Gal.</u>			
0603-01	50.5		Central		Maunawainui
0706-02	153.9		Central		Maunawainui
0501-04	32.9		Southeast		Kamiloloa
0601-01	<u>63.3</u>		Southeast		Kamiloloa
Total	300.6				

[*Appendix, Reference 2, page 13.]

OTHER CENTRAL MOLOKAI

4) Kawela Plantation

The following project data is from the Belt, Collins & Associates Report, Molokai Water Systems Plan, 1982.*

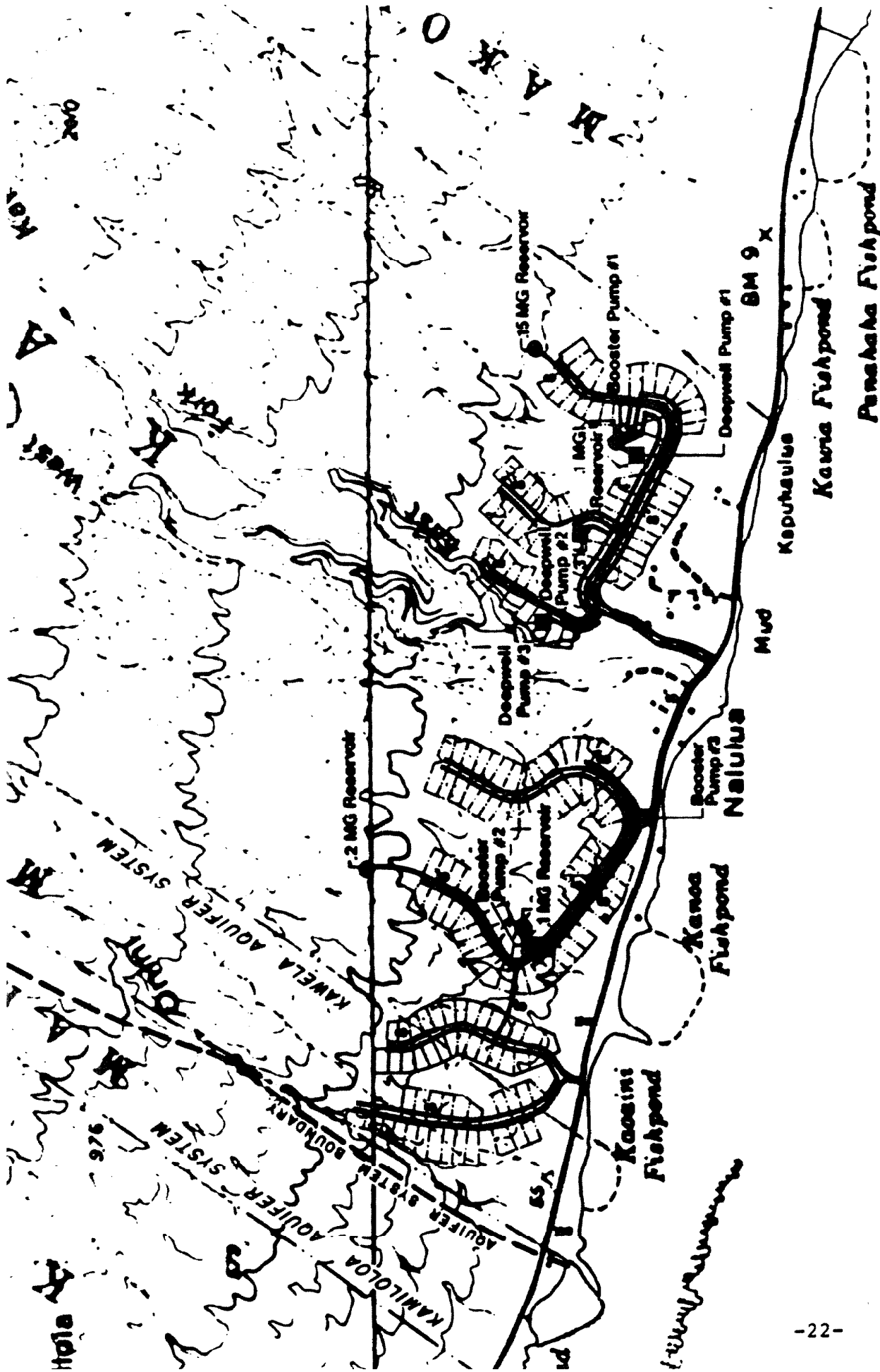
I. Project Data:

1. 210 lots
2. Assume one residence per lot
3. Allow 600 gpd per residence
4. Total average daily water use 130,000 gpd
5. Allow 10% miscellaneous losses
6. Separate system for irrigation

II. Existing Wells: Total withdrawals per registration sheets filed for 1987 was 58.63 million gallons or an average of 161,000 gpd. All the withdrawals were from the Southeast sector - Kawela Aquifer System.

DLNR NOS...	Name	Withdrawal	Aquifer	
		1987	Sector	System
		Unit x 10 ⁶ Gal.		
**0456-04	BreadFruit	6.839	Southeast	Kawela
0456-07	Kawela No. 3	15.298	Southeast	Kawela
0456-08	Kawela No. 1	19.712	Southeast	Kawela
0456-09	Kawela No. 2	16.0	Southeast	Kawela
**0457-02	KPHA No. 2		Southeast	Kawela
**0457-03	KPHA No. 3		Southeast	Kawela
0457-04	Kawela No. 4	0.776	Southeast	Kawela
0458-02	KPHA No. 2A		Southeast	Kawela
**0458-03	KPHA No. 3A		Southeast	Kawela
TOTAL		58.63	Southeast	Kawela

*Ref. 1 Page 57
 **Also filed by Molokai Ranch Co.



**KAWELA PLANTATION
EXISTING SOURCES AND SERVICE AREAS
ISLAND OF MOLOKAI**

Exhibit E



EAST MOLOKAI PRIVATE WATER SYSTEM

Information for private systems in the East Molokai area is from registration sheets filed with the Department of Land and Natural Resources.

The following is a partial summary of private water systems in the East Molokai Region:

KAMALO RANCH

Existing Wells

<u>DLNR NOS.</u>	<u>Withdrawal Low - High Unit: GPD</u>	<u>Sector</u>	<u>Aquifer System</u>
0350-02	10,000 - 60,000	Southeast	Ualapue
0353-02	100 - 200	Southeast	Kawela
0353-01	10,000 - 60,000	Southeast	Kawela

PLACE, M. J.

Existing Well

0350-01	70,000 - 360,000	Southeast	Ualapue
---------	------------------	-----------	---------

AGRICULTURAL WATER SYSTEMS

MOLOKAI IRRIGATION SYSTEM (MIS)

[*]Built by the State and funded by Federal and State funds, the initial phase of this project was completed in 1962. Surface sources diverted in Waikolu Valley, coupled with groundwater sources from three drilled wells, supply water which is transported via a 10-mile tunnel and pipeline transmission link from the wet northeast section to the central plain. A 1.4 billion gallon butyl-lined open reservoir at Kualapuu stores the water prior to its entering a distribution network extending from Hoolehua to Mahana.

The MIS was built to be used exclusively for agricultural purposes. Water is sold to agricultural customers at a price of \$0.16 (1990 price) per 1000 gal. The Division of Resource Management of the Dept. of Agriculture (DOA), operators of the system, continues to get additional requests for more agricultural water. Currently, the Division of Water and Land Management (DOWALD), DLNR, is preparing for additional well drilling in Waikolu Valley to increase the yield to the MIS.[**]

[*Appendix, Reference 2, page 9.]

MOLOKAI IRRIGATION SYSTEM (MIS) - (Contd)

Total flow for fiscal year 1988 (Oct. 1987-Sept. 1988) measured by United States Geological Survey (USGS) at the Molokai Tunnel West Portal was 2,450 million gallons (MG). Other data for fiscal 1988 are:

- 1) Daily mean - 6.7 MG
- 2) Maximum Daily Flow - 22.6 MG (Jan. 2, 26)
- 3) Minimum Daily flow - 0.8MG (Sept. 5-6, 14-18).

The approximate service area and sources are shown in Exhibit F.

MOLOKAI IRRIGATION SYSTEM

Existing Sources

Surface

Four stream diversions in Waikolu Valley.

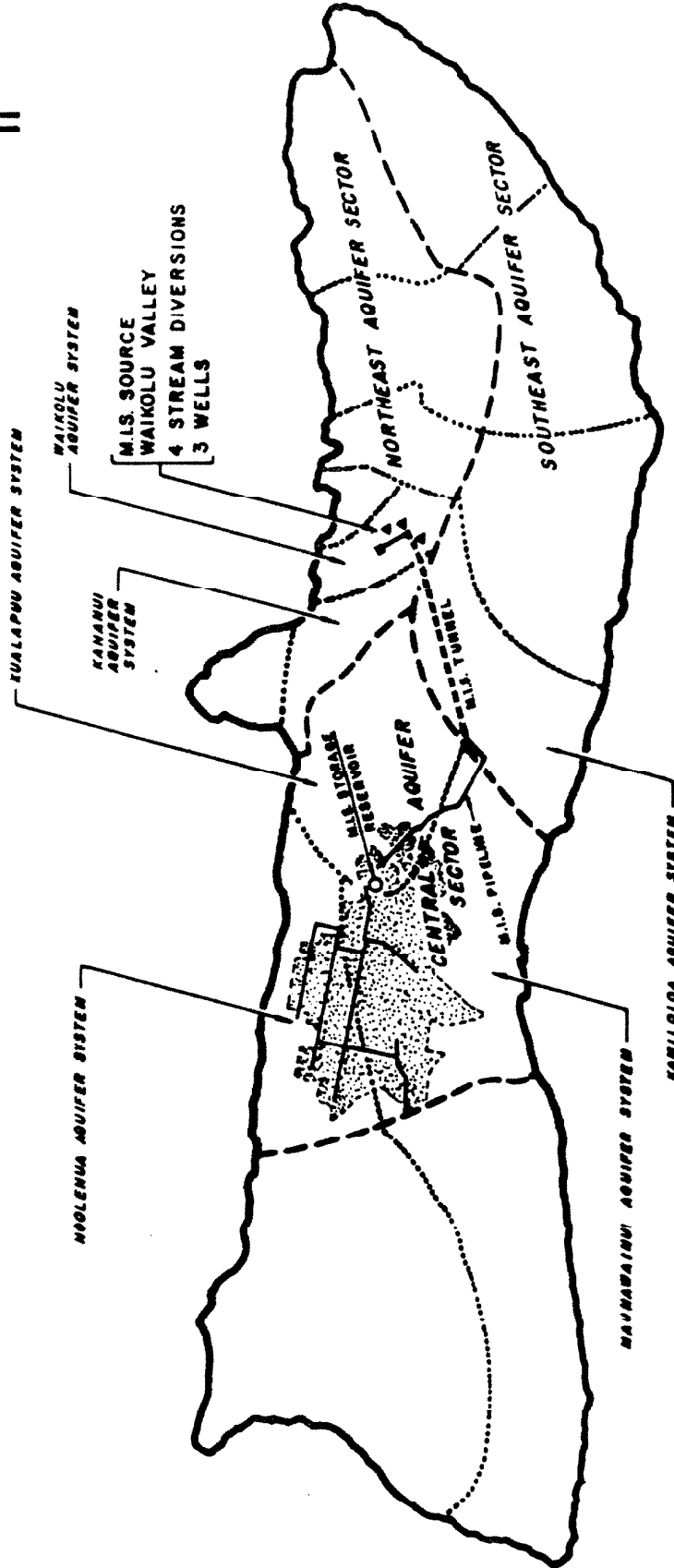
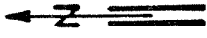
Groundwater

<u>DLNR NO.</u>	<u>DESCRIPTION</u>	<u>PUMP CAPACITY</u>
0855-01	Well 22	1.5 MGD
0855-02	Well 23	1.5 MGD
0855-03	Well 24	1.5 MGD

Future Sources

Groundwater

<u>DLNR NO.</u>
0855-04
0855-05
0855-06



EXISTING SERVICE AREA
MOLOKAI IRRIGATION SYSTEM

Exhibit F

MOLOKAI IRRIGATION SYSTEM EXISTING SOURCES AND SERVICE AREAS ISLAND OF MOLOKAI

OTHER WATER SYSTEMS

EXISTING

<u>System Name</u>	<u>Owner - comment</u>
Kalaupapa Settlement	National Park Service: "Water from one pumped well with a 300 gpm pump is used for domestic supply to 150 connections at Kalaupapa National Historic Park."* <u>Current average usage is approximately 1.0 MGD.</u>
Waialala	State Parks

FUTURE

Water systems associated with permitted use in agricultural areas.

*Commission on Water Resource Management, Declarations of Water Use: Category 1, Nov. 29, 1989; Page Sec. 1-134.

SUMMARY OF WATER WITHDRAWAL BY
AQUIFER SECTOR AND AQUIFER SYSTEMS

Introduction:

Island of Molokai Water Use and Development Plan inventories have been summarized as withdrawals from groundwater and surface water sources. In addition, the groundwater and surface water sources have been summarized by aquifer sectors and systems.

Exhibit G shows island of Molokai by aquifer classification. A description of aquifer classification by Dr. John Mink is included in Appendix C.

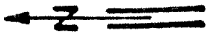
The quantity of water available in an aquifer depends on hydrogeological structure and climatic cycles, as rainfall, vegetation, stream flows, etc. Withdrawal of water from an aquifer can be regulated to sustain safe yields that will not degrade the aquifer quality. The quality of an aquifer is in part maintained or improved by the application of water to an aquifer. This process called recharging is a natural process and also can be accomplished by irrigation of cultivated or planted areas.

The following tables are withdrawal summaries, first for Total Withdrawals, second for Municipal and Private Domestic Systems, and third for Agricultural Private Water Systems.

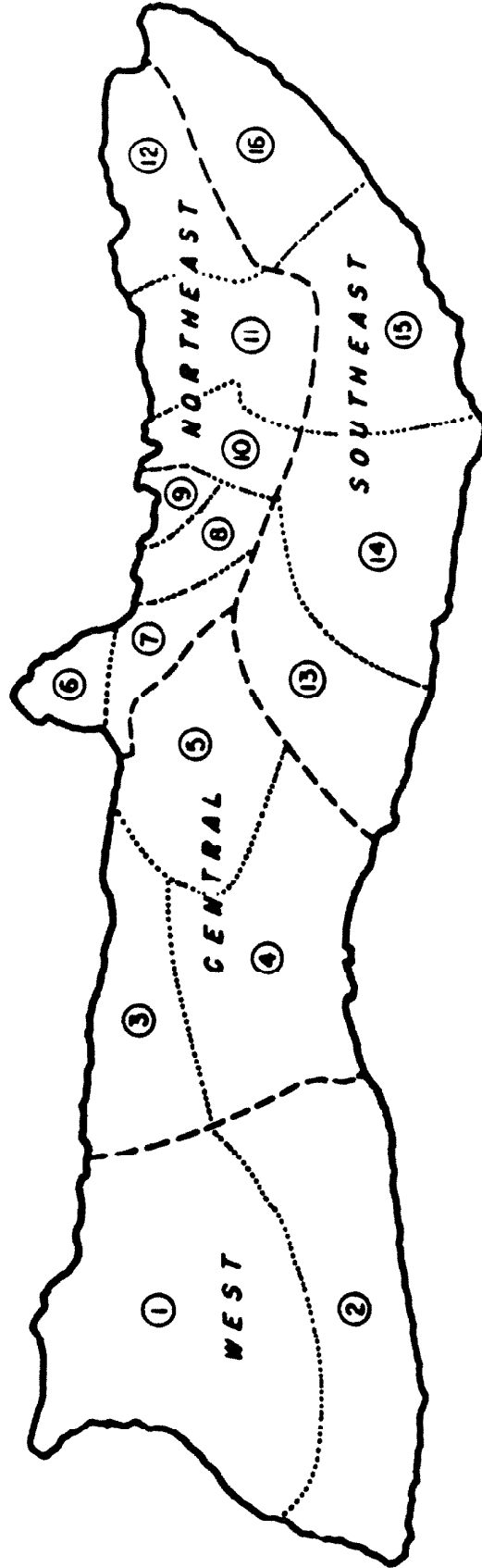
[The Kualapuu system withdrawal data is incomplete for the year 2010 because of current analysis of various alternatives].

AQUIFER SYSTEM IDENTIFICATION

<u>WEST SECTOR</u>	<u>NORTHEAST SECTOR</u>	<u>SOUTHEAST SECTOR</u>
1 KALUAKOI	6 KALAUAPA	13 KAMILOLOA
2 PUNAKOU	7 KANANUI	14 KAWELA
	8 WAIKOLU	15 UALAPUE
	9 MAUPU	16 WAIALUA
	10 PELEKUNU	
	11 WAILAU	
	12 MALAWA	



- - - - - Aquifer Sector Boundary
 Aquifer System Boundary



**AQUIFER CLASSIFICATIONS
FOR ISLAND OF MOLOKAI**

Exhibit G

ISLAND OF MOLOKAI
 TOTAL MUNICIPAL, PRIVATE, AGRICULTURAL AND OTHER
 WATER SYSTEMS
 WITHDRAWALS AND TRANSFERS
 by AQUIFER SECTORS AND SYSTEMS
 unit:MGD

WITHDRAWAL	YEAR 1988			YEAR 2010		
	SURFACE	GROUND	TOTAL	SURFACE	GROUND	TOTAL
CENTRAL						
HOOLEHUA						
MAHEMANAINUI						
KUALAPUU	0.10	1.06	1.16	0.00	5.30	5.30 *
NORTHEAST						
KALAUAPAPA						
KAHANUI						
WAIKOLU	4.84	2.70	7.54	4.80	2.70	7.50
HAUPU						
PELEKUNU						
WAILAU						
HALANA	0.00		0.00	0.00		0.00
SOUTHEAST						
KAMILOLOA	0.03		0.03			
KAWELA	0.08	0.52	0.60		0.55	0.55
UALAPUE		0.40	0.40		0.42	0.42
WAIALUA						
WEST						
KALUAROHI						
PUNALOU						
TOTAL	5.05	4.68	9.73	4.80	[3.67] 8.97	[8.47] 13.77

[*Kualapuu aquifer withdrawal data for year 2010 incomplete.]

* The above 5.3 figure for water withdrawn from the Central Aquifer Sector by the year 2010 is based on the 5 to 6 MGD estimate of the sustainable yield for the Kualapuu Aquifer by the state geologist. The figure assumes the following approximate withdrawals by the six potential large-scale users of water on Moloka'i: DHHL (1.50 MGD), County Department of Water Supply (1.25 MGD), Molokai Ranch (.85 MGD), Kukui Molokai, Inc. (1.70 MGD), and Alpha U.S.A. (0.00 MGD). These estimated withdrawals are not prescribed allocations.

The major water users who are currently relying on the Kualapuu Aquifer as a source have projected water needs which significantly exceed the aquifer's estimated capacity, and it is anticipated that other sources will have to be developed. These source options have not been specifically identified, but may include the development of other aquifers, surface water sources and/or desalinization facilities.

ISLAND OF MOLOKAI
MUNICIPAL AND PRIVATE DOMESTIC
WATER SYSTEMS
WITHDRAWALS
by AQUIFER SECTORS AND SYSTEMS

WITHDRAWAL	YEAR 1988			YEAR 2010			
	SURFACE	GROUND	TOTAL	SURFACE	GROUND	TOTAL	
CENTRAL							
HOOLEKUA							
MAUNAWAINUI							
KUALAPUU	0.10	1.06	1.16	<u>0.00</u>	<u>5.30</u>	<u>5.30</u>	*
NORTHEAST							
KALAPAPA							
KAHANUI							
WAIKOLU	0.41		0.41				
HAUPU							
PELEKONU							
WAILAU							
HALAWA	0.00		0.00	0.00		0.00	
SOUTHEAST							
KAMILOLOA	0.03		0.03				
KAWELA	0.08	0.48	0.56		0.51	0.51	
UALAPUE		0.18	0.18		0.20	0.20	
WAIALUA							
WEST							
KALUAKOI.							
PUNALOU							
TOTAL	0.62	1.72	2.34	0.00	[0.71] <u>6.01</u>	[0.71] <u>6.01</u>	

[*Kualapuu aquifer withdrawal data for year 2010 incomplete]

* The above 5.3 figure for water withdrawn from the Central Aquifer Sector by the year 2010 is based on the 5 to 6 MGD estimate of the sustainable yield for the Kualapuu Aquifer by the state geologist. The figure assumes the following approximate withdrawals by the six potential large-scale users of water on Moloka'i: DHHL (1.50 MGD), County Department of Water Supply (1.25 MGD), Molokai Ranch (.85 MGD), Kukui Molokai, Inc. (1.70 MGD), and Alpha U.S.A. (0.00 MGD). These estimated withdrawals are not prescribed allocations.

The major water users who are currently relying on the Kualapuu Aquifer as a source have projected water needs which significantly exceed the aquifer's estimated capacity, and it is anticipated that other sources will have to be developed. These source options have not been specifically identified, but may include the development of other aquifers, surface water sources and/or desalinization facilities.

ISLAND OF MOLOKAI
TOTAL AGRICULTURAL PRIVATE
WATER SYSTEMS
WITHDRAWALS AND TRANSFERS
by AQUIFER SECTORS AND SYSTEMS
unit:MGD

WITHDRAWAL	YEAR 1988			YEAR 2010		
	SURFACE	GROUND	TOTAL	SURFACE	GROUND	TOTAL
CENTRAL						
HOOLEHUA						
MAUNAWAINUI						
KUALAPUU						
NORTHEAST						
KALAUAPAPA						
KAHANUI						
WAIKOLU	4.43	2.70	7.13	4.80	2.70	7.50
HAUPU						
PELEKUNU						
WAILAU						
HALAWA						
SOUTHEAST						
KAMILOLOA						
KAWELA		0.04	0.04		0.04	0.04
UALAPUE		0.22	0.22		0.22	0.22
WAIALUA						
WEST						
KALUAKOI						
PUNALOU						
TOTAL	4.43	2.96	7.39	4.80	2.96	7.76

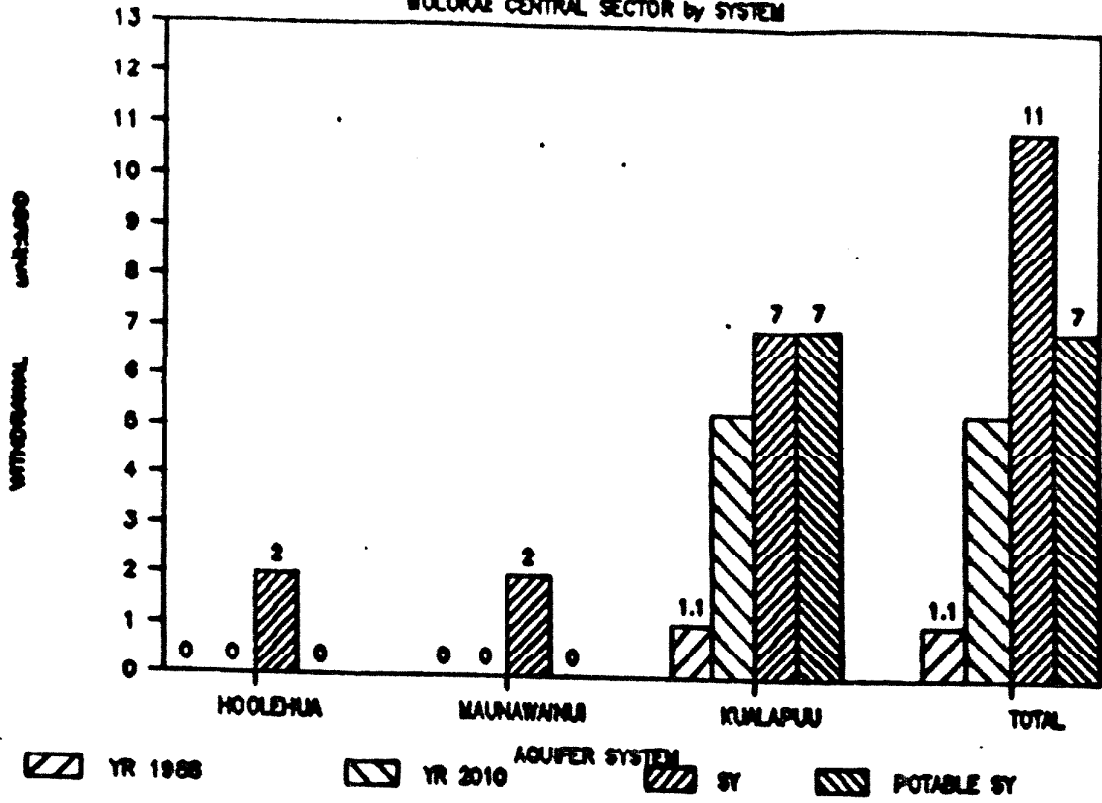
GROUNDWATER WITHDRAWAL BY AQUIFER SECTOR-SYSTEM

The following bar charts are summaries of total groundwater withdrawal compared to total groundwater sustainable yield and potable groundwater sustainable yield. The summaries are for the years 1988 and 2010.

Potable groundwater sustainable yields are less than total sustainable yields in the Central (Hoolehua, Maunawainui) and the entire West sectors.

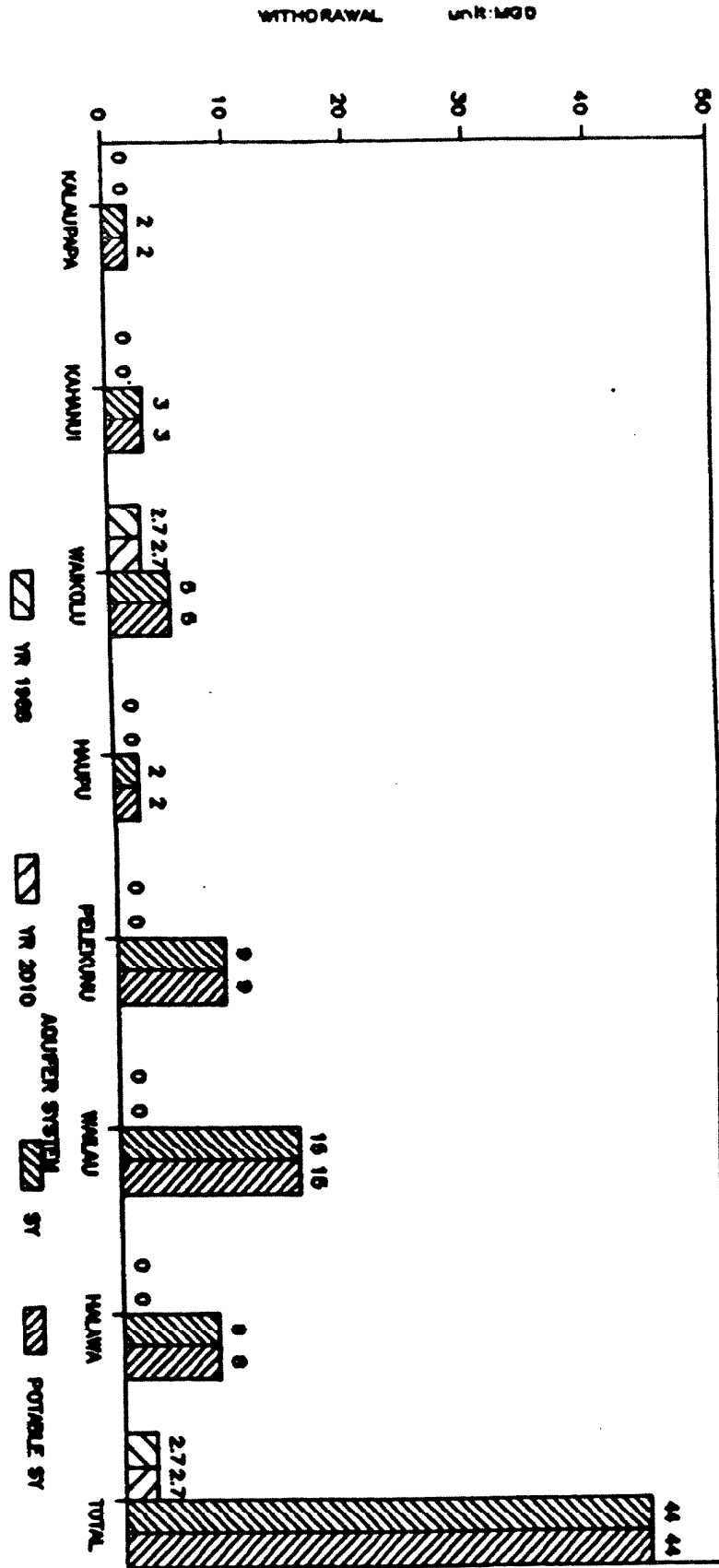
GROUNDWATER WITHDRAWAL

MOLOKAI CENTRAL SECTOR by SYSTEM



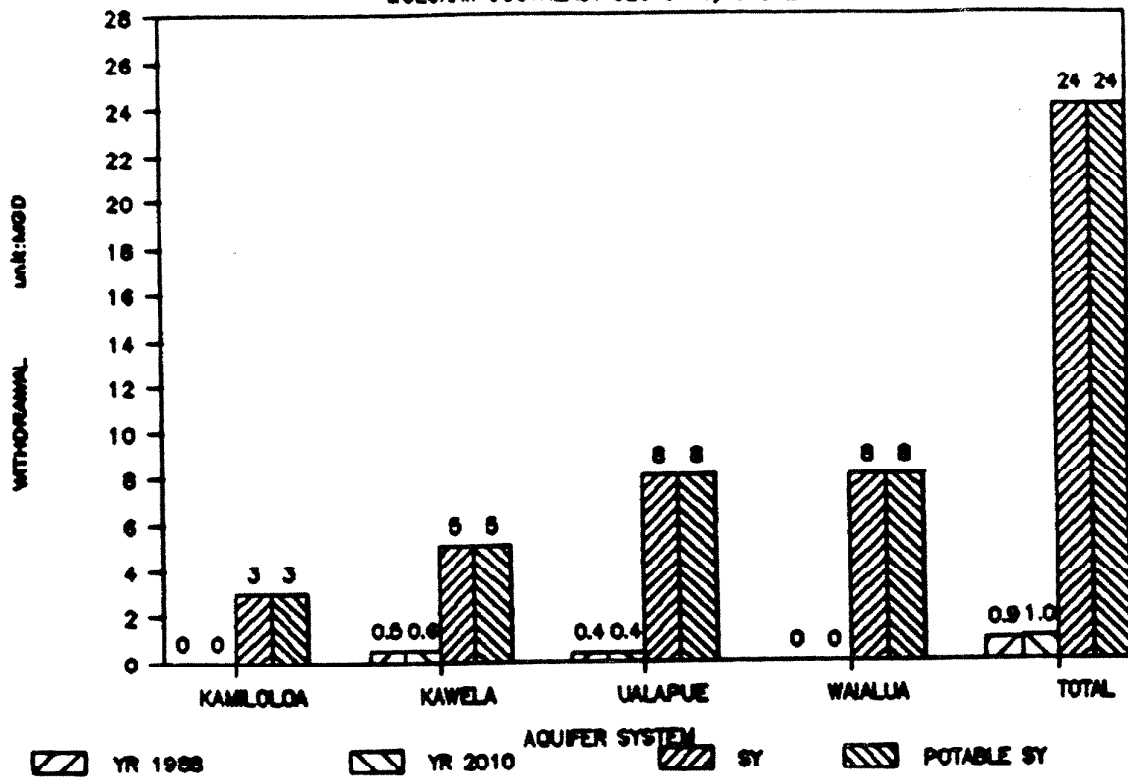
GROUNDWATER WITHDRAWAL

MOLOKAI: NORTHEAST SECTOR by SYSTEM



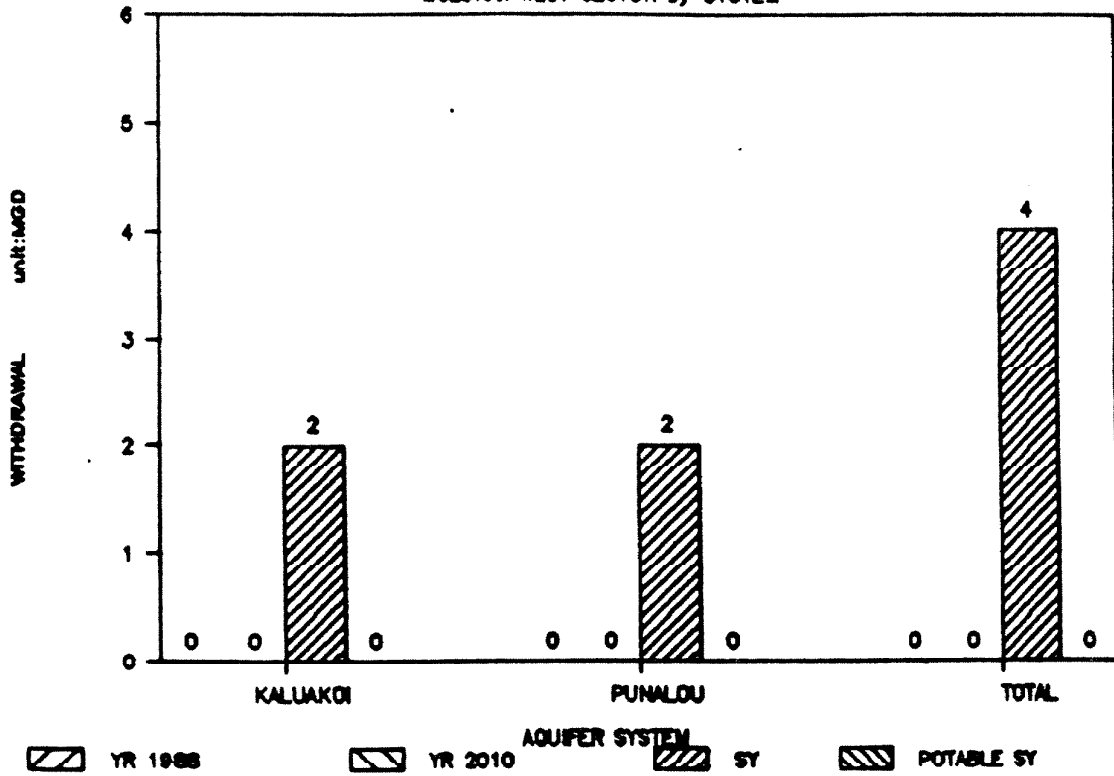
GROUNDWATER WITHDRAWAL

MOLOKAI: SOUTHEAST SECTOR by SYSTEM



GROUNDWATER WITHDRAWAL

MOLOKAI: WEST SECTOR by SYSTEM



MOLOKAI

FUTURE STUDY AREAS

Major water systems on Molokai are an interlace of several major landowners and the communities served from municipal, private and state water sources.

Future water plans for West Molokai resort development plans have not been finalized. The major focus is on additional water source development within the Central Sector-Kualapuu System aquifer.

Information to validate the sustainable yield of 7 MGD for Kualapuu System is needed.

Molokai Ranch surface water systems for Kualapuu and Manawainui periodically fail to comply with the Safe Water Drinking Act requirements. An abatement program should be in the planning process.

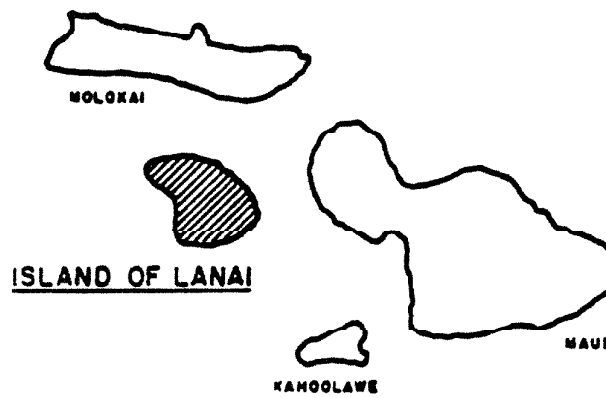
The Belt, Collins & Associates report Molokai Water System Plan for the Maui County Department of Water Supply, 1982, pp 96-102 lists potential hydro-generation plants.

Future water distribution systems as potential hydro-generation plants should be reviewed.

REFERENCES

1. Belt, Collins & Associates. 1982. Molokai Water Systems Plan. Report prepared for the Maui County Department of Water Supply.

C O U N T Y O F M A U I
W A T E R U S E A N D
D E V E L O P M E N T P L A N
I S L A N D O F L A N A I



LOCATION MAP

TABLE OF CONTENTS

I. INTRODUCTION	Page 1
II. EXISTING LAND USES AND FUTURE PROJECTIONS	2-4
III. EXISTING WATER SUPPLY AND CONSUMPTION	3
IV. PROJECTED POPULATION	5-6
V. PROJECTED WATER DEMANDS	6-7
VI. SUMMARY OF FUTURE WATER DEMANDS	8
VII. EXISTING & PROJECTED WATER SUPPLY & DISTRIBUTION SYSTEM	9
VIII. RESOURCE AVAILABILITY	9-11

EXHIBITS

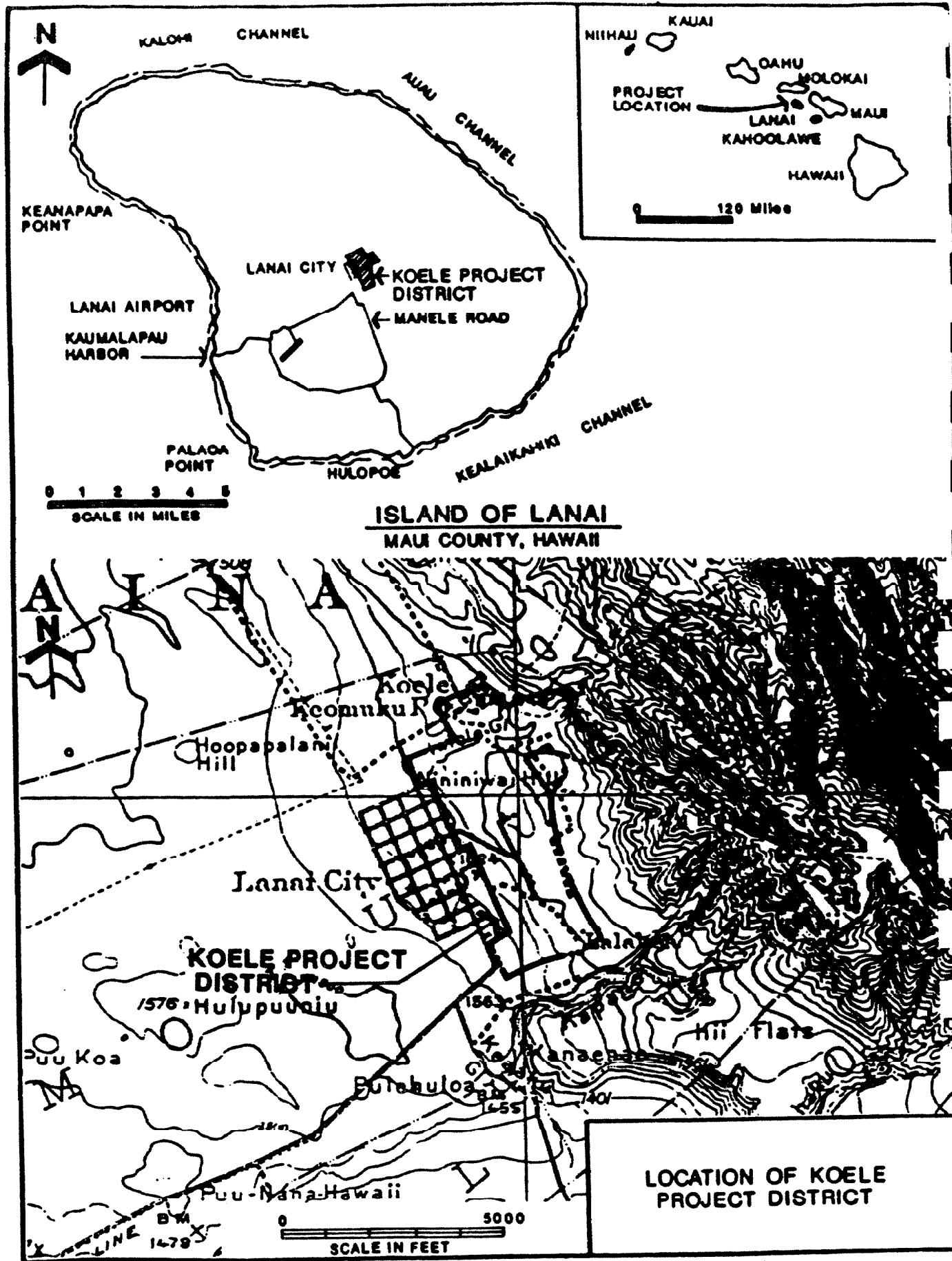
<u>Exhibit</u>		<u>Page</u>
A	LOCATION OF KOELE PROJECT DISTRICT	3
B	LOCATION OF MANELE PROJECT DISTRICT	4
C	DEVELOPMENT PLAN - WELL LOCATIONS AND SERVICE AREA MAP	11

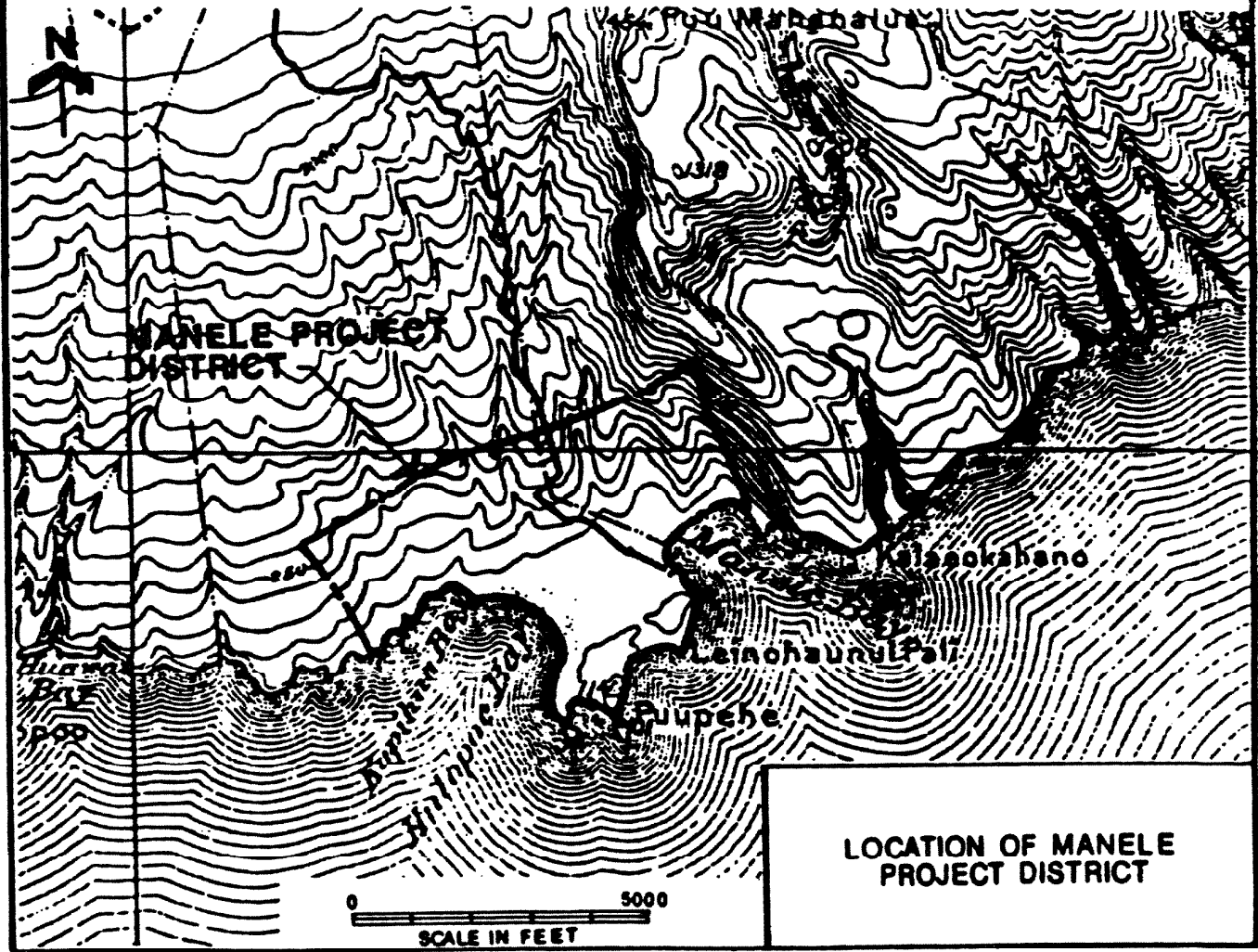
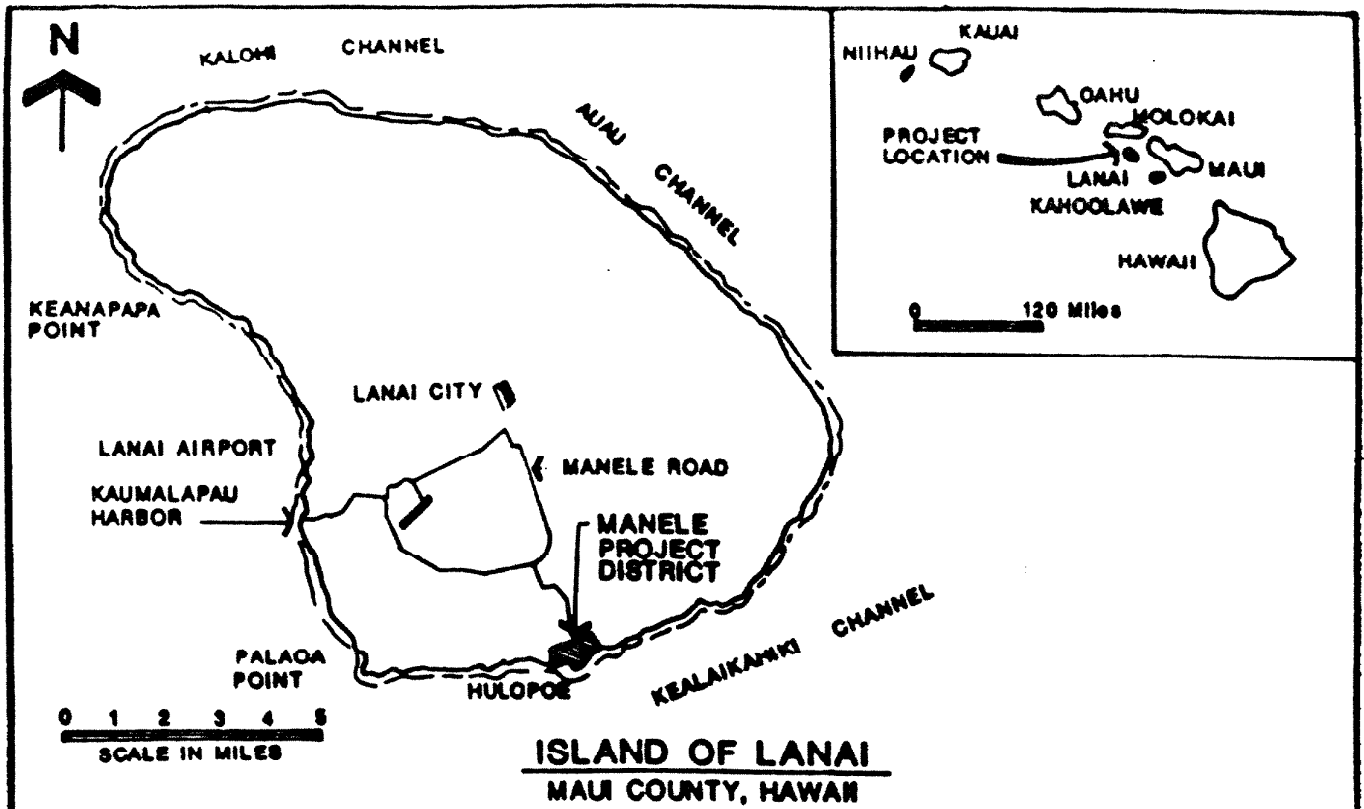
WATER USE AND DEVELOPMENT PLAN
FOR THE ISLAND OF LANAI

Approximately 98% of the land on the island of Lanai is owned by Castle & Cooke, Inc., Castle & Cooke, Inc. is also the owner and purveyor of the domestic and agricultural water system on the island.

The Water Use and Development Plan for the island of Lanai was prepared by M&E Pacific, Inc., for Castle & Cooke, Inc. This report includes the following:

1. Existing Land Uses & Future Projection
2. Existing Water Supply & Consumption
3. Projected Population
4. Projected Water Demands
5. Summary of Future Water Demands
6. Existing & Projected Water Supply & Distribution System
7. Resource Availability





Existing Land Uses and Future Projections

The Lanai Community Plan recommended that the County promote the visitor industry as a secondary economic activity by providing sites for hotel development, while maintaining pineapple cultivation as the primary economic activity. Other activities recommended include the promotion of diversified agriculture and fishing and aquaculture industries.

The recommendations of the Community Plan are currently being implemented. The Lodge at Koele Hotel and the Manele Bay Hotel are presently under construction for the respective project districts (Exhibits A and B). The pineapple operation has been converted from a non-irrigated to an irrigated plantation, thereby increasing crop yields. However, pineapple irrigation has increased to 2.4 MGD from 1.5 MGD as the rate averaged over the year. Plans are also underway to develop diversified agriculture to include pigs, cattle, crops, and food commodities intended for use by the hotels.

Existing Water Supply and Consumption

There is a single water purveyor on the island. The water supply and distribution system are being operated as a public utility, but under private ownership. There are no municipal water supply systems on Lanai. The present average water consumption is shown in the following table:

<u>Present Average Water Consumption</u>	
Domestic and commercial	0.38 MGD*
Pineapple irrigation	<u>2.40</u> MGD**
Total	2.78 MGD

*Average 1950-1988
**Average 1983-1987

With the increasing employment opportunities, a proportionate increase in population is expected. The new employment opportunities are primarily with the hotels and resorts. Secondary employment will occur to service the population; secondary employment includes government workers, retail, and service jobs.

Projected Population

The Department of Labor and Industrial Relations, State of Hawaii, reviewed the expanding labor force needed to support the visitor industry on Lanai.*

The existing population (1988) is 2,200. With the hotel construction at Manele and at Koele, employment opportunities were created for 750 jobs. If these jobs were filled entirely by in-migrants, there will be a population increase equivalent to the employees hired, their families, and the secondary employment which would be generated to service the increased population.

Over the years, it is anticipated that there will be a further increase in population because of birth rates offset by out-migration from Lanai. The Community Plan suggested using a population of 4,500 by the year 2000, and it appears to be a realistic estimate using employment figures and the employment opportunities that would become available with the establishment

* State of Hawaii, Department of Labor and Industrial Relations, "Lanai: A Look at Its Expanding Labor Force," December, 1988.

of the Lanai visitor industry. The resident population projection is shown in the following table:

Resident Population Projection

1988	2,200
1990	2,770
1995	3,930
2005	4,570
2010	4,800

Assuming an optimistic economic activity, a population of 4,500 would be reached sometime around the year 2005. The net growth rate from the existing population and from a growing economy could further increase the population to 4,800 by the year 2010.

Projected Water Demands

Water consumption under the projected conditions of increasing population is made assuming a unit consumption of 150 gallons per person per day for domestic use. The existing consumption for residential use is 110 gallons per person per day. Other uses drawn from the Lanai City grid include export of water to Kaunapali, partial irrigation of the golf course fairways and greens, business and commercial establishments. In the future scenario, an increase in per capita consumption is projected and a separate accounting is made to accommodate the needs of the visitor industry and for landscape irrigation which is a prominent feature in the resort development.

By the year 2010, housing development is projected to accommodate the increasing residential population. Additional residential development will be completed by that time as part of the resort development in the Koele Project District and the Manele Project District. It is anticipated that the resort dwelling units will be second home communities. The ultimate visitor population on the average, in the distant future, will be hotel guests and part-time resort residents. Typical occupancy rates averaged over the year are 75 percent for hotels and 25 percent for resort communities. The demand on the water resources of Lanai is based on the average occupancy over the year. The visitor population is projected ultimately to be 1,300 persons averaged over the year. The water demand per visitor is taken to be 175 gallons per day which includes the demands generated by the business and service establishments planned for the island.

Landscape irrigation will be a prominent water use, but it has the flexibility of utilizing a lesser water quality source. The Community Plan suggested the development of recycled water and the use of brackish water on the island for irrigation purposes. This is the intended direction of the water resource development plan for landscape irrigation. Irrigated landscape includes the hotel and resort grounds, Hulopoe Beach Park, and two golf courses - one at Koele and the other at Manele.

Pineapple irrigation is projected to consume less amount of water into the future.

Summary of Future Water Demand

Water demand by various categories projected for the future to the year 2010 is shown in the following table.

Projected Water Demand

	<u>Average Daily, MGD</u>	
	<u>High Level</u>	<u>Alternate Sources</u>
Domestic*	1.00	
Pineapple	1.80	
Commercial	0.25	
Landscape		
Koele Hotel	0.18	
Koele Golf Course	0.25	
Hulopoe	0.15	
Manele Golf Course		0.8
Manele Bay Hotel	0.23	
Community Gardens and other landscape	---	0.4
TOTAL	3.86 MGD	1.2 MGD

* Based on per capita consumption. Requirement by County Code will show 1.5 MGD (600 GPD/unit for single-family residence; 560 GPD for multi-family residence).

The categories of consumption are also specified according to the projected water sources. The highest and best use is planned for the high level aquifers on the island. The secondary use of landscape irrigation is projected to be drawn from alternate water sources which include brackish waters and recycled sewage effluent.

Existing and Projected Water Supply and Distribution System

The existing and projected water supply and distribution system is shown in Exhibit C. Lanai City derives its principal water source from the Maunalei System. The remainder of the sources, Wells 1 through 5 and Shaft 3, are mainly irrigation water supplies for pineapple.

Recently Wells 6 and 7 have been drilled and are ready for production. Well 6 will be connected directly to the Lanai City grid for domestic consumption, and Well 7 will serve as an irrigation water source. Drilling is underway for Wells 8 and 9 to meet increasing demands in the future. Well 10 is also under construction as an exploratory well for alternate sources for landscape irrigation mainly at Manele. Additional wells will be constructed as necessary to meet future requirements.

Resource Availability

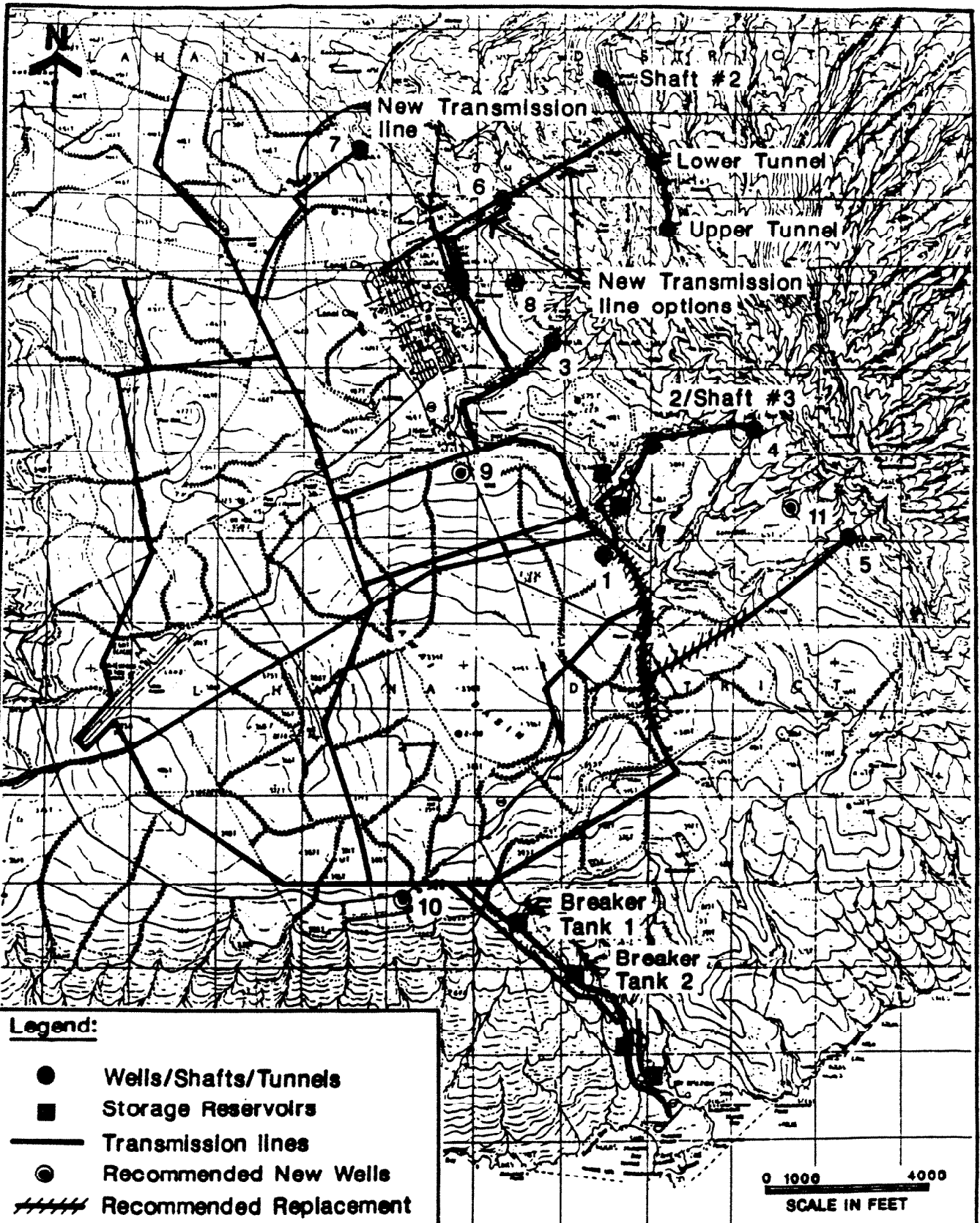
The principle water source is drawn from the high level aquifer. The existing wells are located at elevations greater than 1,400 feet above sea level. Brackish water sources are in use along the northern and windward side of the island from small dug wells near the coastline. Brackish waters are expected along the southern rim of the Palawai Basin where Well 10 is located.

The sustainable yield from the high level aquifer has been estimated by two hydrologists working independently. The first hydrologist was Keith Anderson who used the hydrologic balance method to derive a sustainable yield value of 6.2 MGD. The

second was John Mink who used hydrologic modeling to derive an estimate of 6.0 MGD*. The two conclusions, independently reached, agree remarkably well.

The projected demand from the high level aquifer is well within the availability of that resource.

* M&E Pacific, Inc., "Water Resources Development Plan for the Island of Lanai, Lanai, Hawaii," March 1989.



Legend:

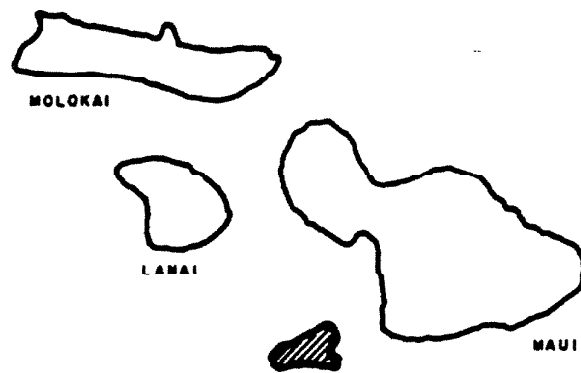
- Wells/Shfts/Tunnels
- Storage Reservoirs
- Transmission lines
- ⊙ Recommended New Wells
- //// Recommended Replacement

0 1000 4000
SCALE IN FEET

**Lanai Water Resources
Development Plan**

**WELL LOCATIONS AND SERVICE
AREA MAP**

C O U N T Y O F M A U I
W A T E R U S E A N D
D E V E L O P M E N T P L A N
I S L A N D O F
K A H O ' O L A W E



ISLAND OF KAHOOLAWE

LOCATION MAP



WATER USE AND DEVELOPMENT PLAN
KAHO'OLAWÉ

TABLE OF CONTENTS

	<u>Page</u>
Table of Contents	i
I. EXISTING AND FUTURE LAND USE & RELATED WATER NEEDS	
Kaho'olawe Community Plan	1-3
Present Land Use and Related Water Needs	4
Future Land Use and Projected Water Demand	5
a. Revegetation/Soil Conservation	5
b. Community Plan/Cultural Use	6
c. Military Use	6-7
II. WATER RESOURCE INVENTORY	
Ground Water	8
Surface Water	8
Rain Catchment	9
Desalinization	9
Importation	9
Mist Interception	10
III. WATER DEVELOPMENT	
Ground Water	11
Surface/Rain Water	12
Desalinization	12
Importation	12
REFERENCES	14

I. EXISTING AND FUTURE LAND USE & RELATED WATER NEEDS

Kaho'olawe, the southern most island of Maui County, is approximately 7 miles southwest of Makena. (See Figure 1) The island is approximately 11 miles long and six miles wide, for an area of 28,000 acres or 45 square miles. Moa'ula, the highest point, rises to 1,500 feet above sealevel.

The entire island is in the State Conservation District, and is a special management area under the Hawai'i Coastal Zone Act. Since 1953, Kaho'olawe has been under the jurisdiction of the U.S. Navy, and is used for target practice, by authority of a federal executive order.

Cooperative management of Kaho'olawe's cultural and natural resources is afforded through a 1978 Memorandum of Understanding with the State of Hawai'i, and a 1980 Consent Decree with the Protect Kaho'olawe 'Ohana.

Kaho'olawe Community Plan

The Kaho'olawe Community Plan was adopted on June 4, 1982 by Ordinance No. 1233 of the County of Maui. The Kaho'olawe Community Plan was mandated by the charter of Maui, and contains "the desired sequence, patterns, and characteristics of future developments as well as standards and principles."

The plan identifies a proposed pattern, distribution and intensity of land use practices on Kaho'olawe for a 15-20 year framework. Generally the plan calls for the development of Kaho'olawe as a cultural park, with permanent and temporary base camps for the purpose of conducting educational, religious, cultural and scientific activities. A 20 year phase out of all military use is proposed.

A number of island activities are specified, all of which have some demand for water. These activities include:

1. Development and maintenance of hiking trails for visitor safety and to protect archaeological sites.

2. Development of base camps at nine (9) bays around the island, and one (1) upland camp, for accommodation of up to 50 people each.
3. Development of a fire suppression program to protect vegetation.
4. Archaeological site stabilization and maintenance.
5. Erosion control activities such as revegetation, wind breaks, goat eradication, construction of check dams, and other activities.
6. Designation of an increasing portion of the land base (over 15 years) as a Cultural Use Area for the purpose of conducting educational, cultural, scientific and religious activities.

Figure 1

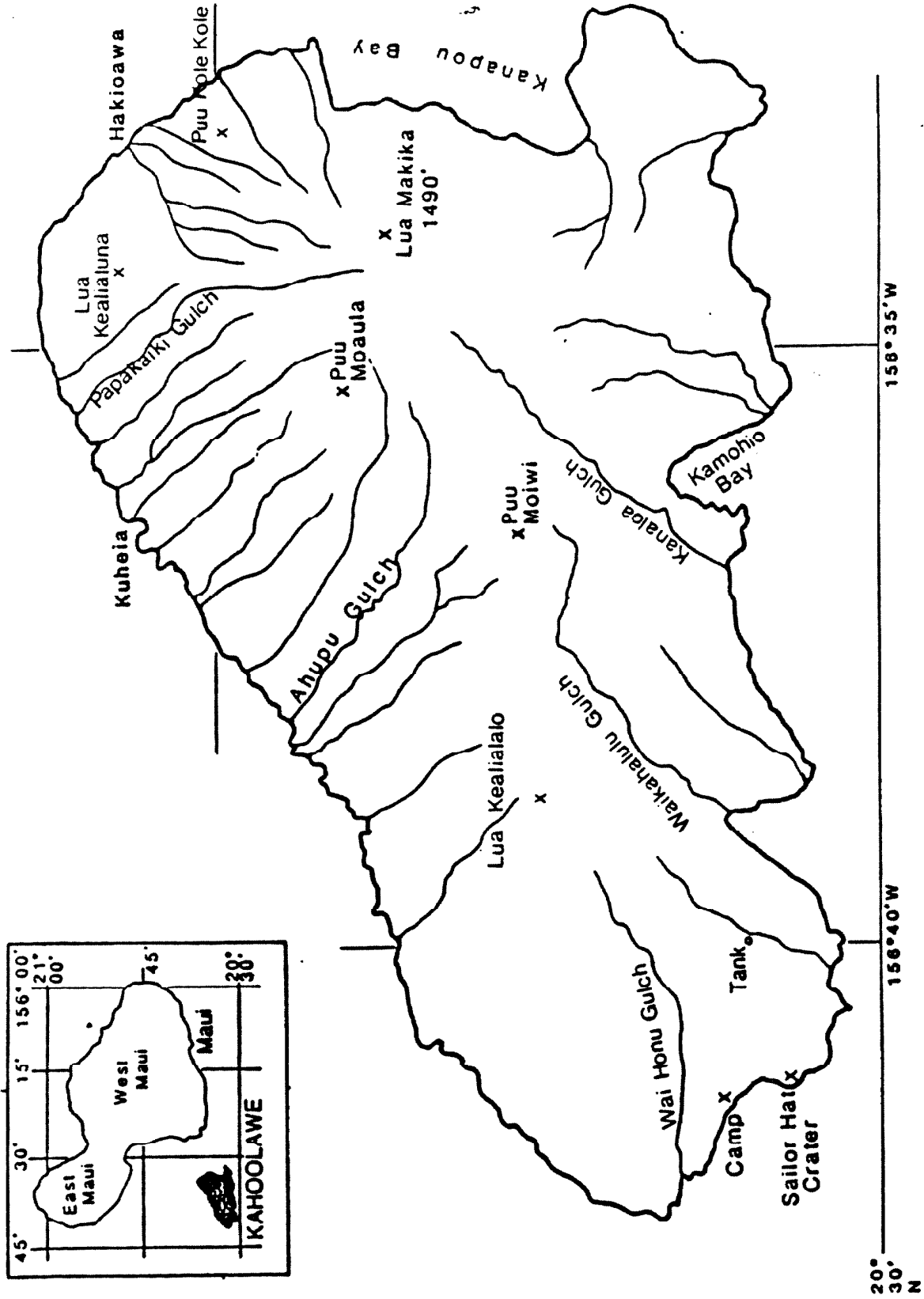


Figure 1. Map of Kaho'olawe showing major streams and features. Many small drainages are not included in this map. (After Stearns, 1939).

Present Land Use and Related Water Needs

The present land use on Kaho'olawe can be characterized by three activities: 1) educational, scientific and cultural use, 2) revegetation/soil conservation, and 3) military use.

The Kaho'olawe Community Plan is presently being implemented to a limited extent by the cultural activities of the Protect Kaho'olawe 'Ohana/Fund. Ongoing soil conservation and revegetation activities are conducted by the State Department of Land and Natural Resources, the Protect Kaho'olawe 'Ohana/Fund, the Native Hawaiian Plant Society and the US Navy. Different branches of the US military use the island monthly for bombing, ship to shore shelling, and artillery practice. All of these activities currently use water.

Most of the present water demand on Kaho'olawe is met by water importation. The Protect Kaho'olawe 'Ohana imports approximately 2,500 gallons monthly (25,000 gallons annually) to support limited educational, cultural, and scientific activities associated with the Kaho'olawe Community Plan. In addition, the 'Ohana with funding from the State has constructed rainfall harvesting structures with 2,920 gallons of storage capacity.

Other State and community revegetation/soil conservation efforts are supported by ad hoc water importation or by supplies imported by the U.S. Navy.

The Navy has two 10,000 gallon storage tanks on Kaho'olawe. They import water every two weeks for a total of 26,400 gallons per month, or 316,000 gallons annually.

1988 Water Use on Kaho'olawe*

<u>Use/User</u>	<u>Annual Consumption</u>
Community Plan (PKO)	27,920 gallons
Military Use	<u>316,800 gallons</u>
TOTAL	344,720 gallons

* Source: Kaho'olawe Water Resources Study.

Future Land Use and Projected Water Demand

The State has recently completed a comprehensive DRAFT Kaho'olawe Water Resources Study. The study, while still in draft form, contains useful information for planning future land and water use on Kaho'olawe. The study calls for an ambitious program of coordinated resource management to restore Kaho'olawe's degraded environment, while expanding Community Plan related activities, and pursuing the development of water resources. Data presented in this plan on existing and projected water demand, as well as developable sources, is taken from the draft State study.

The draft study's proposed land use and projected water use is especially pertinent in light of a \$250,000 appropriation by the Hawai'i State Legislature of a Grant-In-Aid to the Protect Kaho'olawe 'Ohana to continue water and soil conservation work on the island for FY89-90 through FY90-91.

Land use proposed for the present and future bieniums includes dramatic increases in revegetation/soil conservation activities, and Community Plan related activities. Military use is projected to remain constant. (The Community Plan calls for diminishing military activity.) Future water demand on Kaho'olawe will originate from these three sources.

a. Revegetation/Soil Conservation

Rehabilitation of Kaho'olawe's soil, vegetation, and water environment has been proposed for many years. Future revegetation/soil conservation programs must expand in scope in order to arrest the current degradation processes. The revegetation/soil conservation program, funded for 1989 through 1991 and expected to continue through the next decade, is projected to need approximately 350,000 gallons annually.

This figure is based on start up needs for native plants that would become water self-sufficient after being established.

b. Kaho'olawe Community Plan

The Kaho'olawe Community Plan calls for soil conservation and revegetation as well as educational, scientific, and cultural activities. Water demand is calculated from water consumption by individuals averaging six (6) gallons per island visit.

Activities identified in the plan include: the construction and use of hiking trails, the development of a fire suppression program, and the development of additional base camps with small scale planting projects. Water demand figures represent increasing public visitation and participation in these Community Plan projects. Total projected water demand for community plan activities, excluding revegetation, is 146,500 gallons annually.

Community Plan Water Needs*

<u>Use</u>	<u>Annual Consumption</u>
Base Camp Development	90,000 gallons
Hiking Trails/Cultural Use	1,000 gallons
Fire Suppression	54,000 gallons
Educational/Scientific	1,500 gallons
<hr/>	<hr/>
TOTAL	146,500 gallons

* Source: Kaho'olawe Water Resources Study.

c. Military Water Use

The Navy's water use on Kaho'olawe is primarily for drinking water, showers and cooking. 100-150 personnel stay regularly for 10 day periods, and 10 individuals remain on island at all times. Total projected annual consumption is 316,800 gallons.

Summary of Kaho'olawe Water Needs*

<u>Use</u>	<u>Annual Consumption (gallons)</u>		
	Present	Proposed	25% Future Growth
Revegetation/Soil	0	350,000	437,500
Community Plan	27,920	146,500	183,125
Military Use	316,800	316,800	316,800
TOTAL	344,720	813,300	1,016,625

* Source: Kaho'olawe Water Resources Study.

Total estimated water demand is 813,300 gallons annually. Allowing a 25% increase in demand over time for additional revegetation and domestic needs brings Kaho'olawe's projected annual water demand to approximately 1 million gallons per year.

II. KAHO'OLAWA WATER SOURCES

The 1989 DRAFT State study discovered a significant ground water resource, as well as a huge potential for surface water collection. Six sources of water on Kaho'olawe are summarized below.

Ground Water

There are two types of ground water on Kaho'olawe: the newly discovered dike impounded source, and a historically developed basal source. The actual yield, quantity, and quality of ground water on Kaho'olawe is unknown and awaits further investigation. The volume of dike impounded water is believed to be between 65,865 and 263,463 acre-feet, or 21 to 86 billion gallons (1 acrefoot equals 325,900 gallons). It is suspected that the source may be brackish due to high dissolved solids.

Because of the present degraded state of Kaho'olawe's surface environment, surface recharge of the aquifer is very low so sustainable yield may be minimal. However even with a very low yield, the dike impounded ground water could be a significant resource for upland revegetation efforts.

A thin basal lense is also present on Kaho'olawe. Historically this source was tapped by wells but became brackish in the early twentieth century. Research suggests that removal of kiawe trees from valley floors would significantly improve the quality of the basal ground water resource.

Surface Water

The annual quantity of runoff on Kaho'olawe is estimated at 58,300 acrefeet or 19 billion gallons. Historically surface water catchment served as the primary source of water on

Kaho'olawe, especially from 1915-1950, after the wells became brackish.

Surface water catchment is problematic, due to the extremely high sediment load (up to 90%). Historically diversion structures have filled up with sediment and need to be frequently dug out. If the sediment problem can be resolved, either through soil erosion control or filters, surface water catchment offers high potential for water development.

Rainfall Harvesting

Rainfall catchment was also used historically on Kaho'olawe, with developed storage capacity in excess of 50,000 gallons in 1939. While quantities available through rainfall harvesting are small in comparison of with the island's total needs, it could significantly meet the demand of drinking water for the base camp and hiking trail requirements of the Kaho'olawe Community Plan.

Desalinization

Desalinization or demineralization of brackish or salt water through reverse osmosis offers significant opportunity to meet a portion of Kaho'olawe's water demand. Small self-contained desalinization units have wide application in rural and marine settings, and could be used for meeting basecamp potable water needs for the Community Plan. A power source (photo-voltaic), routine maintenance, and a disposal method for waste brine are requirements of desalinization.

Importation of Water

Importation of fresh water has become the primary source of domestic water on Kaho'olawe in the later half of this century. Given the size of the present and projected water demand, importation is the easiest way to meet the need.

However the cost of importation is high in that it does not diminish over time. Furthermore, water importation is difficult logistically given the present transportation infrastructure available. Both the Navy and the 'Ohana cost of importation is in excess of \$4,000 per delivery.

There have been suggestions in the past to run a water line from Maui to Kaho'olawe, though the feasibility of such a proposal has never been investigated.

Direct Interception of Cloud, Mist and Fog Water

Fog drip is an important component of the water budget in many arid areas. Apparently this is responsible for the healthy appearance of existing plants on the Kaho'olawe hardpan. Fog and mist often enshroud the summit area of Kaho'olawe, and grasses are wet in the early morning hours.

Significant interception of fog and mist has been demonstrated on Mauna Kea with a louvered aluminum shade screen. Interception can also be accomplished by plant species with favorable interception characteristics. Direct interception is an important water resource for the upland revegetation program.

III. WATER DEVELOPMENT

The overall guiding factor to the development of any natural and cultural resources on Kaho'olawe is the need for a comprehensive strategy for environmental restoration. The stabilization of the soil, water and vegetation environment is the key to the viability of future uses, including the development of a cultural park, as envisioned in the Kaho'olawe Community Plan. Water development on Kaho'olawe must proceed cautiously due to the degraded island environment, and must incorporate a comprehensive environmental restoration strategy.

There are four major sources of water that can be developed to satisfy the water needs of Kaho'olawe. Each of the four --surface/rain catchment, ground water, importation, and desalinization-- could be developed through a combination of strategies to meet the various water requirements on the island.

Cost estimates and projected yield from various sources are taken from the DRAFT Kaho'olawe Water Resources Study. Please refer to this document for more detailed explanations and cost analysis. Figures reflect one time development cost in 1988 dollars.

Ground Water

The first stage of water development is the design and implementation of a drilling program to identify aquifer properties such as porosity, transmissivity, hydraulic conductivity, yield, sustainable yield, and water quality. If dike impounded water is found to be recoverable in sufficient quantities, wells could be developed to service a revegetation program on the top of the island. Basal water could also be developed at coastal base camps through the selective felling of kiawe trees to reduce evapo-transpiration.

Costs of a ground water exploration and development program are estimated to be \$1,223,800.00. Maintenance and operations

costs would be subject to the quality, yeild, ultimate use, and delivery system of the ground water resource.

Surface/Rain Water

The development of surface runoff and precipitation facilities are expected to harvest a minimum of 120,000 gallons of water per year. Rainfall harvesting would be accomplished through construction of several structures at base camps and in the mauka region over the next four years.

The development of surface runoff contemplates the renovation of existing runoff catchments and storage facilities at Kuhe'e'ia and Ahupu with storage capacity in excess of 600,000 gallons. Also diversion into old bomb craters in the mauka regions could capture an additional 60,000 gallons.

Surface/rainfall development costs are estimated at \$3,760.00 per catchment structure. Maintnenance and operations costs would depend on the extent of the revegetation program and associated irrigation system. Surface catchment maintenance will be considerably more expensive than rain catchment due to sedimentation.

Desalinization

Desalinization of approximately 70,000 gallons on an annual basis is possible by the development of small desalinization units at four base camps around the island.

Per unit purchase and operation cost is \$21,500.00 or \$86,000 for four base camps. Annual maintenance and operations costs are approximately \$4,800 for four units or \$0.07 per gallon.

Importation

Water importation is recommended to meet the ongoing water demand for military use. Annual cost to the Navy is approximately \$88,800.00 or \$0.28 per gallon.

Summary of Proposed Water Development and
Associated Costs*

Water Source	Community Plan	% of demand supplied Revegetation Program	Military Use	Development Cost ⁺
Imported Water	0	0	100%	\$ 88,800.00
Surface Runoff	10%	24%	0	55,000.00
Rain Catchment	25%	24%	0	50,000.00
Ground Water	0	43%-100%	0	1,181,000.00
Desalinization	65%	0	0	80,000.00
TOTALS	100%	100%	100%	\$1,454,800.00

* Source: Kaho'olawe Water Resources Study.

+ Values reflect one time development costs in 1989 dollars.
Operating costs not available.

REFERENCES

County of Maui. Kaho'olawe Community Plan. 1982.

State of Hawai'i, Department of Land and Natural Resources,
Division of Water and Land Management. (DRAFT) Kaho'olawe
Water Resources Study. 1989.

Stearns, H.T. Geology and Ground-water Resources of the
Islands of Lana'i and Kaho'olawe, Hawai'i, Hawai'i Division of
Hydrography, Bulletin 6, 1940.

A P P E N D I X E S

A - DEFINITIONS

B - COMMUNITY PLAN EXHIBITS

C - AQUIFER

D - AQUIFER WITHDRAWALS

A P P E N D I X A

D E F I N I T I O N S

DEFINITIONS

AGRICULTURAL PRIVATE WATER SYSTEM

Water systems owned and/or operated by private enterprise. Does not include municipal water used to irrigate agricultural operations.

AQUIFER SYSTEM

Defined by aquifer classification scheme. See Appendix C.

BRACKISH WATERS

Waters with dissolved inorganic ions (salinity) greater than 0.5 parts per thousand, but less than thirty parts per thousand.

CENTRAL MAUI SOURCE JOINT VENTURE

Members of joint venture are Wailea Development Company, Inc., C. Brewer Properties, Inc., A & B Properties, Inc., and Seibu Hawaii, Inc.

DIVERSIONS

Water diverted from a stream to a water system.

EAST MAUI WATER DEVELOPMENT AGREEMENT

Members of agreement are Dept. of Water Supply, County of Maui, A & B Properties, Inc., Baldwin Pacific Properties, Inc., Maui 670 Limited Partnership, and Maui Lani Partners.

LOSSES

(Water System) - includes water used or lost for fire fighting, broken mains, washing streets, and losses from metering adjustments, etc.

MAJOR PRIVATE DOMESTIC WATER SYSTEMS

Private water systems for individual/personal needs and commercial use.

PRODUCTION

Consumption or water demand plus system losses.

RECHARGE

A process to replenish an aquifer.

REGISTRATION SHEETS (Two types of forms were filed)

1. Register wells and declaration of water use; and
2. To register stream diversion works and declaration of water use. Forms filed at Department of Land and Natural Resources, Division of Water Resource Management, P. O. Box 373, Honolulu, HI 96809.

SALINE WATERS

Waters with dissolved inorganic ions greater than thirty parts per thousand.

SUBINTAKE

Water diverted from a ditch to a water system.

SUSTAINABLE YIELD

See Appendix C.

TRANSFER OF WATER

Water transported from one aquifer sector or system to another aquifer sector or system.

WATER SYSTEM

Water service including source and distribution to an area by a purveyor.

WITHDRAWAL

Withdrawal from wells and diversions from streams.

A P P E N D I X B

COUNTY OF MAUI - COMMUNITY PLANS

Community Plans of the County of Maui

The County of Maui includes the islands of Maui, Lanai, Molokai, and Kahoolawe. For planning purposes, the entire County was further divided into nine community planning regions. As of December, 1987, the Maui County Council has adopted by ordinance all nine regional community plans as a current and comprehensive guide for future growth and development.

County of Maui
Nine Community Plans
and Date of Adoption

Island of Maui

Wailuku-Kahului Community Plan - December, 1987
Kihei-Makena Community Plan - July, 1985
Lahaina Community Plan - December, 1983
Paia-Haiku Community Plan - April, 1983
Makawao-Pukalani-Kula Community Plan - October, 1987
Hana Community Plan - July, 1982

Island of Molokai

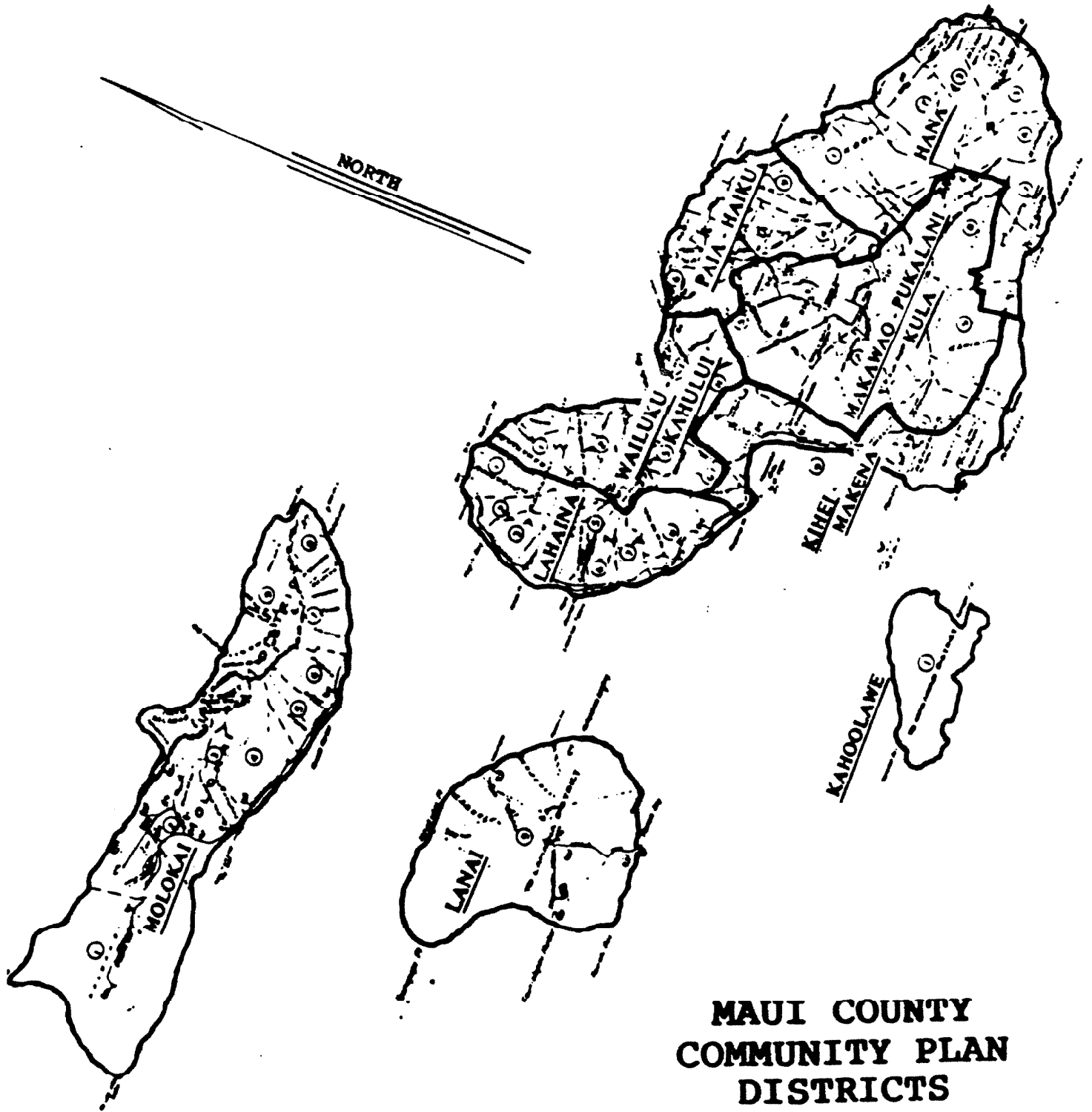
Molokai Community Plan - January, 1984

Island of Lanai

Lanai Community Plan - April, 1983

Island of Kahoolawe

Kahoolawe Community Plan - June, 1982



**MAUI COUNTY
COMMUNITY PLAN
DISTRICTS**

I S L A N D O F M A U I

COMMUNITY PLAN EXHIBITS

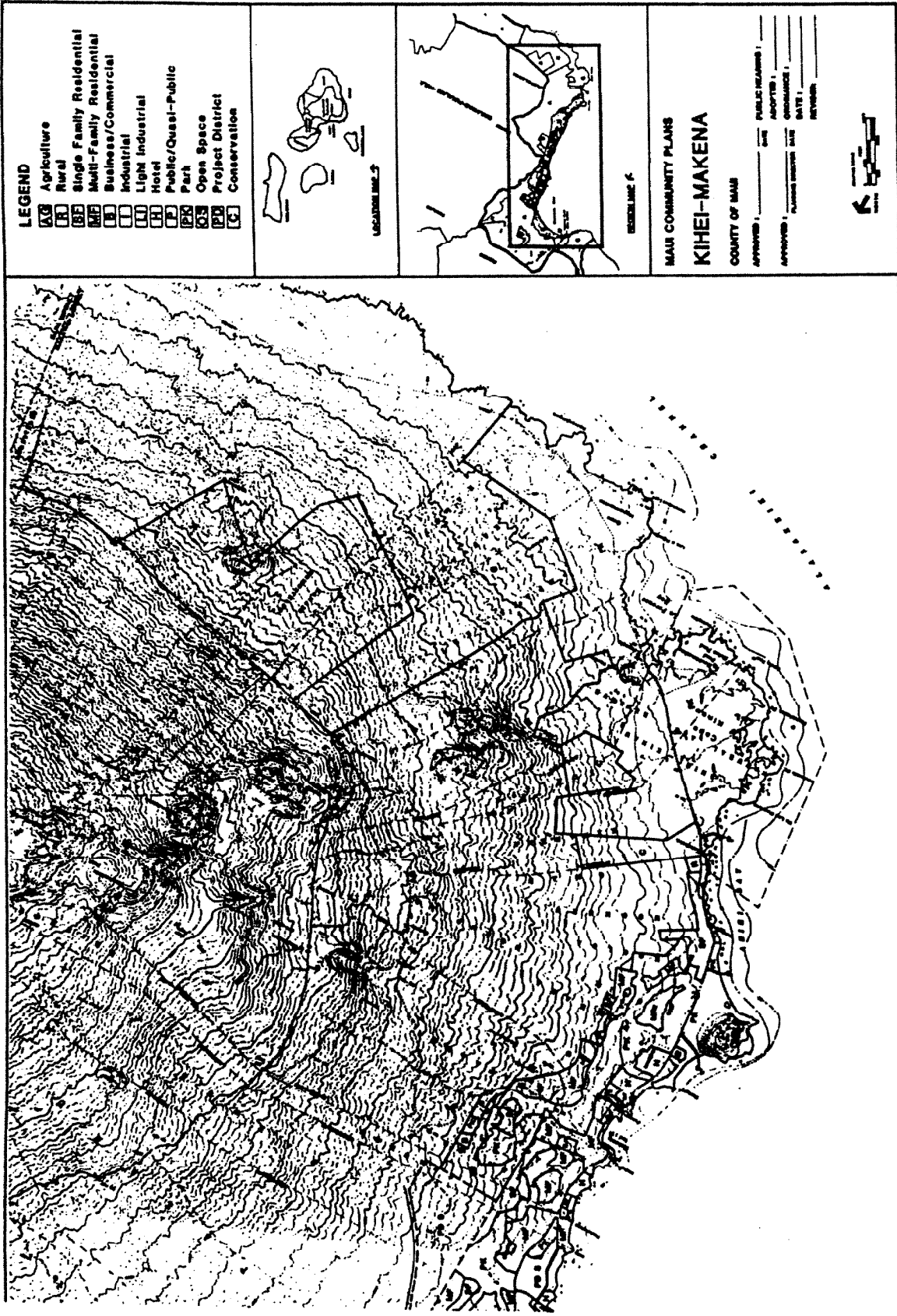
LEGEND

AG	Agriculture
R	Rural
SF	Single Family Residential
MF	Multi-Family Residential
B	Business/Commercial
BR	Business/Multi-Family
BI	Business/Industrial
LI	Light Industrial
HI	Heavy Industrial
H	Hotel
P	Public/Quasi-Public
PK	Park
OS	Open Space
PD	Project District
A	Airport

PRELIMINARY COPY
SUBJECT TO CHANGE

WAILUKU-KAHULULU
LAND USE

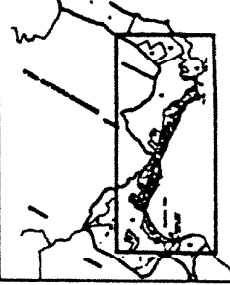






LEGEND

- Agriculture
- Rural
- Single Family Residential
- Multi-Family Residential
- Business/Commercial
- Industrial
- Light Industrial
- Hotel
- Park
- Public/Quasi-Public
- Open Space
- Project District
- Conservation



ENCLOSURE 6

**MAUI COMMUNITY PLANS
KIHIKI-MAKENA**

COUNTY OF MAUI

APPROVED: _____ DATE: _____
 PUBLIC HEARING: _____ DATE: _____
 APPROVED: _____ DATE: _____
 APPROVED: _____ DATE: _____



LEGEND

	AG	Agriculture
	R	Rural
	BC	Business/Commercial
	SR	Single Family Residential
	MR	Multi-Family Residential
	H	Hotel
	P	Public/Quasi-Public
	PA	Park

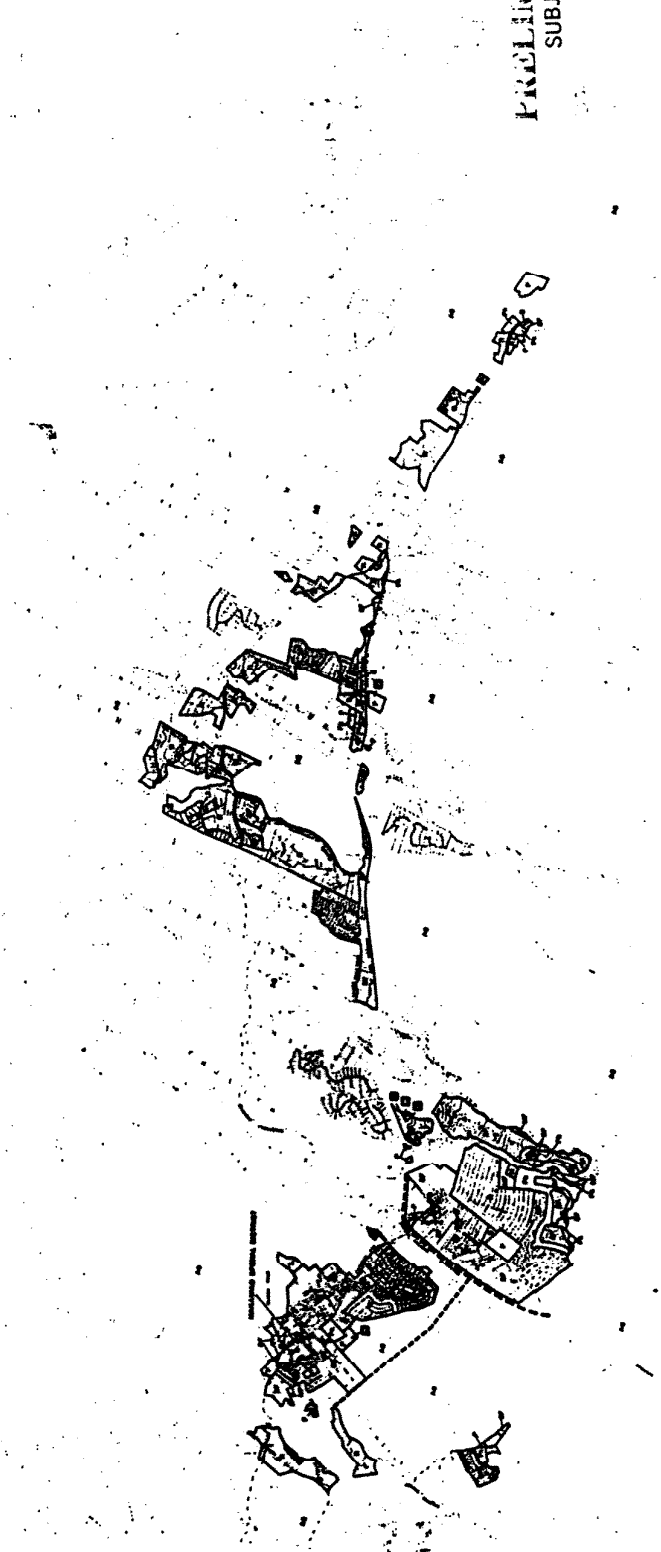
	Proposed Highway
	Proposed Secondary Road
	Proposed School Facility
	Proposed Library Facility
	Proposed Health Facility
	Proposed Fire Station
	Special District

PRELIMINARY COPY
SUBJECT TO CHANGE

MAKAWAC - PUKALANI - KULA

Scale: 1" = 1000'

North Arrow



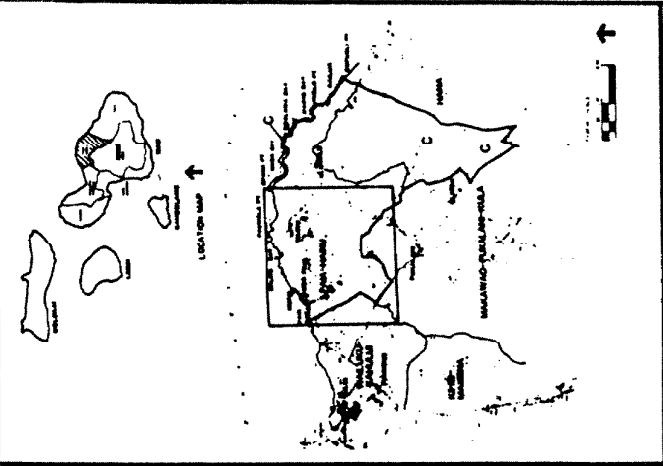
LEGEND

LAND USE :

- C Commercial
- AG Agriculture
- R Residential
- SP Special Purpose
- MP Medium Density Residential
- LD Low Density Residential
- LI Light Industrial
- HI Heavy Industrial
- SI Single-Family Detached
- DF District Office
- PO Public Office
- PS Public School
- PC Public Community Center
- PA Public Amusement
- PE Public Entertainment
- PF Public Facility
- PK Public Kitchen

PROPOSED NEW OR MODIFIED PUBLIC FACILITIES :

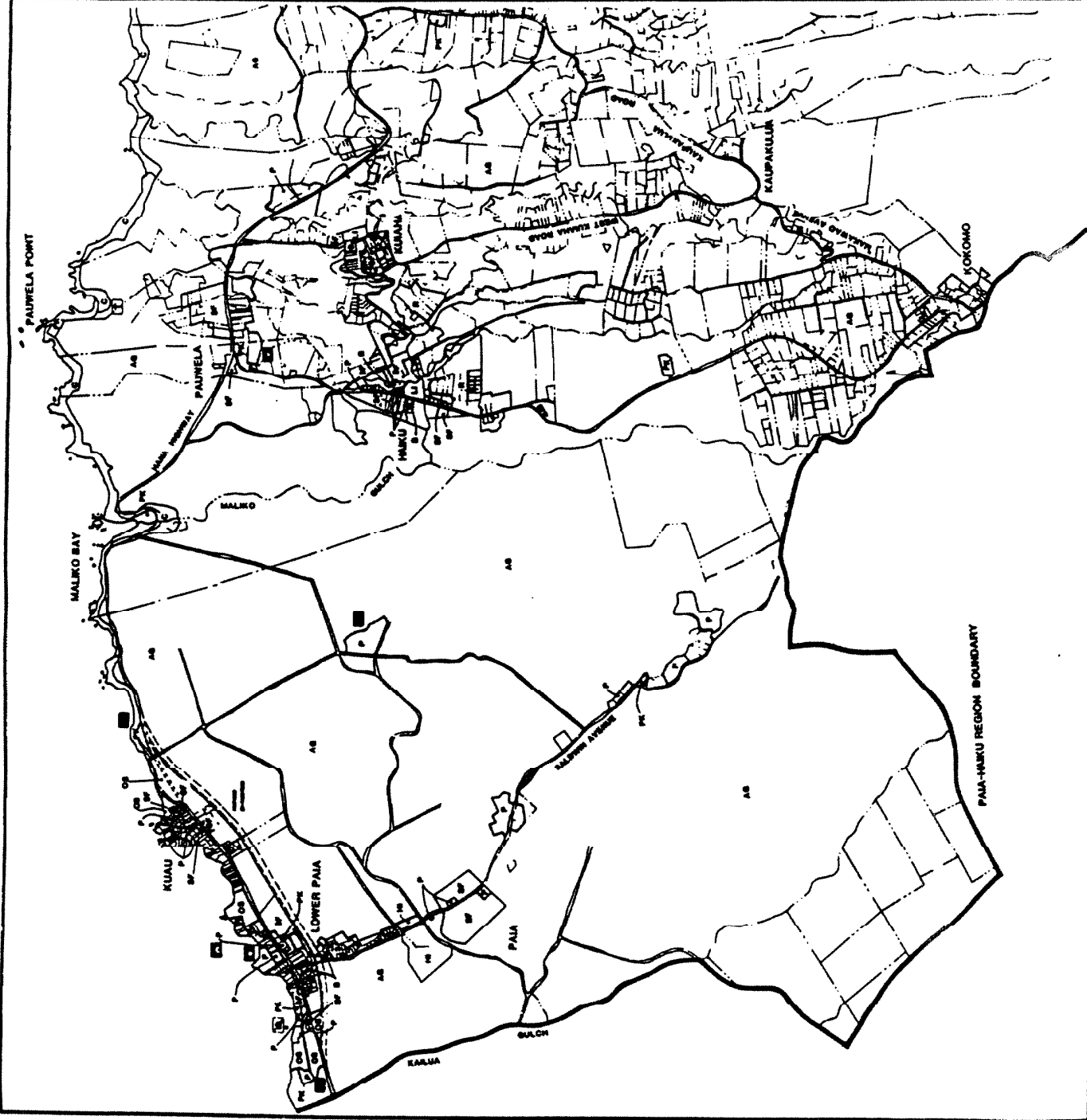
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MAUI COMMUNITY PLANS
PAIA-HAKU
 COUNTY OF MAUI

APPROVED: _____ DATE: _____ PUBLIC HEARING: 3/16/83
 ADOPTED: 5/5/83
 APPROVED: [Signature] DATE: _____ PLANNING DIRECTOR DATE: _____
 DATE: _____ REVIEWED: _____

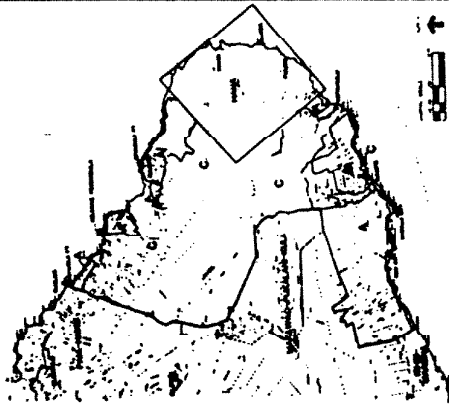
PAIA-HAKU



LEGEND

- LAND USE:**
- C-1 Commercial
 - C-2 Commercial
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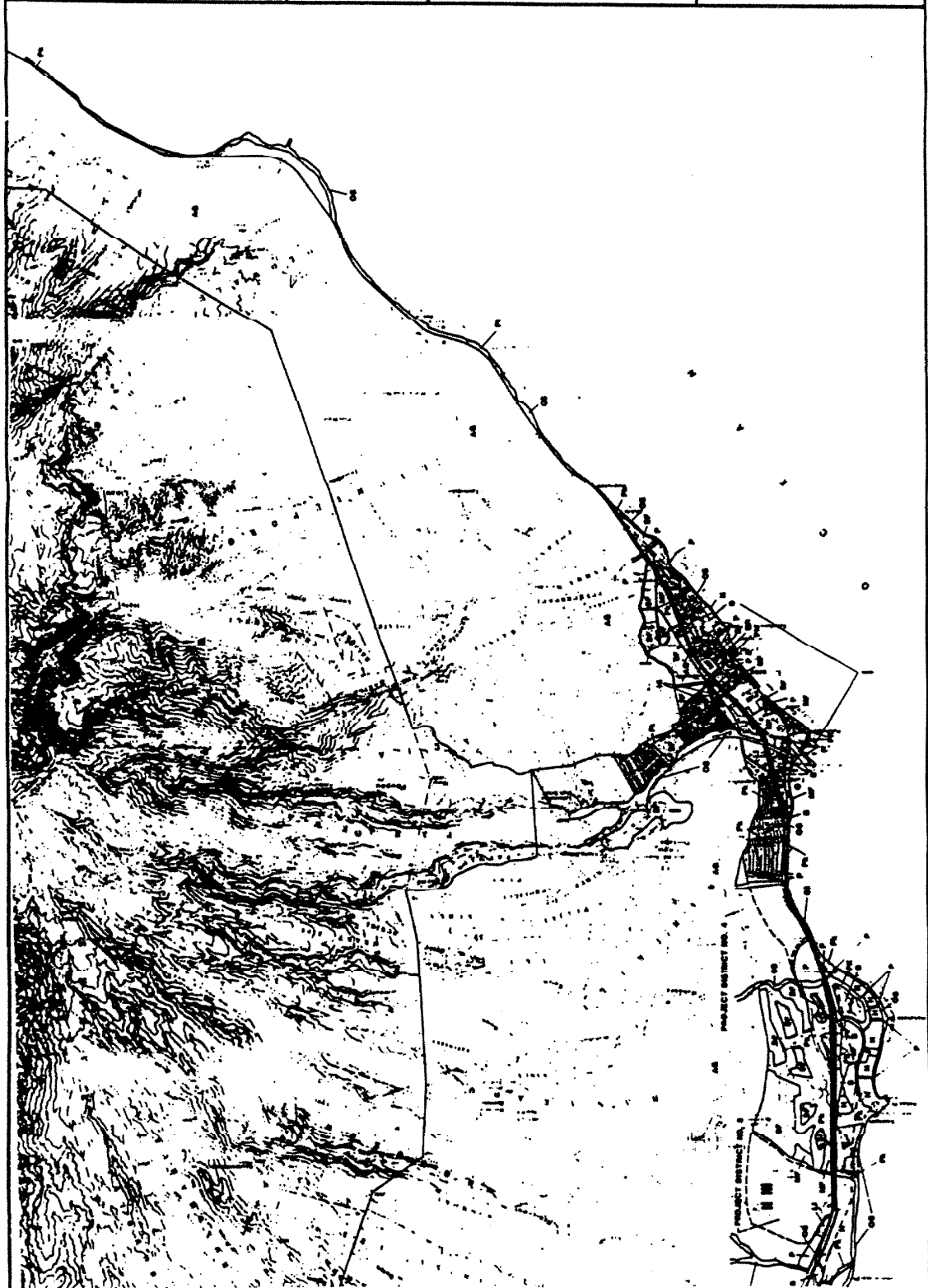
- PROPOSED NEW & IMPROVED PUBLIC FACILITIES:**
- 1. Community Center
 - 2. Fire Station
 - 3. Police Station
 - 4. Public Library
 - 5. Public Works Building
 - 6. Public Storage Building
 - 7. Public Office Building
 - 8. Public Parking Lot
 - 9. Public Restroom
 - 10. Public Drinking Water
 - 11. Public Sewerage
 - 12. Public Storm Drainage
 - 13. Public Street Lighting
 - 14. Public Street Sweeping
 - 15. Public Street Maintenance
 - 16. Public Street Repaving
 - 17. Public Street Widening
 - 18. Public Street Relocating
 - 19. Public Street Closing
 - 20. Public Street Opening
 - 21. Public Street Relocating
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 - 96. Public Street Relocating
 - 97. Public Street Closing
 - 98. Public Street Opening
 - 99. Public Street Relocating
 - 100. Public Street Closing



**MAUI COMMUNITY PLANS
HANA
COUNTY OF MAUI**

APPROVED: _____ DATE: _____
 PUBLIC HEARING: 5/17/82
 ADOPTED: 7/23/82
 APPROVED: 1/1/84 ORDINANCE: 12,87
 COUNTY ENGINEER DATE: _____
 REVISOR: _____

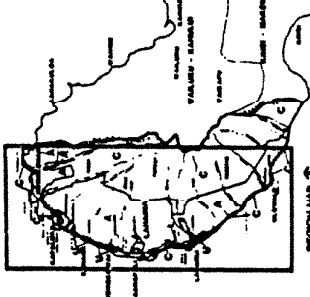
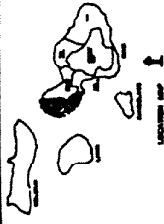




LEGEND

- AG Agricultural
- RF Single Family Residential
- MF Multi-Family Residential
- BC Business/Commercial
- BM Business/Multi-Family
- HI Heavy Industrial
- LI Light Industrial
- HT Hotel
- LP Public/Quasi-Public
- PK Park
- OS Open Space
- PD Protect District
- AP Airport

- Phase 1
- Phase 2
- Phase 3

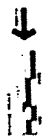


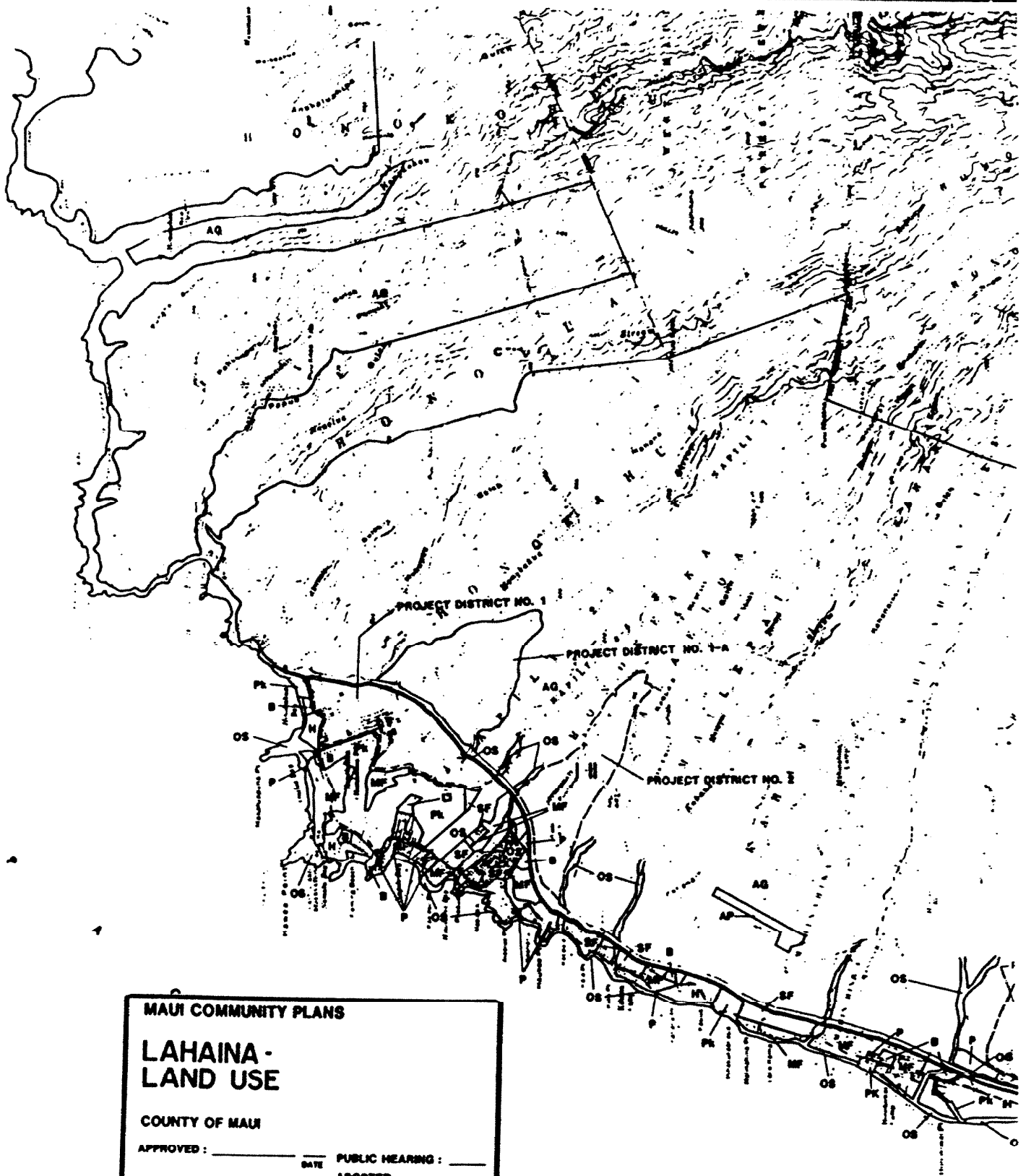
MAUI COMMUNITY PLANS

**LAHAINA
LAND USE**

COUNTY OF MAUI

APPROVED: _____ PUBLIC HEARINGS: _____
 DATE: _____ ADOPTED: _____
 APPROVED: _____ COMPLIANCE: _____
 DATE: _____ REVIEWED: _____





MAUI COMMUNITY PLANS

LAHAINA - LAND USE

COUNTY OF MAUI

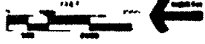
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ADOPTED: _____

APPROVED: _____ PLANNING DIRECTOR DATE _____ ORDINANCE: _____

DATE: _____

REVISED: _____

GRAPHIC SCALE

 0 100 200 FEET

I S L A N D O F M O L O K A I

COMMUNITY PLAN EXHIBITS

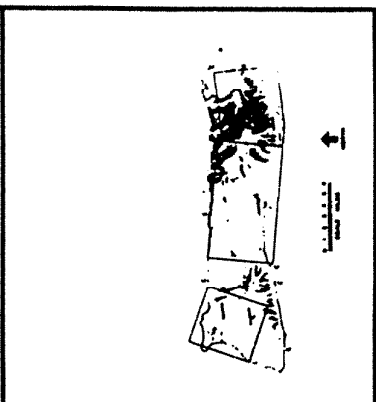
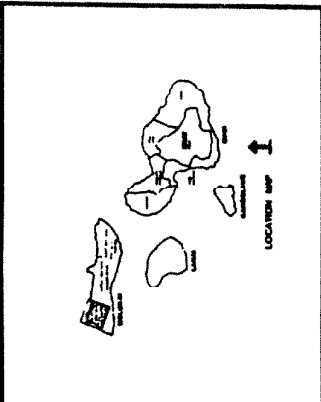
LEGEND

LAND USE:

- Conservation
- Agriculture
- Open Space
- Single-Family Residential
- Multi-Family Residential
- Business/Commercial
- Light Industrial
- Heavy Industrial
- Hotel/Resort
- Manufacturing
- Public
- Park

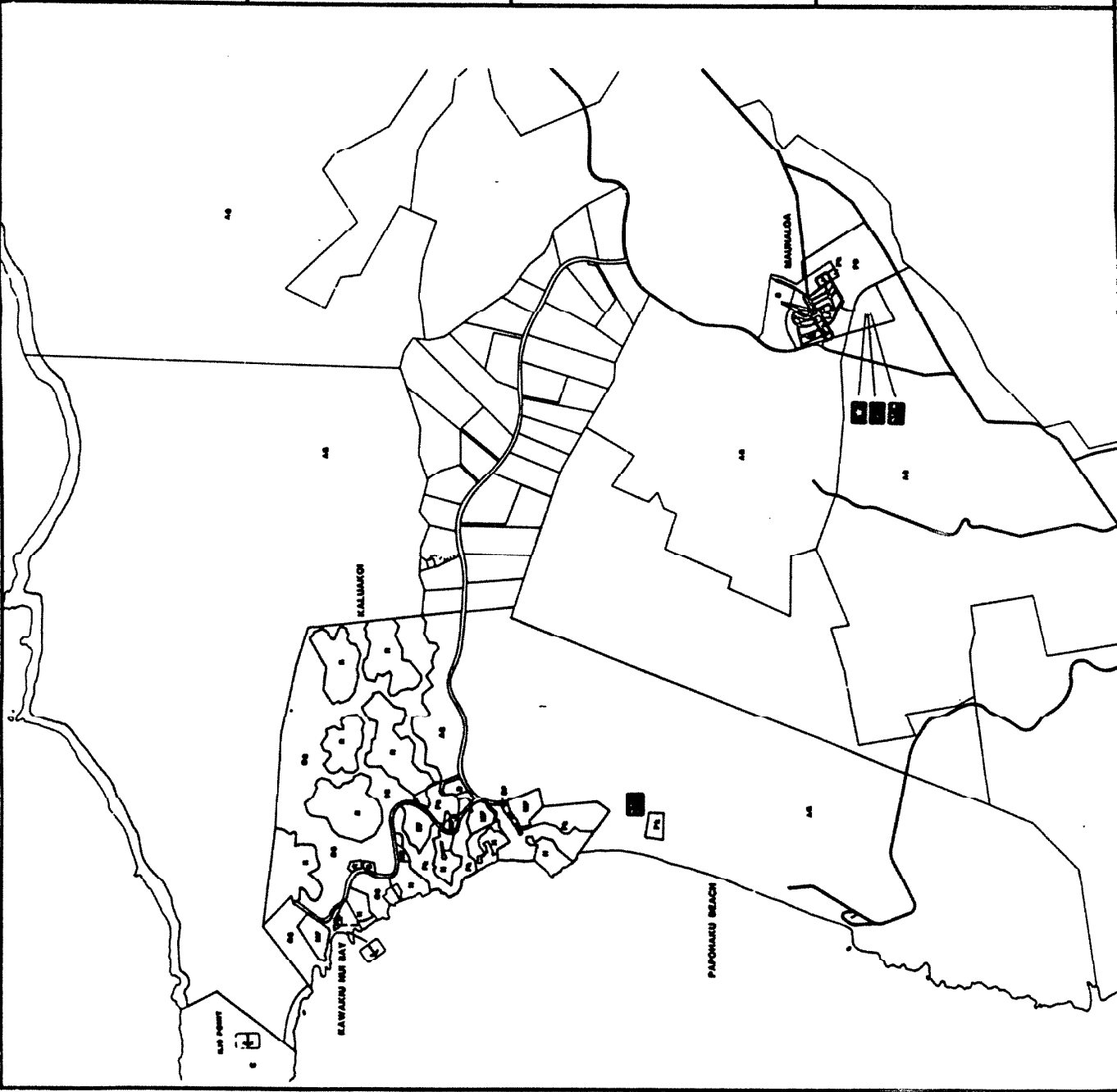
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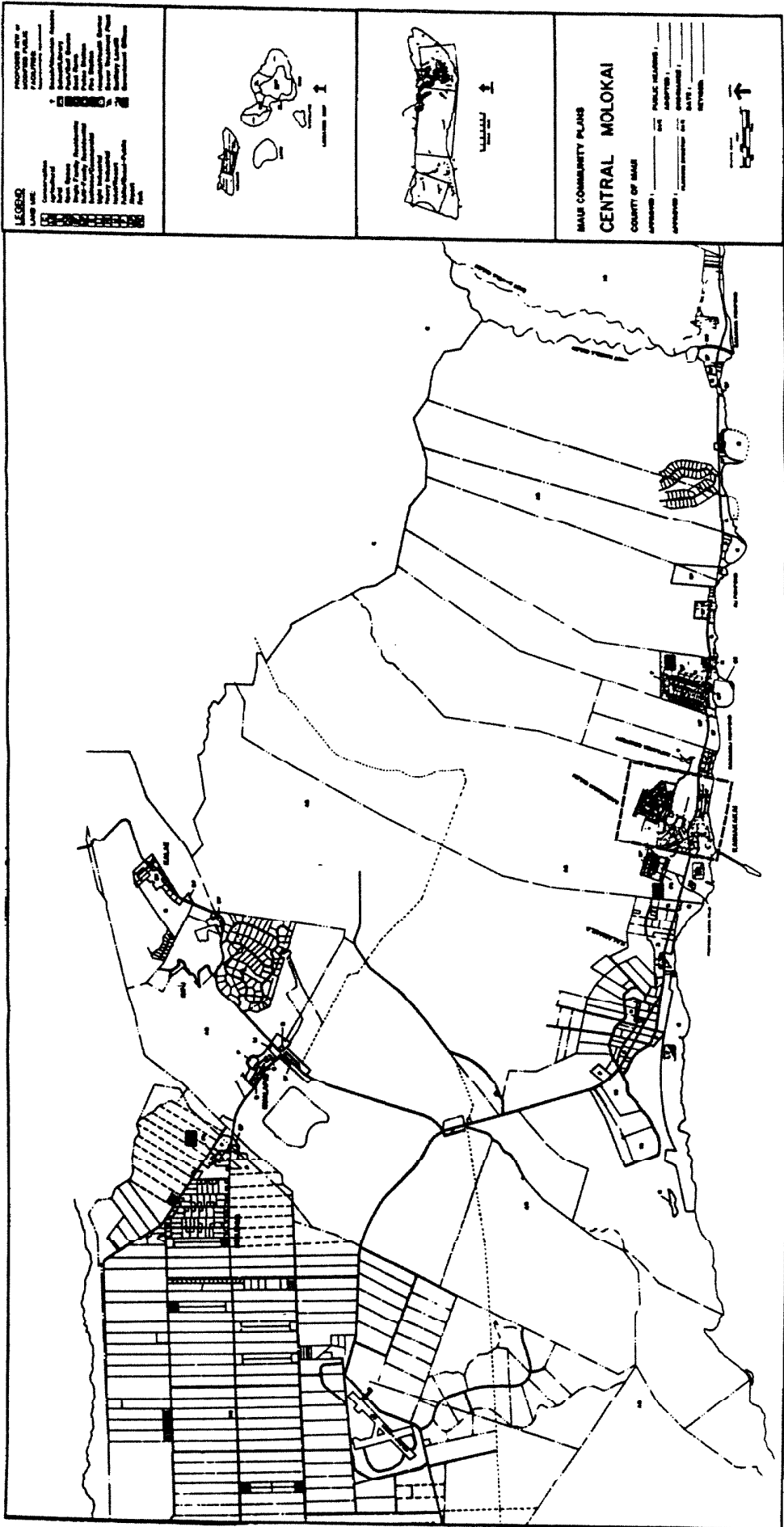
- Beach/Beachfront Access
- Public Building
- Park/Club/Center
- Post Office
- Police Station
- Public Storage
- Fire Station
- Hospital/Health Center
- Senior Treatment Plant
- Sanitary Landfill
- Government Office



MAUI COMMUNITY PLANS
WEST MOLOKAI
 COUNTY OF MAUI

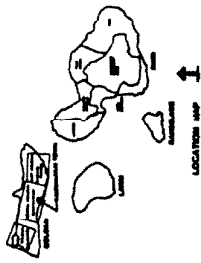
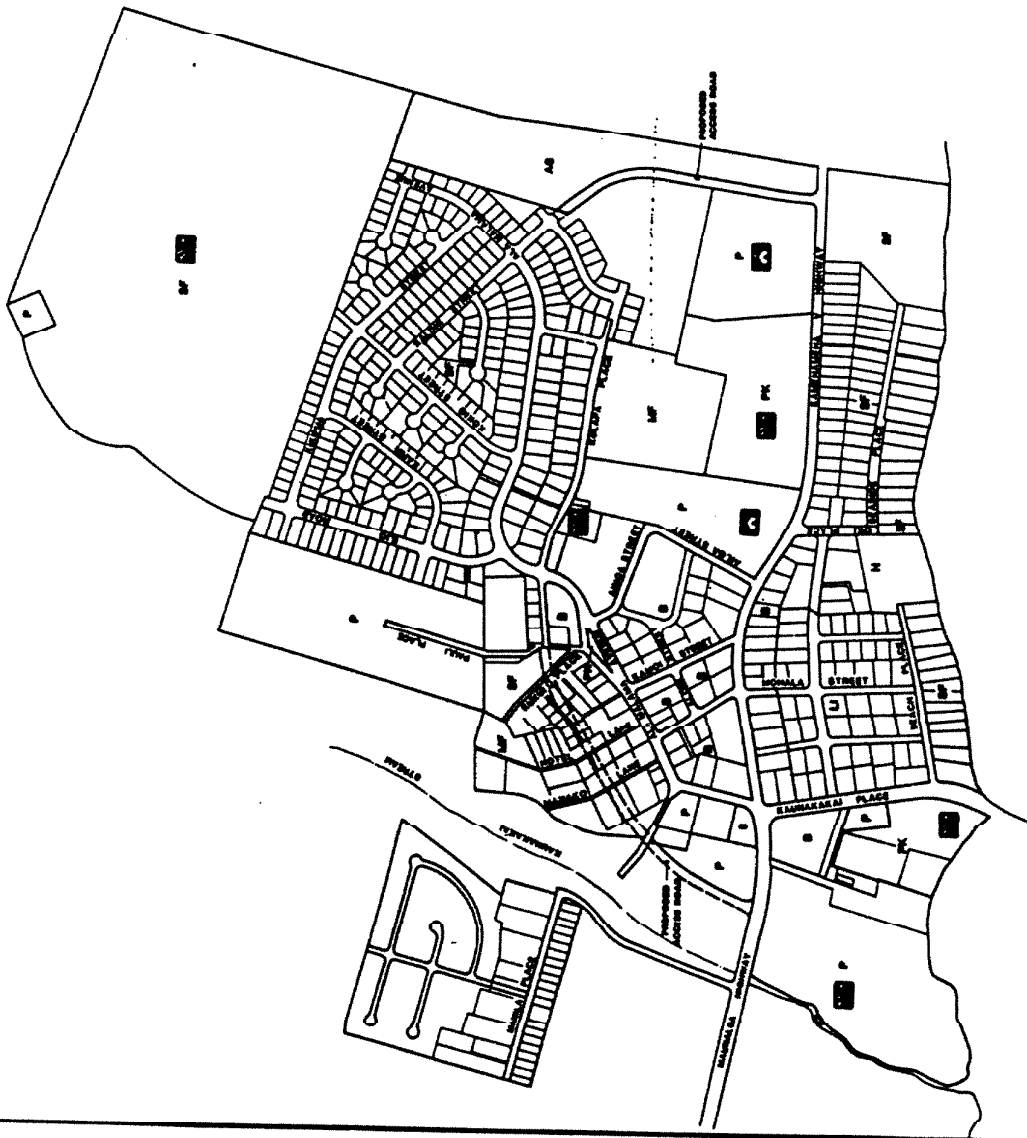
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 ADOPTED: _____ ORDNANCE: _____
 PLANNING DIRECTOR DATE: _____
 REVISION: _____





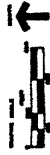
LEGEND
LAND USE:
 C1 Conservation
 A1 Agricultural
 R1 Rural
 G1 Open Space
 SF Single-Family Residential
 MF Medium-Density Residential
 LI Light Industrial
 HI Heavy Industrial
 HO Hotel/Hotel-Resort
 PU Public/Quasi-Public
 AP Airport
 PA Park

PROPOSED NEW or MODIFIED PUBLIC FACILITIES:
 Government Incinerator
 Beach/Mantle Access
 School/Library
 Park/Club/Center
 Air Station
 Public Station
 Fire Station
 Hospital/Health Center
 Sewer Treatment Plant
 Sanitary Landfill
 Government Office

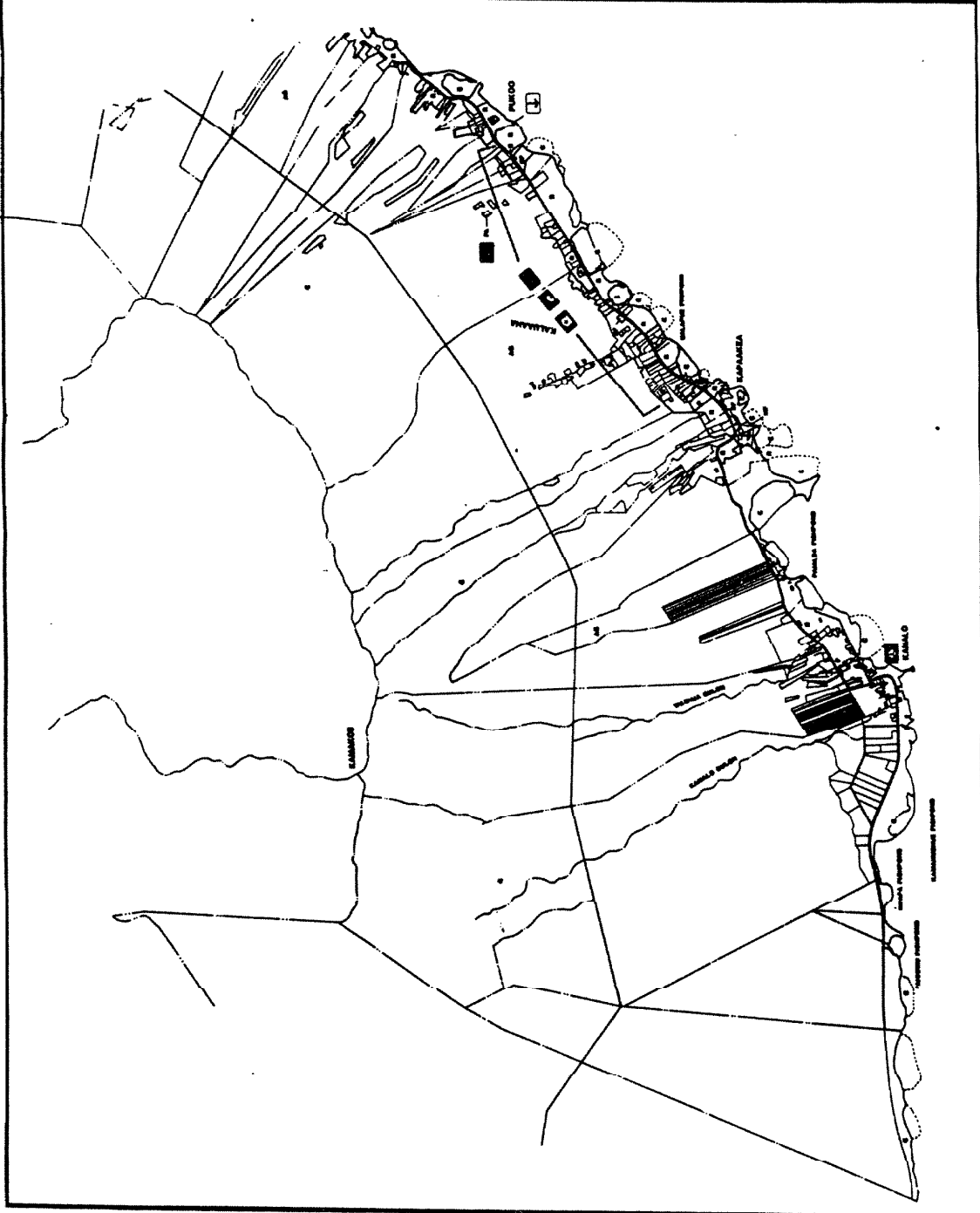


**MAUI COMMUNITY PLANS
 MOLOKAI -
 KAUNAKAKAI TOWN
 COUNTY OF MAUI**

APPROVED: _____ DATE _____ PUBLIC HEARING: _____
 ADOPTED: _____
 APPROVED: _____ PLANNING DIRECTOR DATE: _____
 REVIEWED: _____



<p>LEGEND</p> <p>LAND USE:</p> <ul style="list-style-type: none"> Industrial Commercial Residential Office Medium Density Residential High Density Residential Public Highway Highway Interchange Highway Station Public/Quasi-Public Agriculture Forest 	<p>PROPOSED NEW & MODIFIED PUBLIC FACILITIES:</p> <ul style="list-style-type: none"> 1 School 2 Library 3 Post Office 4 Fire Station 5 Police Station 6 Hospital/Clinic 7 Day Care 8 Senior Center 9 Community Office 	<p>MAUI MAP</p>	<p>EAST MOLOKAI MAP</p>	<p>MAUI COMMUNITY PLANS</p> <p>EAST MOLOKAI</p> <p>COURT OF MAUI</p> <p>APPROVED: _____ DATE: _____</p> <p>ADOPTED: _____ DATE: _____</p> <p>PUBLIC HEARING: _____ DATE: _____</p> <p>PLANNING DIRECTOR: _____</p> <p>COMMUNITY DEVELOPMENT DIRECTOR: _____</p> <p>PLANNING COMMISSION: _____</p> <p>PLANNING BOARD: _____</p>
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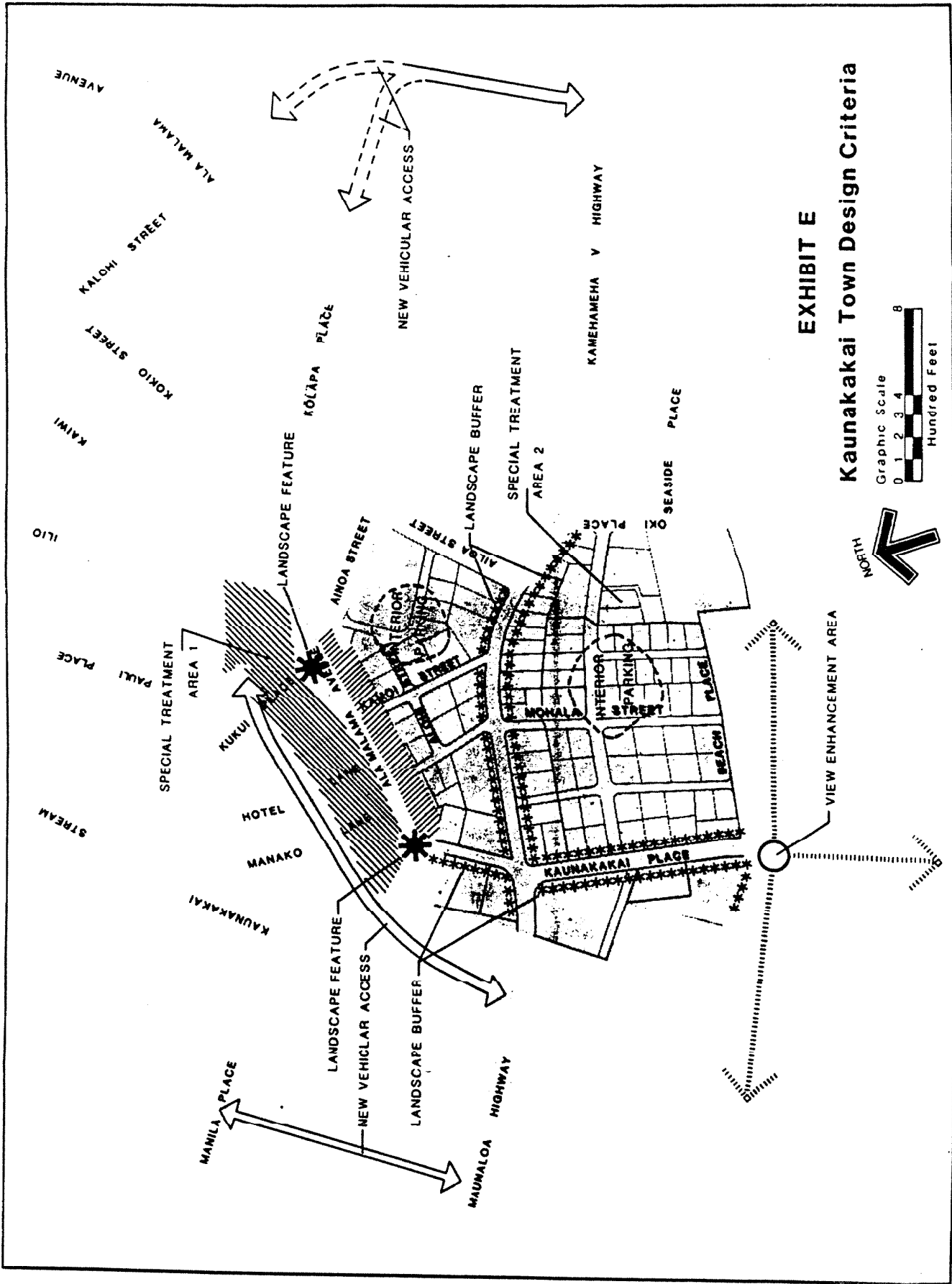
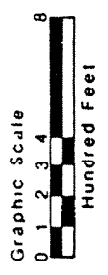
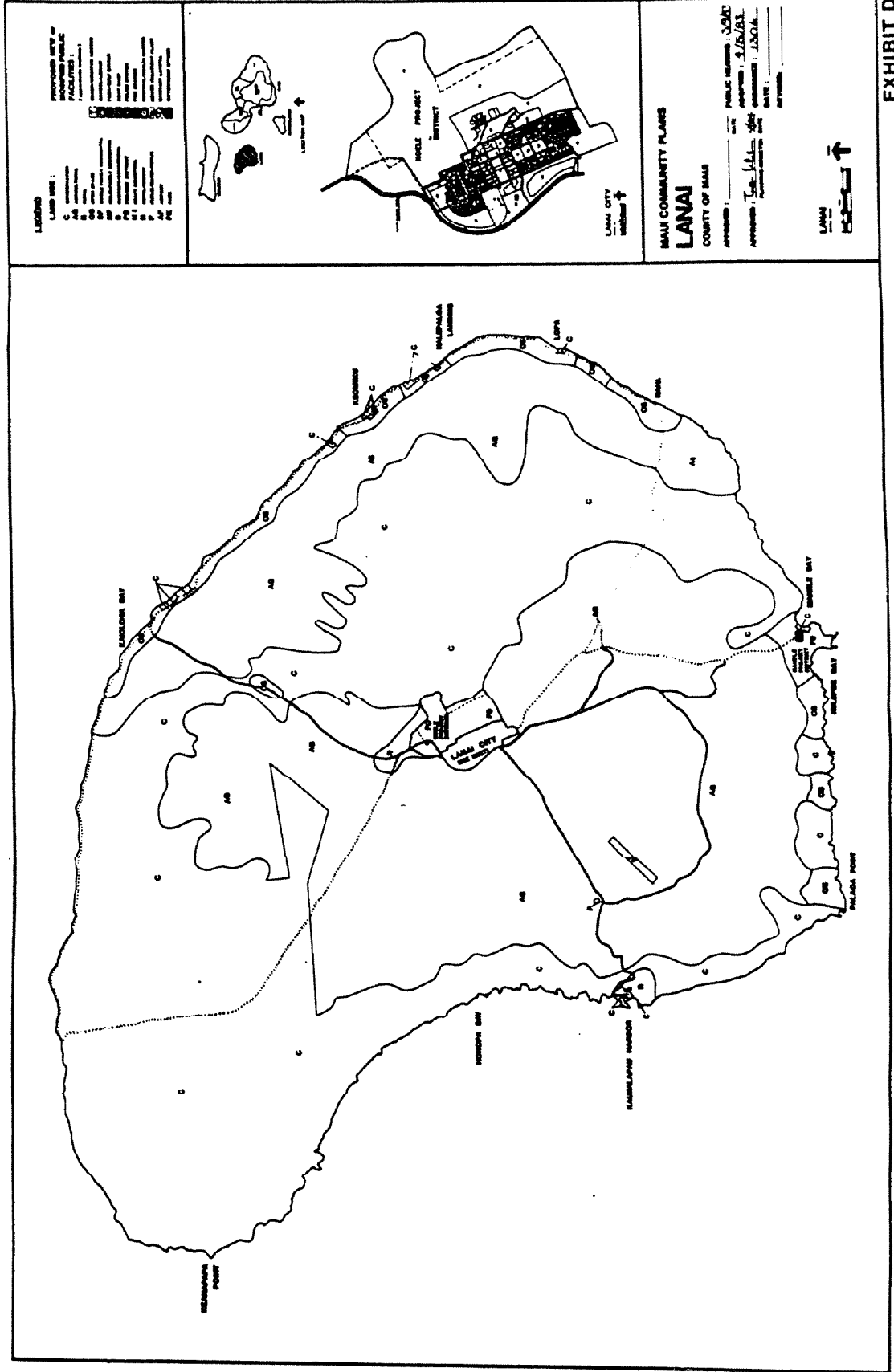


EXHIBIT E
Kaunakakai Town Design Criteria



I S L A N D O F L A N A I

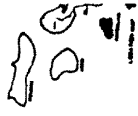
COMMUNITY PLAN EXHIBITS



I S L A N D O F K A H O ' O L A W E

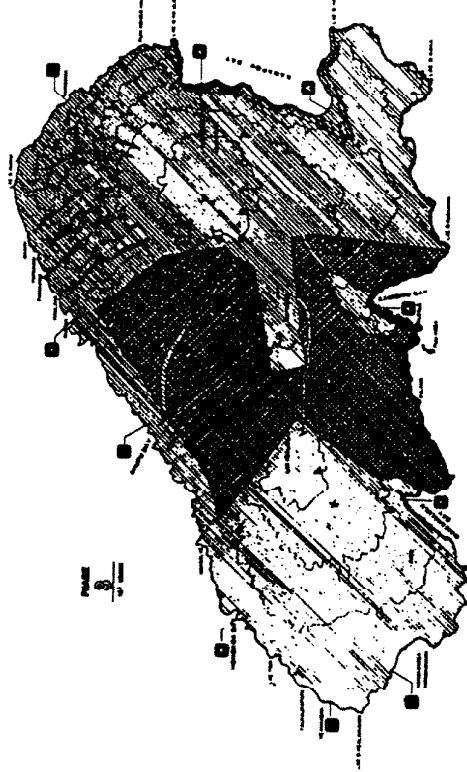
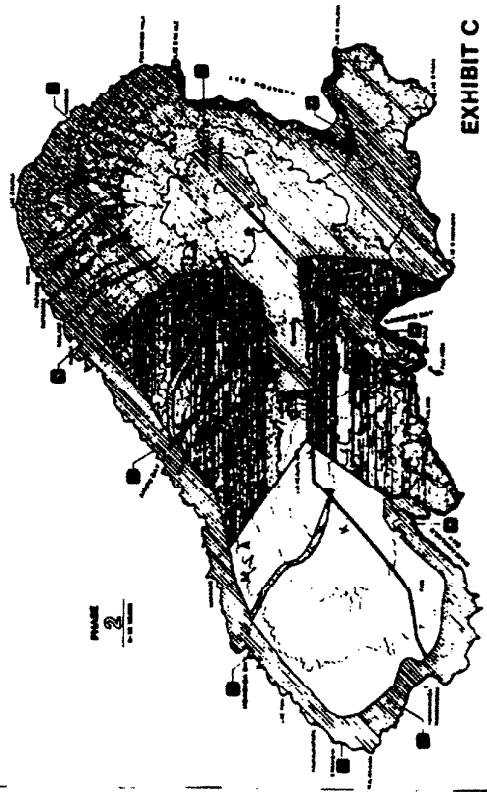
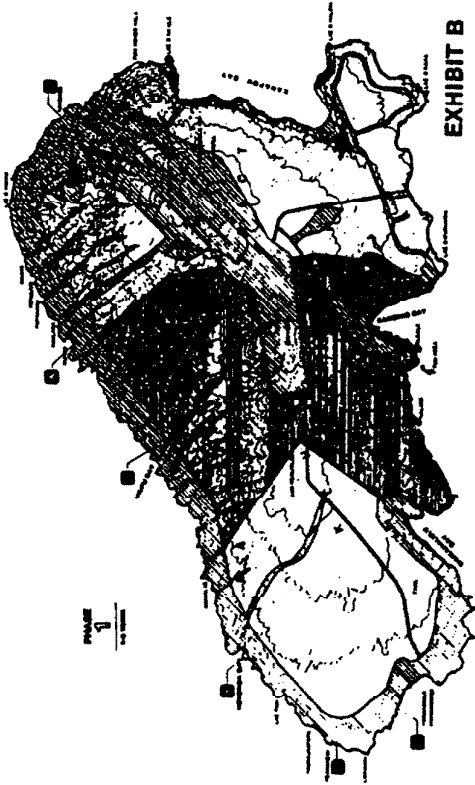
COMMUNITY PLAN EXHIBIT

LEGEND:
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MAUI COMMUNITY PLANE
KAHOOLAWE
 COUNTY OF MAUI
 ADDRESS: [Illegible]
 [Illegible]

KAHOOLAWE



A P P E N D I X C

AQUIFER CLASSIFICATION

AND

SUSTAINABLE YIELD

AQUIFER CLASSIFICATION
AND
ESTIMATES OF SUSTAINABLE YIELD
BY AQUIFER SYSTEMS

The following explanations on aquifer classification and sustainable yields are from the State Water Resources Protection Plan, Volume 1, by George A. L. Yuen & Associates, Inc., Jan. 1990, p. 91-96. Further explanations of sustainable yield by aquifer systems are included in the report.

AQUIFER CLASSIFICATION

A consistent scheme of classification and nomenclature for the aquifers of the State of Hawaii has been created to assist in planning studies. The effort was initiated several years ago by the State Department of Health in response to US Environmental Protection Agency directives and is being formulated by the Water Resources Research Center of the University of Hawaii.

Aquifer Classification starts with an island as the largest component in the hierarchy, followed by Aquifer Sectors and Aquifer Systems. Eventually Aquifer Types and Aquifer Units will be identified, but for general planning purposes the Sector-System categories are sufficient.

Each island is divided into Aquifer Sectors which reflect broad hydrogeological similarities yet maintain traditional hydrographic, topographic and historical boundaries where possible. Aquifer Systems are more specifically defined by hydraulic continuity among aquifers in the system.

Each island is identified by its USGS number (1 = Niihau; 2 = Kauai; 3 = Oahu; 4 = Molokai; 5 = Lanai; 6 = Maui; 7 = Kahoolawe; and 8 = Hawaii) as the first digit in the Aquifer Code, followed by two digits for an Aquifer Sector, followed by two more digits for an Aquifer System. Sectors and Systems are also assigned names. Hawaiian place names are preferred, but for some Sectors geographic orientation such as North, East, South, West, Central and Windward are required for clarity. All Aquifer Systems have Hawaiian names.

SUSTAINABLE YIELD

Sustainable yield refers to the forced withdrawal rate of groundwater that could be sustained indefinitely without affecting either the quality of the pumped water or the volume rate of pumping. It depends upon the head selected as the minimum allowable during continuous pumping. Head is the elevation of the unconfined water table above sea level. There is not a unique value for sustainable yield; the value depends on the head that will preserve the integrity of the groundwater resource at the level decided upon by the manager.

Sustainable yield is equal to a fraction of the recharge. In basal lens the fraction is usually more than half and sometimes greater than three fourths where initial heads are high. In high level aquifers about three fourths of the recharge can be taken as sustainable yield.

The simplest way to understand the behavior of a groundwater system from the management point of view is to treat the system as a single unit exhibiting global rather than local response behavior. At the equilibrium state, global sustainable yield depends on the initial head, the rate of recharge and the selected equilibrium head. A sustainable yield exists for each value of an equilibrium head between the limits of head greater than zero (0) and less than the initial head. Sustainable yield is always less than recharge. If it were to equal or exceed recharge, head would eventually go to zero because outflow from the aquifer is a combination of

natural leakage and draft. For a sustainable yield to exist, a balance must be established among leakage, which is controlled by head, draft and recharge.

Sustainable Yield Estimates

Good estimates of sustainable yield need a reliable data base. In most of the State not enough is known about the extent and behavior of groundwater to allow more than a weak estimate of sustainable yields. Only in Southern Oahu, Lanai and West Maui, where many years of investigation have been devoted to unravelling the complexities of groundwater occurrence, can the sustainable yields be accepted with confidence.

The sustainable yield estimated for each Aquifer System in the State is based on a simple pre-development water balance equation. The output components of runoff, evapotranspiration and infiltration are equated to rainfall as follows:

$$P = ET + RO + I$$

in which P is average rainfall, ET is average evapotranspiration, RO is average runoff and I is average infiltration (recharge). The balance was computed for each Aquifer System using averages based on the data record. The averages incorporate high level and basal aquifer regions but exclude caprock areas.

The estimates were limited to basal aquifer conditions except where high level groundwater is dominant or reaches to the coast. The typical sequence of aquifers in the Hawaiian

Island is from a zone of high level water in mountainous regions to a basal aquifer terminating either at the coast or beneath caprock some distance off the coast. Groundwater in the high level aquifers passes into basal aquifers. Where groundwater is removed directly from a high level source, the sustainable yield calculated for the basal aquifer must be reduced.

The estimates of sustainable yield are not meant to be an exact number which could be used in final planning documents. The estimates are constrained not only by the scanty data base but also by the fact that they do not consider the feasibility of developing the groundwater. The estimates should be not be equated to developable groundwater. In many regions, taking advantage of a high estimate would not be economically feasible.

Considerations restricting the unqualified use of the sustainable yield estimates are as follows:

1. The estimate is computed by the water balance method for pre-development conditions. This means that transfer of water from one Aquifer System to another for irrigation is not taken into account in the System affected by recharge from surplus irrigation.

2. The sustainable yield is correlated with an equilibrium head chosen on the basis of experience in the islands. The experience may not be relevant to a given aquifer, however. An equilibrium head higher than the one selected would result in a lower sustainable yield, and the converse would be true for a small equilibrium head.

3. Assumptions about the state of an aquifer may be faulty, in particular a value for the initial head.

4. Sustainable yield is calculated as the total supply developable. In most cases the estimate would be potable where optimal extraction techniques were employed, but in some instances none of the estimate would be potable.

5. The sustainable yield estimate should not be equated to feasibly developable water, either technically or economically.

In view of the above limitations, the sustainable yield estimates should be used as a guide in planning rather than an inflexible constraint.

A P P E N D I X D

**SUMMARIES OF WITHDRAWALS
BY AQUIFERS**

SUMMARY OF WITHDRAWALS BY AQUIFERS

ISLAND OF MAUI

LAHAINA AQUIFER SECTOR

WAILUKU AQUIFER SECTOR

CENTRAL AQUIFER SECTOR

KOOLAU AQUIFER SECTOR

HANA AQUIFER SECTOR

KAHIKINUI AQUIFER SECTOR

MUNICIPAL AND MAJOR PRIVATE DOMESTIC SYSTEMS

ISLAND OF MOLOKAI

MUNICIPAL AND PRIVATE DOMESTIC SYSTEMS

AGRICULTURAL SYSTEMS

SUMMARY OF WITHDRAWALS

WITHDRAWAL FROM LAHAINA AQUIFER SECTOR

This aquifer sector has been described by the former USGS Aquifer boundaries; i.e., Sector A, B, C. Sustainable yields have been calculated by Dr. John Mink based on the water use and development plans of Lahaina municipal, domestic, and agricultural water systems and is shown in the following table. Some adjustments will be made for the Kapalua domestic groundwater withdrawal.

Sustainable Yield and Average Demand (MGD)
Sectors A and B, Lahaina District, West Maui (5/21/89)

	<u>1987 A</u>	<u>1987 B</u>	<u>1987 Tot.</u>	<u>2000 A</u>	<u>2000 B</u>	<u>2000 Tot.</u>	<u>2010 A</u>	<u>2010 B</u>	<u>2010 Tot.</u>
County	2.6	0.5	3.1	3.7	3.5	7.2	4.8	3.5	8.3
Kapalua	0.0	0.0	0.0	0.7	0.0	0.7	0.9*	0.0	0.9
Kaanapali	0.0	2.6	2.6	0.0	6.7	6.7	0.0	6.7	6.7
Tot. Domestic	2.6	3.1	5.7	4.4	10.2	14.6	5.7	10.2	15.9
Kaanapali Irr. net	0.0	1.2	1.2	0.0	1.8	1.8	0.0	1.8	1.8
PMCo. Net Irr.	0.0	11.8	11.8	0.0	5.2	5.2	0.0	5.2	5.2
Tot. Demand	2.6	16.1	18.7	4.4	17.2	21.6	5.7	17.2	22.9
Sust. Yield	11.0	22.0	33.0	11.0	22.0	33.0	11.0	22.0	33.0
Surplus	8.4	5.9	14.3	6.6	4.8	11.4	5.3	4.8	10.1

Without irrigated agriculture and transfer of Honokohau Ditch water from Sector A to B, the sustainable yield of Sector A would be 16 MGD and that of Sector B would be 18 MGD, a total of 34 MGD.

*To be adjusted for Kapalua plans.

WITHDRAWAL FROM WAILUKU AQUIFER SECTOR

Groundwater from the Iao aquifer system of the Wailuku sector is the source for the Central Maui water system. After average daily withdrawals reach 18 million gallons per day, withdrawals will be from the adjacent Waihee aquifer system. Then after a present plan to withdraw 4 million gallons per day from the Waihee Aquifer System, the Central water system will withdraw from the Koolau sector-Haiku aquifer system.

Groundwater withdrawal from Waihee aquifer of 0.2 MGD is for agricultural lots is planned by year 2010.

Total surface water withdrawals for agriculture was an average of 107.3 million gallons per day in 1987. An average of 28.3 million gallons per day was transferred from the Wailuku aquifer sector to the Central sector.

For the year 2010 total surface withdrawals of 107.3 MGD is based on 1987 flows. Wailuku Agribusiness projects an average irrigation requirement of 45 MGD by year 2010. The increase of 18.7 MGD over 1987 will decrease other diversions from WAB by a similar amount.

WITHDRAWAL FROM CENTRAL AQUIFER SECTOR

The major withdrawal from the Central aquifer sector is groundwater.

The average total groundwater withdrawal for crop and non-crop agriculture was 170.8 million gallons per day in 1987.

The average total withdrawal for crop and non-crop agriculture for the year 2010 will be an estimated 173 million gallons per day.

Transfer

Transfer of water from other aquifer sectors to the Central Aquifer Sector (for agriculture) for the years 1987 and 2010 are as follows:

<u>From Aquifer Sector-System</u>	<u>1987</u>	<u>2010</u> <u>Unit: MGD</u>
Wailuku-Waihee	28.3	29.5
Koolau-Combination	164.2	164.2

WITHDRAWAL FROM KOOLAU AQUIFER SECTOR

Withdrawals from this aquifer sector in 1987 was 164.2 million gallons per day for agriculture and 5.4 million gallons per day for municipal water systems.

The County of Maui plans groundwater withdrawals of 8.5 MGD from the Haiku system by the year 2010.

The County of Maui plans surface water withdrawals from the combination--Honopou, Waikamoi, Keanae Systems--to increase from 5.4 MGD in year 1987 to 13.4 MGD in year 2010.

WITHDRAWAL FROM HANA AQUIFER SECTOR

Withdrawals for Hana aquifer sector was an average of 0.2 million gallons per day for municipal systems.

The County of Maui projects withdrawals to increase to 0.3 MGD by the year 2010.

WITHDRAWAL FROM KAHIKINUI AQUIFER SYSTEM

Total withdrawals were 100,000 gallons per day in 1987.

No change is projected up to the year 2010.

WITHDRAWAL FOR
MUNICIPAL AND MAJOR PRIVATE
DOMESTIC SYSTEM

The following tables show the withdrawals for municipal and major private water systems by aquifer sectors and systems and by surface (s) and ground (g) sources.

MUNICIPAL and PRIVATE WATER SYSTEM WITHDRAWALS
by aquifer sectors and systems

	KAPALUA		KAHAHALA		KAHAHAHA		CENTRAL		KAHAHAHA		KULA		KAHA		OTHER		TOTAL		
	S	G	S	G	S	G	S	G	S	G	S	G	S	G	S	G	S	G	
AQUIFER																			
WAILUKU SECTOR																			
WAIKAPU SYSTEM																			
IAO SYSTEM							15.1												15.1
WAIKER SYSTEM																			
KAHAKALOHA SYSTEM																			
CENTRAL SECTOR																			
KAHULUI SYSTEM																			
PAIA SYSTEM																			
COMBINE SYSTEMS:																			
KAHAHAHA																			
KAHAHAHA																			
KOOLAHO SECTOR																			
KAHAHAHA SYSTEM									0.2										0.2
COMBINE SYSTEMS:									2.2*		3.0								5.2
HOHOPOU																			
WAIKAMOI																			
KAHAHAHA												0.0							
KAHA SECTOR																			
KAHAHAHA												0.1	0.1					0.1	0.1
COMBINE SYSTEMS:																			
KAHAHAHA																			
WAIKAMOI																			
KIPAHULA																			
KAHAHAHA SECTOR																			
A	0.6				1.2	2.7												1.8	2.7
B				2.5	1.3	0.5									0.3			1.6	3.0
C															0.1			0.1	
TOTAL BY WATER SYSTEM	0.6	0.0		2.5	2.5	3.2	15.1	2.4		3.0		0.1	0.1	0.4			9.0	20.9	
*does not include																			
0.2 mgd pumped up from Kahaha to Kula.																			
																			29.9

MUNICIPAL and PRIVATE WATER SYSTEM WITHDRAWALS
by aquifer sectors and systems

	YEAR 2010														TOTAL												
	unit:mgd																										
	KAPALUA (private)		KAHAHAPALI (private)		LAHAINA municipal		CENTRAL		MAKAHANO		KULA		KAHA		OTHER												
S	G	S	G	S	G	S	G	S	G	S	G	S	G	S	G	S	G										
AQUIFER																											
WAILUKU SECTOR																											
WAIKAPU SYSTEM																											
IAO SYSTEM																											
WAIHEE SYSTEM																											
KAHAHALOA SYSTEM																											
CENTRAL SECTOR																											
KAHULUI SYSTEM																											
PAIA SYSTEM																											
COMBINE SYSTEMS:																											
MAKAHANO																											
KAHOLE																											
KOOLAU SECTOR																											
HAIEU SYSTEM																											
COMBINE SYSTEMS:																											
HOHOPU																											
WAIRAMOI																											
KAHAHA																											
KAHA SECTOR																											
KAHAIPAPA																											
COMBINE SYSTEMS:																											
KUHINA																											
HAIROI																											
KIPAHULU																											
LAHAINA SECTOR																											
A		2.2		1.2		4.0										1.2		7.0									
B				6.7		1.3		3.5								0.1		1.4		10.2							
C																0.1		0.1									
TOTAL BY WATER SYSTEM		0.0		2.2		6.7		2.5		0.3		30.5		5.3		0.1		0.0		0.0		0.2		16.1		40.1	

* does not include

.2 mgd pumped up from Kahaloa to Kula

64.2

ISLAND OF MOLOKAI

WITHDRAWALS FOR MUNICIPAL AND
PRIVATE DOMESTIC SYSTEMS

The following tables show the withdrawals for municipal and private water systems by aquifer sectors and systems and by surface (s) and ground (g) sources for the years 1988 and 2010.

ISLAND OF MOLOKAI
TOTAL WATER SYSTEM WITHDRAWALS
YEAR 1988 unit:mgd YEAR 2010
SURFACE GROUND TOTAL SURFACE GROUND TOTAL

AQUIFER						
CENTRAL						
HOOLEHUA						
MAUNAWINUI						
	0.10	1.06	1.16			Incomplete
NORTHEAST						
KALAUAPAPA						
KAHANUI						
	4.84	2.70	7.54	4.80	2.70	7.50
WAIKOLU						
HAUPU						
PELEKUNU						
WAILAU						
HALAWA						
SOUTHEAST						
	0.00					
	0.03		0.03			
	0.08	0.52	0.60		0.55	0.55
		0.40	0.40		0.42	0.42
KAMILOLOA						
KAWELA						
UALAPUE						
WAIALUA						
WEST						
KALUAKOI						
PUNALOU						
	5.05	4.68	9.73	4.80		Incomplete
TOTAL						

ISLAND OF MOLOKAI
MUNICIPAL AND PRIVATE WATER SYSTEM WITHDRAWALS
YEAR 1988 Unit:MGD

	KAUHAKAHAI		VALAPOE		KALAE		HALANA		MAUHALOA		KUALAPUU		KIPO MAHANAINU		KUKUI		DEHL		KAHOLA PLANT.		SUBTOTAL		TOTAL
	S	G	S	G	S	G	S	G	S	G	S	G	S	G	S	G	S	G	S	G	S	G	
AQUIFER																							
CENTRAL																							
HOOLEHUA																							
MAHANAINU																							
KUALAPUU					0.03						0.03	0.06	0.04		0.60	0.40				0.10	1.06	1.16	
NORTHEAST																							
KALAPAPA																							
KAHANUI																							
WAIKOLA	0.37								0.04											0.41		0.41	
HAPU																							
PELEKUU																							
WAILAO																							
HALANA							0.00														0.00		0.00
SOUTHEAST																							
KAMIOLOA									0.03												0.03		0.03
KAHOLA	0.32								0.05	0.03										0.16	0.08	0.48	0.56
VALAPOE			0.18																			0.18	0.18
WAIALUA																							
WEST																							
KALUAKOI																							
PUHALOU																							
TOTAL	0.37	0.32	0.18	0.03	0.00		0.12		0.06	0.06	0.04		0.60	0.40	0.16	0.62	1.72		2.34				

ISLAND OF MOLOKAI

WITHDRAWALS FOR AGRICULTURAL SYSTEMS

The following tables show withdrawals for agricultural systems by aquifer sectors and systems and by surface (s) and ground (g) sources for the year 1988. The summary for year 2010 is shown identical to year 1988.

ISLAND OF MOLOKAI
TOTAL AGRICULTURAL WATER SYSTEM WITHDRAWALS
YEAR 1988 unit:MGD

	KAMALO RANCH	MIS*	MOLOKAI RANCH	SUBTOTAL	TOTAL
	S	G	S	G	

	KAMALO RANCH	MIS*	MOLOKAI RANCH	SUBTOTAL	TOTAL
	S	G	S	G	
AQUIFER					
CENTRAL					
HOOLEHUA					
MAUNAWINUI					
KUALAPUU					
NORTHEAST					
KALAUPAPA					
KAHANUI					
WAIKOLU		4.43	2.70	4.43	7.13
HAUPU					
PELEKUNU					
WAILAU					
HALAWA					
SOUTHEAST					
KAMILOLOA					
KAWELA		0.04		0.04	0.04
UALAPUE		0.22		0.22	0.22
WAIALUA					
WEST					
KALUAKOI					
PUNALOU					
TOTAL	0.26	4.43	2.70	4.43	7.39

*MIS-Estimate for surface and groundwater:

1. Total MIS flow- 7.5 MGD (Fukunaga Report, 1989)
2. East portal pumps(2)- 1.8 MGD (Belt, Collins, Inc. Report 1982)
3. Assume pump within tunnel- 0.9 MGD
4. Then: groundwater = 2.7 MGD
surface water is (7.5-2.7)= 4.8 MGD.
4.8-0.37(Kaunakakai tap from MIS)

ISLAND OF MOLOKAI										
TOTAL AGRICULTURAL WATER SYSTEM WITHDRAWALS										
YEAR 2010 unit:MGD										
KAMALO RANCH		MIS		MOLOKAI RANCH		SUBTOTAL		TOTAL		
S	G	S	G	S	G	S	G			
AQUIFER										
CENTRAL										
HOOLEHUA										
MAUNAWINUI										
KUALAPUU										
NORTHEAST										
KALAUPAPA										
KAHANUI										
		4.80	2.70			4.80	2.70	7.50		
WAIKOLU										
HAUPU										
PELEKUNU										
WAILAU										
HALAWA										
SOUTHEAST										
KAMILOLOA										
		0.04				0.04		0.04		
KAWELA										
		0.22				0.22		0.22		
UALAPUE										
WAIALUA										
WEST										
KALUAKOI										
PUNALOU										
TOTAL		0.26	4.80	2.70			4.80	2.96	7.76	

*included with surface total