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WAILUKU RIVER HYDROELECTRIC PROJECT

FINAL

ENVIRONMENTAL IMPACT STATEMENT

AUGUST 1989

Kahala Energy Development Corporation

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FINAL

ENVIRONMENTAL IMPACT STATEMENT

WAILUKU RIVER

HYDROELECTRIC PROJECT

Prepared and submitted by:

KRP Information Services
Honolulu, Hawaii

Jacqueline A. Parnell, AICP
General Partner

for:
Kahala Energy Development Corporation

AUGUST 1989

FINAL

ENVIRONMENTAL IMPACT STATEMENT

PROJECT:	WAILUKU RIVER HYDROELECTRIC PROJECT
LOCATION:	SOUTH HILO DISTRICT ISLAND OF HAWAII
APPLICANT:	KAHALA ENERGY DEVELOPMENT CORPORATION 820 MILILANI STREET, SUITE 701 HONOLULU, HAWAII 96813
ACCEPTING AUTHORITY:	BOARD OF LAND AND NATURAL RESOURCES P. O. BOX 621 HONOLULU. HAWAII 96809
CONSULTANT:	KRP INFORMATION SERVICES 1314 SOUTH KING STREET, SUITE 951 P.O. BOX 27506 HONOLULU, HAWAII 96827 (808) 545 3633 CONTACT PERSON: JACQUELINE A. PARNELL

CHANGES MADE IN FINAL EIS
IN RESPONSE TO COMMENTS ON DRAFT EIS

A modified rail transport system has been developed as an alternative to constructing the access road above Kahoama Stream. This is described in Chapter II and illustrated in Exhibit II-2A. Exhibits II-3A and II-3B have been added to illustrate the types of bridges that will be built. The site acreage has been increased from 47 to 52 acres to allow for the possibility of on-site storage.

A new map has been added (Exhibit III-7) showing Conservation District boundaries in the project area. Minor word changes have been made in several sections in response to comments and to correct errors.

Two additional appendices are included. Appendix C consists of the report on the additional field studies and stream flow impact analysis performed in May, 1989. Appendix D is a report of the archaeological reconnaissance study done in 1986, included in response to requests by commentors.

WAILUKU RIVER
HYDROELECTRIC PROJECT

FINAL ENVIRONMENTAL IMPACT STATEMENT

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SUMMARY

The Wailuku River Hydroelectric Power Company, Inc., a wholly-owned subsidiary of Kahala Energy Development Corporation, both Hawaii corporations, proposes to build a 10 megawatt hydropower plant along with appurtenant structures on the Wailuku River, utilizing waters from the Wailuku River and Kalohewahewa Stream.

The proposed project site is located on the eastern coast of the island of Hawaii, approximately 2.5 miles west of the town of Hilo. The project area lies between elevations of 1,000 feet and 2,000 feet within the Hilo Forest Reserve and the Hilo Closed Watershed on lands owned by the State of Hawaii. The principal waterways to be used are the Wailuku River and Kalohewahewa Stream.

The proposed project consists of three diversion structures, a powerhouse, penstocks, access roads, and a transmission line. The total project boundary area covers 52 acres. The amount of land that will be utilized by individual project components is as follows:

Kalohewahewa Diversion Structures	4 Acres
Wailuku Diversion Structure	15 Acres
Penstock and Access Roads	23 Acres
Power Plant	2 Acres
Transmission Lines	8 Acres
TOTAL	52 Acres

Two of the diversion structures will be located on branches of the Kalohewahewa Stream and one will be on the Wailuku River. The elevation of the planned diversion structures is 1940 feet above mean sea level. This is a change from plans previously submitted in the CDUA and NOP which placed the diversion structures at elevation 1545 feet The combined flows from the Kalohewahewa and the Wailuku will be transmitted via penstock to a power plant located on the right bank of the Wailuku River at elevation 1040 feet.

The maintenance of aquatic habitats is the major environmental concern associated with the project. Measures to ensure that there will be no significant adverse impacts on aquatic habitats and species have been incorporated into the design and operation features of the project.

The project will provide improved access for resource management, including control of feral pigs. The company will work with the Division of Forestry and Wildlife to develop a management program to enhance native vegetation and habitat for endangered birds in the project area.

In addition to a Conservation District Use Permit, the project will require permits from the Commission on Water Resource Management for Stream Diversion Works and Stream Channel Alteration, and approval of a petition to amend the Interim Stream Flow Standards. The project will also require a U.S. Army Corps of Engineers permit. This environmental impact statement is intended to be the principal document to support these requests.

CHAPTER I

INTRODUCTION

PROJECT

The Wailuku River Hydroelectric Power Company, Inc., a wholly-owned subsidiary of Kahala Energy Development Corporation, both Hawaii corporations, proposes to build a 10 megawatt hydropower plant along with appurtenant structures on the Wailuku River, utilizing waters from the Wailuku River and Kalohewahewa Stream. The purpose of the project is to generate electricity for use by residents of the County of Hawaii utilizing a renewable resource. The project has been designed to avoid negative impacts on stream habitats that could have resulted from a previously proposed project on the river.

PROJECT HISTORY

In 1981, the State Department of Planning and Economic Development (now the Department of Business and Economic Development or DBED), in cooperation with the U.S. Department of Energy, conducted a study on the potential for hydroelectric power production in Hawaii. This study was conducted pursuant to the state's firm commitment "to expanding its use of indigenous, renewable energy resources to replace imported petroleum." The report, *Hydroelectric Power in Hawaii: A Reconnaissance Survey*, identifies all existing hydropower facilities and the streams and rivers on the major islands with the potential for hydropower production. One of the areas identified as having a high potential for production of electricity consists of the tributaries and upper reaches of the Wailuku River on the island of Hawaii.

In 1982, the Honolulu District, U.S. Army Corps of Engineers, prepared a preliminary technical report on the Wailuku River and Honolii Stream as part of the Hilo Area Comprehensive Study. The purpose of this study was to identify, on an initial basis, the need for further investigation. In response to a request by DBED, the Corps performed site specific feasibility studies for developing hydroelectric power on the two waterways. This study, completed in 1984, concluded that hydroelectric power production on the Wailuku River was feasible.

In 1985, the Garratt-Callahan Company, a California corporation, initiated studies to prepare an environmental assessment of the area preparatory to applying for permission from the Department of Land and Natural Resources (DLNR) to divert water from Hookelekele Stream and the Wailuku river to provide water to a hydropower plant to be built downstream on the Wailuku River. During 1986, special studies, including archaeological, flora, fauna, and aquatic surveys, were conducted by Associated Engineering Consultants for Garratt-Callahan. A Conservation District Use Application (CDUA) with an accompanying Environmental Assessment was filed with DLNR on March 21, 1986, and a Notice of Preparation of an Environmental Impact

Statement (EIS) was published in the Office of Environmental Quality Control (OEQC) Bulletin on July 23, 1986.

The public review process produced a large number of constructive comments on the project. In response to these comments, and particularly on the recommendation of the aquatic biologist, the project was partially reconfigured to eliminate use of Hookelekele Stream, a habitat for o'opu. Part way through the project revision process and preparation of a draft environmental impact statement, for reasons not connected to the project, the effort was terminated. The CDUA was withdrawn in February, 1987.

In 1988, the environmental studies and other documents pertaining to the project area were acquired by Kahala Energy Development Corporation on behalf of the Wailuku River Hydroelectric Power Company. The information in these documents, updated as appropriate and necessary, provided the background information for the Environmental Assessment and Notice of Preparation of an Environmental Impact Statement published in 1988 in conjunction with a new CDUA. Additional studies and surveys have been conducted to support this environmental impact statement.

PRESENT PROJECT

Since the time of submittal of the CDUA and the Environmental Assessment by Kahala Energy, several revisions have been made to the project concept. The purpose of the proposed revisions, which will be discussed below, is to enhance the project environmentally while at the same time providing project reliability.

The major revision to the project is the relocation of the diversion works from elevation 1,545 feet upstream to elevation 1,940 feet. While this requires an increase in penstock and access road length, it provides three very beneficial enhancements. First, it locates the diversion works at an elevation in the stream channels that do not provide habitat for the *Lentipes* nor other fish species. No sightings have occurred at this elevation. Only a very limited amount of atyid shrimp, which are much more abundant at lower elevations, have been observed at elevations of 1900+ feet. Secondly, the geologic conditions of the river are much more conducive for diversion structures and diversion works. Consequently, the structures will be substantially smaller and less evident. Thirdly, at the higher elevation, less water is required to generate an equal amount of power than at the lower diversion site. This leaves more water in the streams, allows for the downsizing of the penstock, and provides more reliability to the owner and the end user.

Other modifications include the relocation of the penstock to the south of the Wailuku River. One reason for this is to avoid the slide area and fault system located in the Lauiole Falls area. While the penstock is somewhat longer, it will also be much easier to construct. The penstock was also relocated to avoid impacts to the *Lentipes* in the Hookelekele Stream during construction and maintenance of the access roads and penstock.

CHAPTER II

DESCRIPTION OF PROPOSED ACTION

PROJECT AREA

The proposed project site is located on the eastern coast of the island of Hawaii, approximately 2.5 miles west of the town of Hilo (Exhibit II-1). The topography and features of the area are depicted on the U.S. Geological Survey (USGS) Piihonua Quadrangle Map, Island of Hawaii, South Hilo District. The project area lies between elevations of 1,000 feet and 2,000 feet within the Hilo Forest Reserve and the Hilo Closed Watershed on lands owned by the State of Hawaii. The three proposed diversion structures, penstock intakes, and upper portions of the penstocks will be located within State Conservation District lands designated as subzone (P) Protected. The proposed powerhouse and lower portions of the penstocks will be located within State Conservation District lands designated as subzone (L) Limited. The principal waterways to be used are the Wailuku River and Kalohewahewa Stream. Hookelekele Stream will remain free flowing.

Because most of the area is within the Closed Watershed, access is restricted. No stream-related recreation activities are permitted. Hunting for wild pigs is allowed upon securing permission from the Department of Land and Natural Resources.

The Hawaii County Department of Water Supply maintains three intake structures and pipelines in the area. The primary intake is at Kahoama, providing approximately 6 million gallons per day (MGD). The Pukamaui and Lauiole intakes provide 1.5 MGD. Projected demand is 10 MGD. During the dry season, Kahoama plus all of the water in the Wailuku River system cannot provide enough water for the City of Hilo and a well source supplies the additional water needed.

The U.S. Geological Survey (USGS) maintains a gaging station, No. 16704000, on the right bank of the Wailuku River approximately 0.2 miles downstream from its confluence with Hookelekele Stream.

There are no electrical utilities located on the parcel. An existing 69 Kv transmission line lies approximately 5,100 feet to the east at Akolea Road. The transmission line is owned and maintained by the Hawaii Electric Light Company (HELCO). A 12 Kv line runs north and south to the east of Piihonua.

PROJECT DESCRIPTION

The project consists of three relatively small diversion structures, two on branches of the Kalohewahewa and one on the Wailuku River. The elevation of the planned diversion structures is 1940 feet above mean sea level. This is a change from plans previously submitted in the CDUA which placed the diversion strcutures at elevation

1545 feet. Water from the Kalohewahewa will be transmitted southerly, crossing the Wailuku River to a point of bifurcation on the south side of the Wailuku River. The combined flows from the Kalohewahewa and the Wailuku will then be transmitted via penstock easterly parallel to the Wailuku River, crossing the Kahoama Stream to the project power plant. The power plant will be located at the site previously proposed on the right bank of the Wailuku River at elevation 1040, approximately 1,000 feet downstream from the USGS gaging station #16704000. The location and drawings of the project are presented in Exhibits II-1 through II-7.

The electrical transmission line from the power plant will be pole mounted and extend easterly approximately 5,100 feet to connect with the existing 69 KW line on Akolea Road owned by Hawaii Electric Light Company (HELCO). If satisfactory arrangements can be made, the generated power will be sold to HELCO. Arrangements with other end users are being investigated.

Electrical power and telephone services will be required at the diversion dam sites. Facilities for said services will be installed with the penstock as shown in Exhibit II-2.

Access for the project will be obtained by utilization of existing roadways and by construction of access roads. The access roads, wherever possible, will follow the penstock and pipeline alignments.

Also, as part of this project, facilities will be installed to deliver water from the power plant tailrace to the Hawaii County Department of Water Supply facilities. The tentative point of delivery is near Reservoir #1 at approximate elevation 1000'.

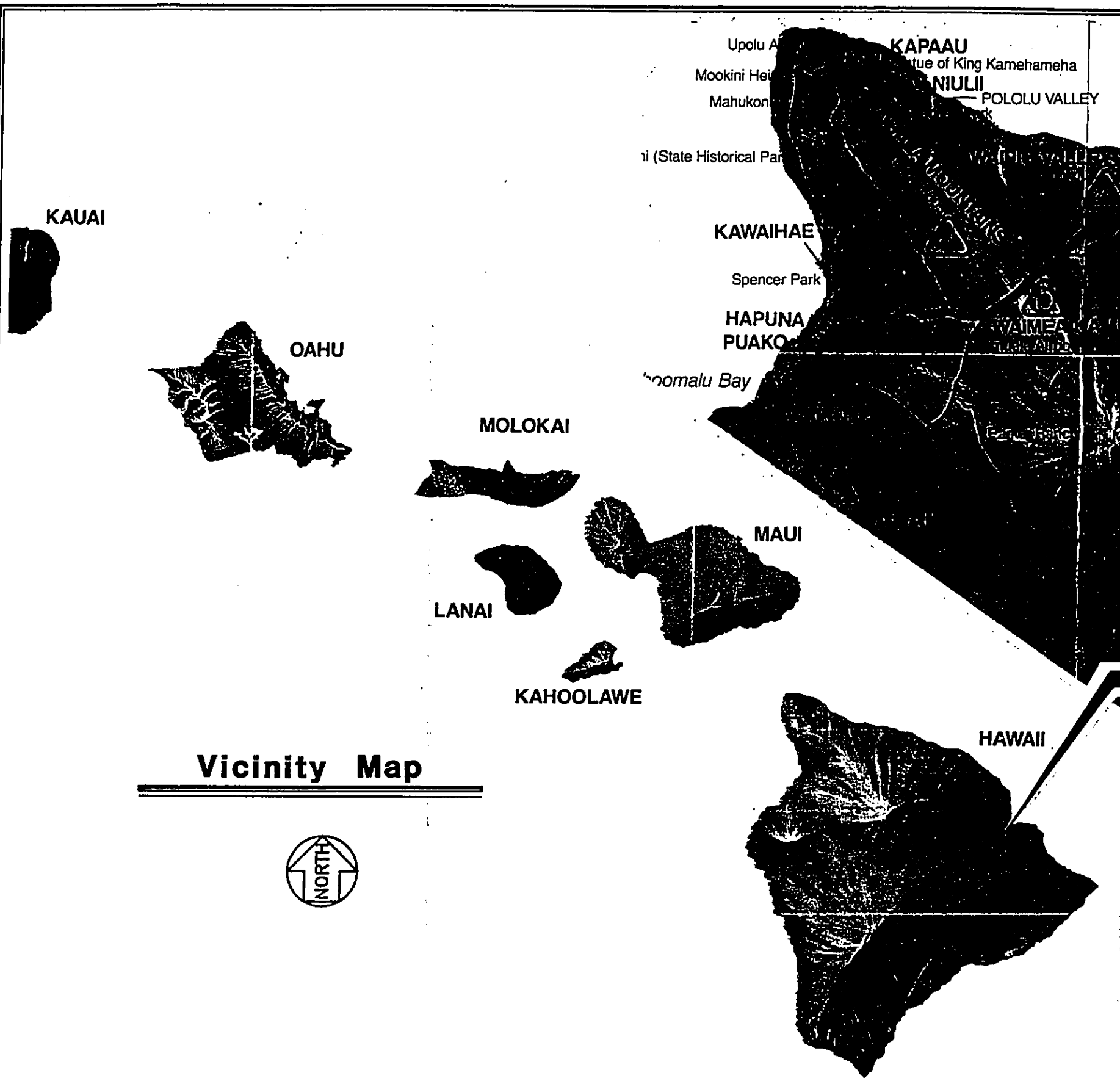
The amount of land acreage needed to construct the project is 52 acres. Individual project component needs are as follows:

Kalohewahewa Diversion Structures	4 Acres
Wailuku Diversion Structure	15 Acres
Penstock and Access Roads	23 Acres
Power Plant	2 Acres
Transmission Lines	8 Acres
TOTAL	52 Acres

DIVERSION STRUCTURES

Three diversion structures will be required for this project. Locations for the diversions are presented in Exhibit II-3. One benefit realized by the relocation of the diversion structures to the 1,940 foot elevation is the simplicity of diverting at these locations. Larger structures will not be required. Foundation materials are competent basalt rock, making a positive cutoff relatively easy.

Two diversions will be on the forks of the Kalohewahewa. At the present location, the concrete and rock diversion should not exceed 10 feet in height at either location.



Vicinity Map

KAHAL
DEVELOP
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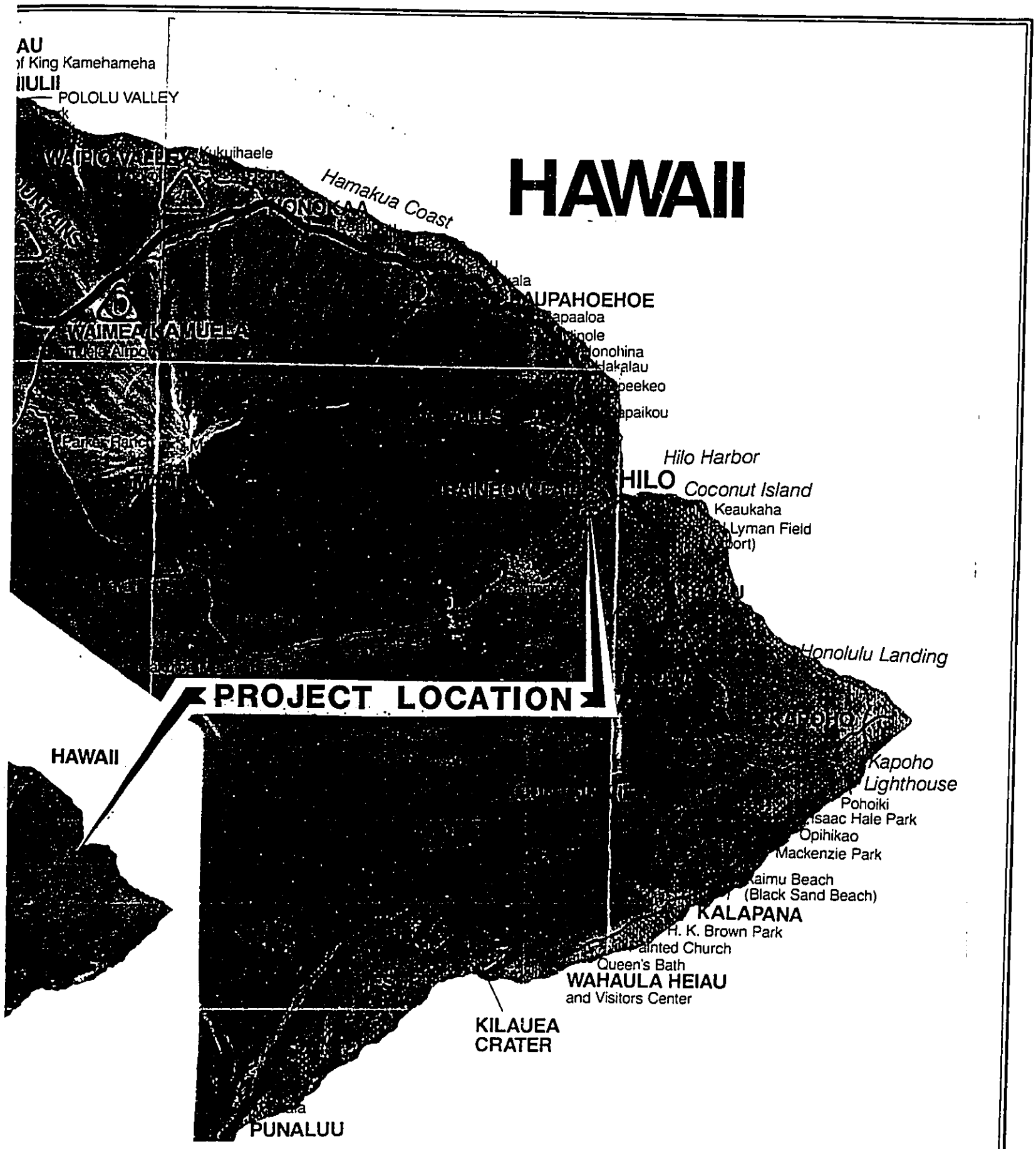
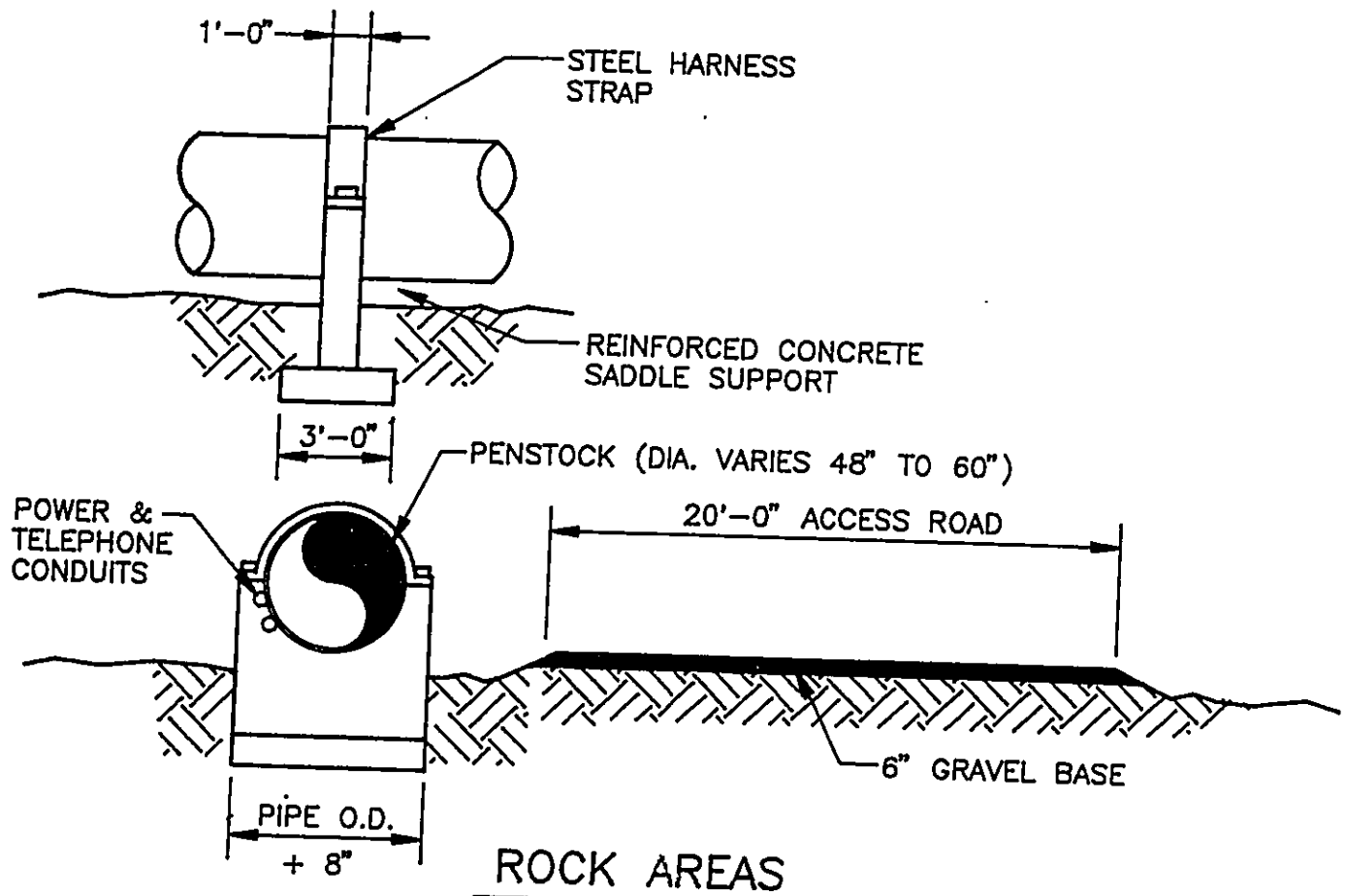
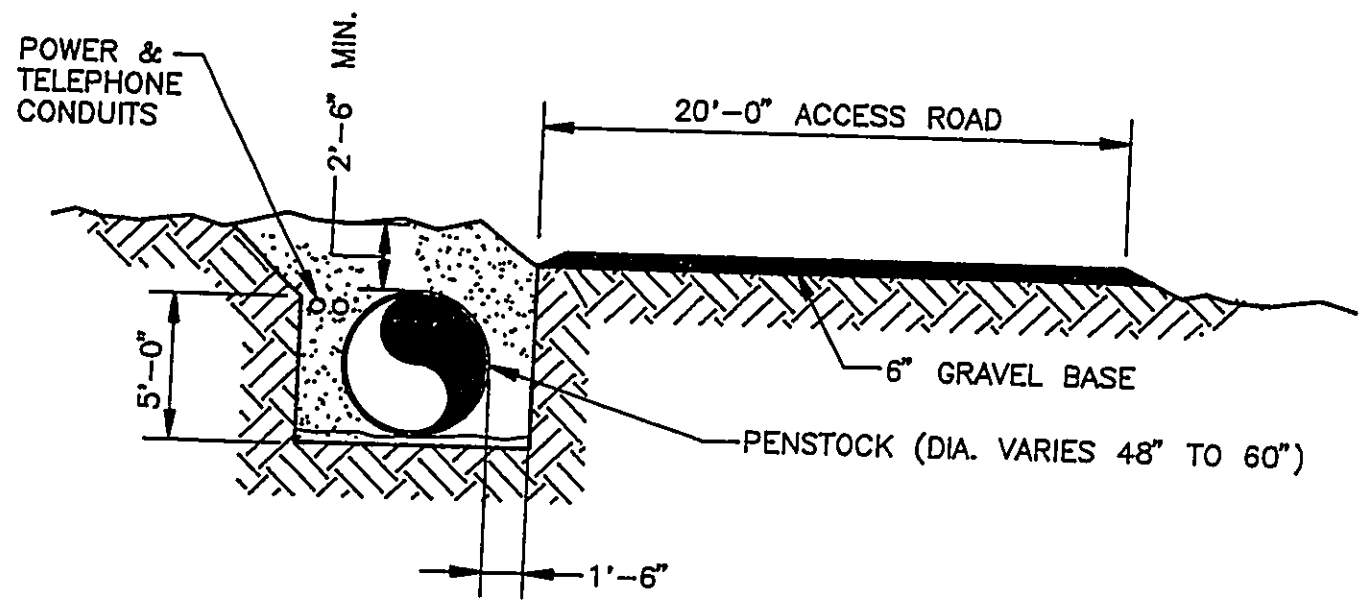
Drawn By: CF



KAHALA ENERGY DEVELOPMENT CORP. HONOLULU, HAWAII	WAILUKU RIVER HYDROELECTRIC PROJECT
Drawn By: CREAMER & NOBLE INC.	PROJECT LOCATION MAP EXHIBIT II-1

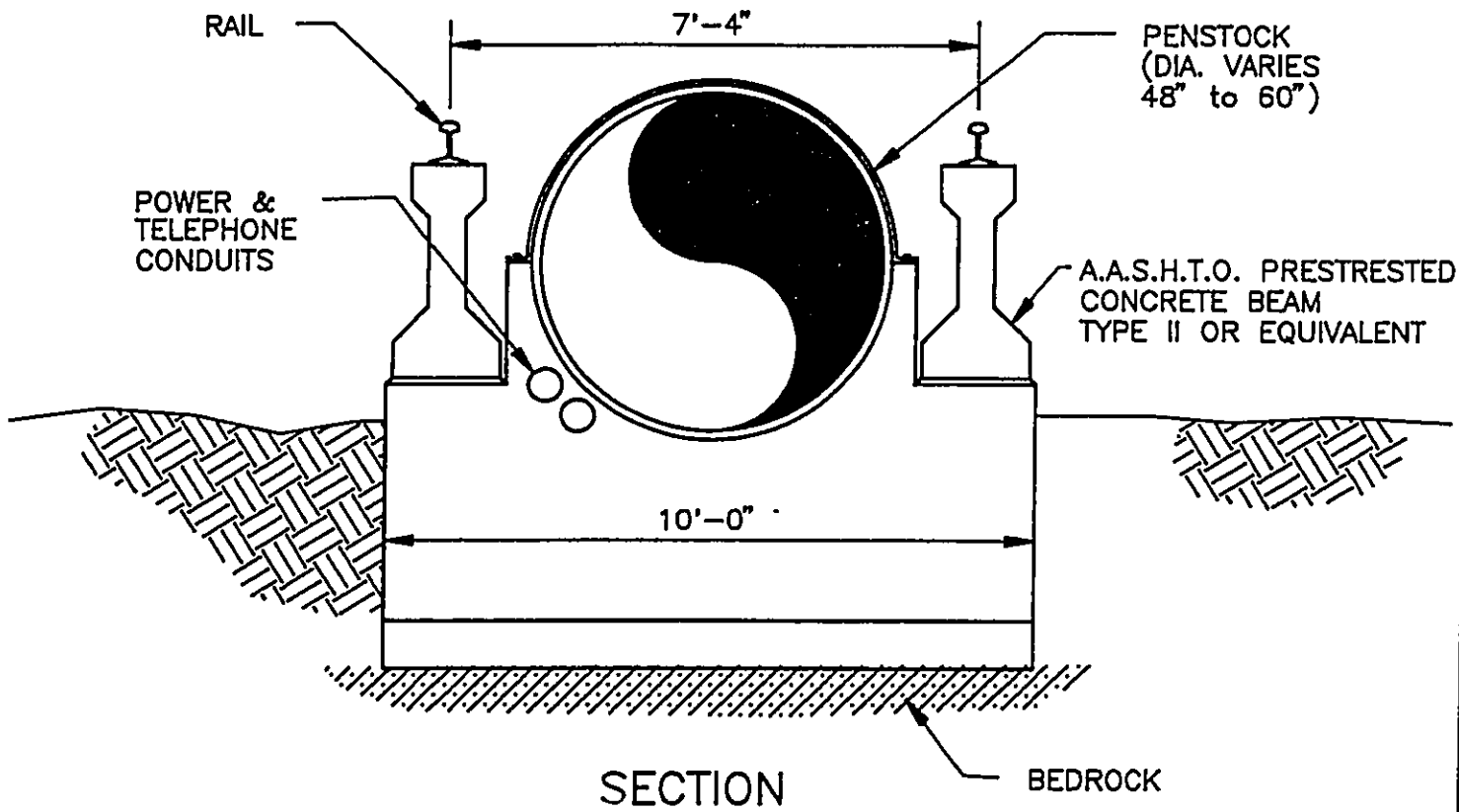


ROCK AREAS

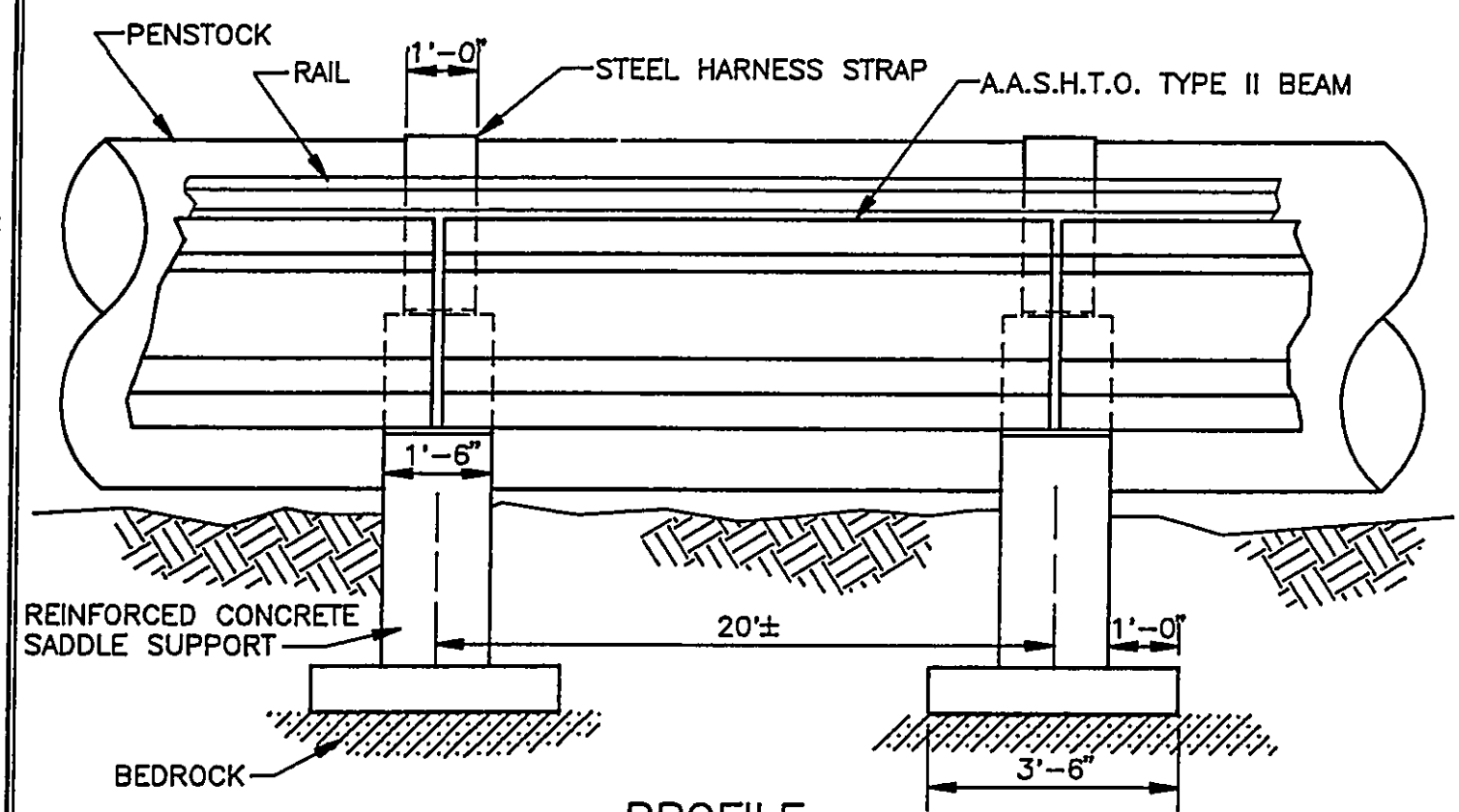


NON-ROCK AREAS

KAHALA ENERGY DEVELOPMENT CORP. HONOLULU, HAWAII	WAILUKU RIVER HYDROELECTRIC PROJECT
Drawn By: CREAMER & NOBLE INC.	TYPICAL PENSTOCK CONSTRUCTION EXHIBIT II-2

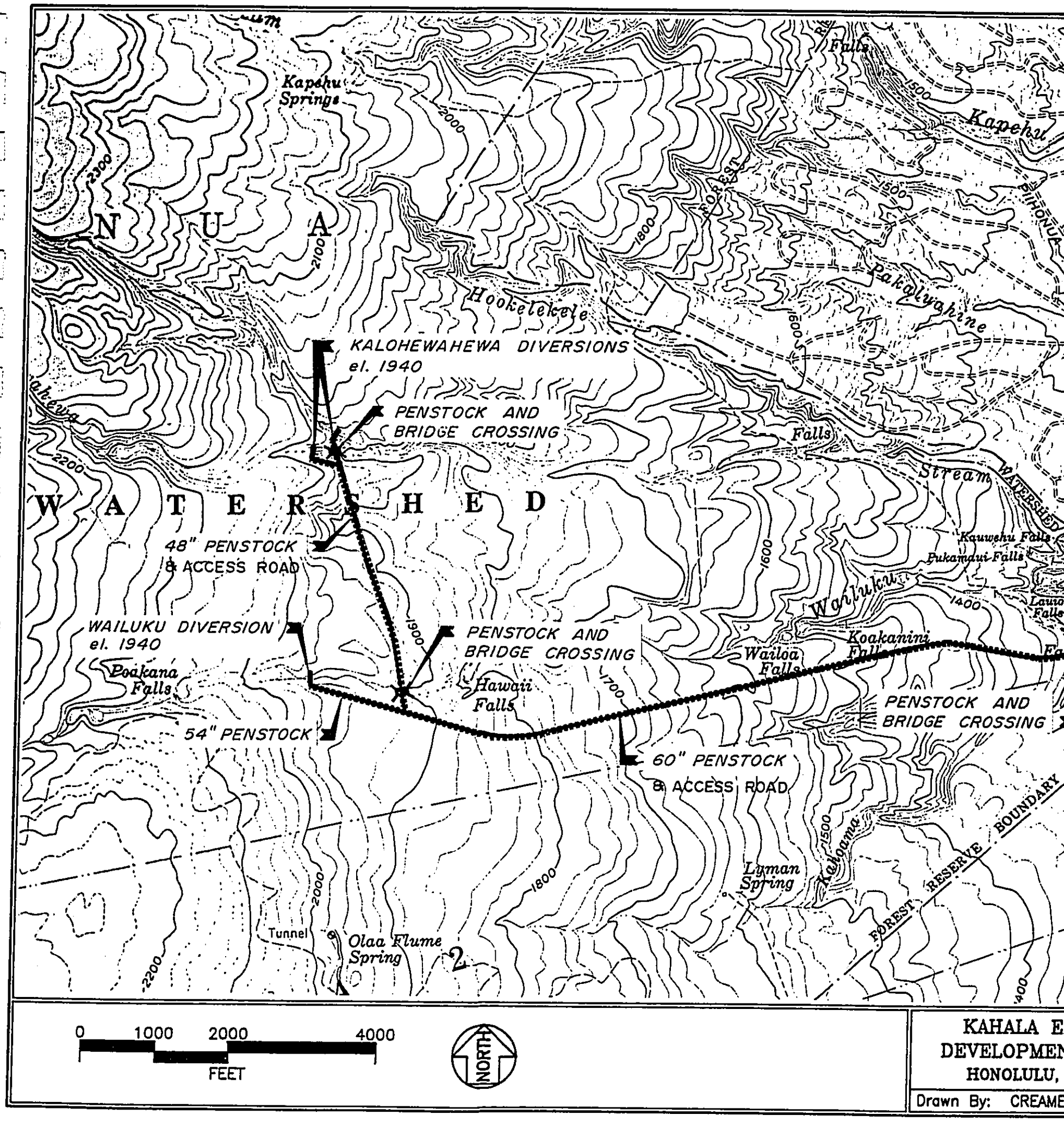


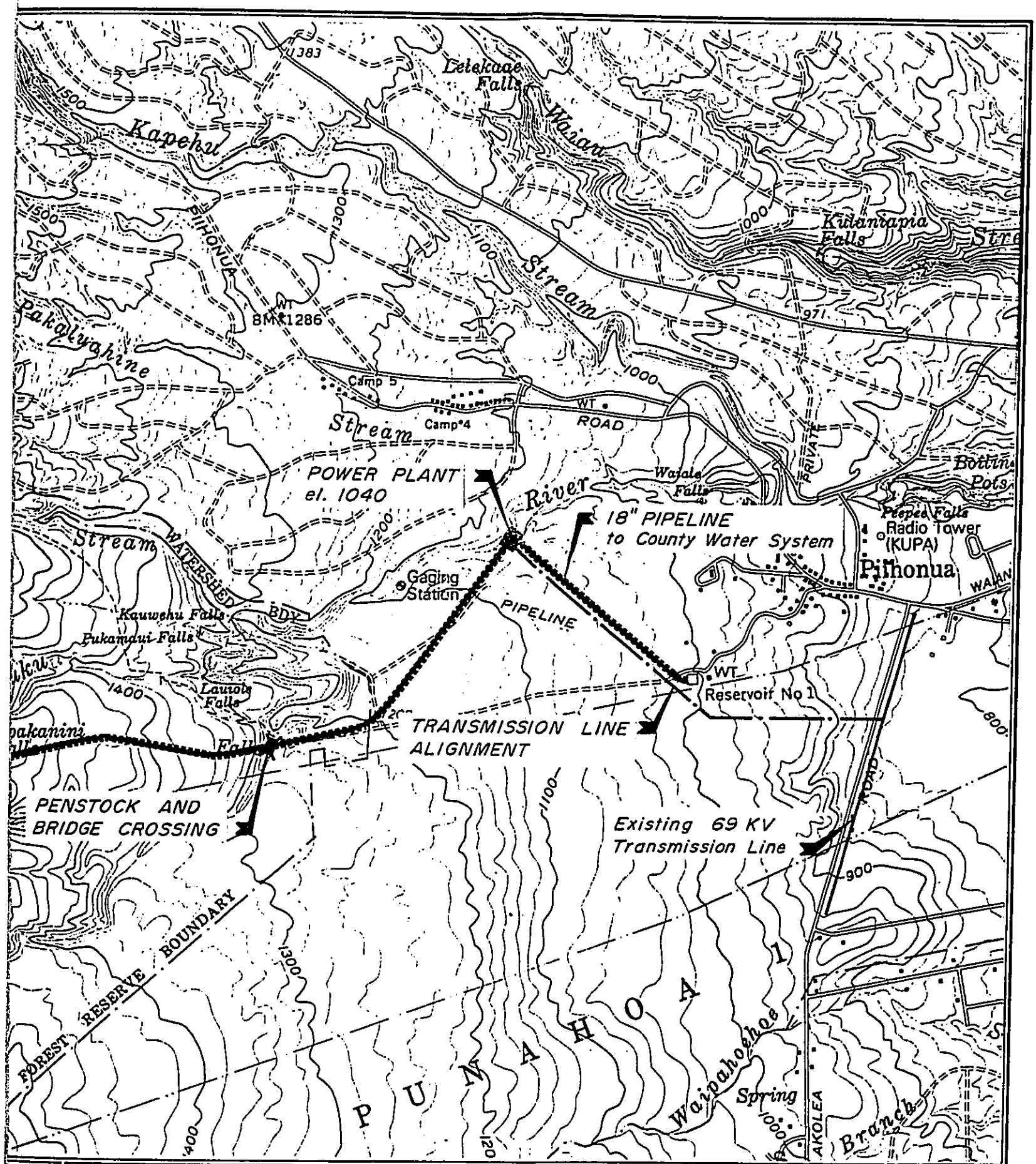
SECTION



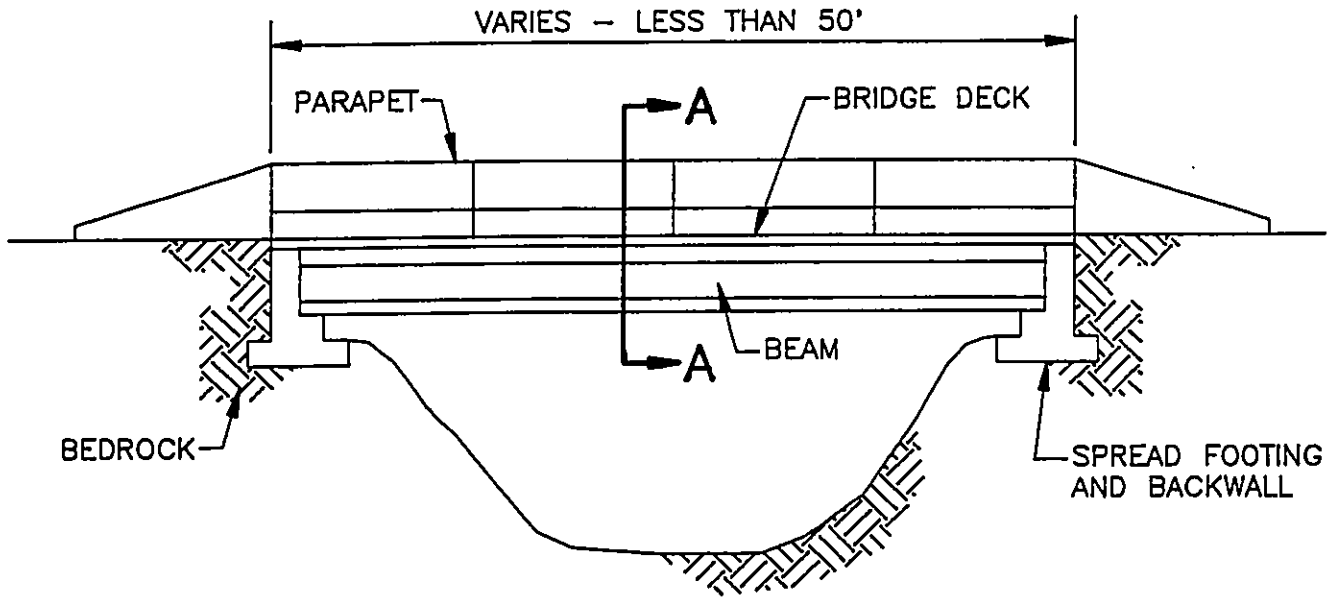
PROFILE

KAHALA ENERGY DEVELOPMENT CORP. HONOLULU, HAWAII	WAILUKU RIVER HYDROELECTRIC PROJECT
Drawn By: CREAMER & NOBLE INC.	TYPICAL PENSTOCK CONSTRUCTION EXHIBIT II-2A

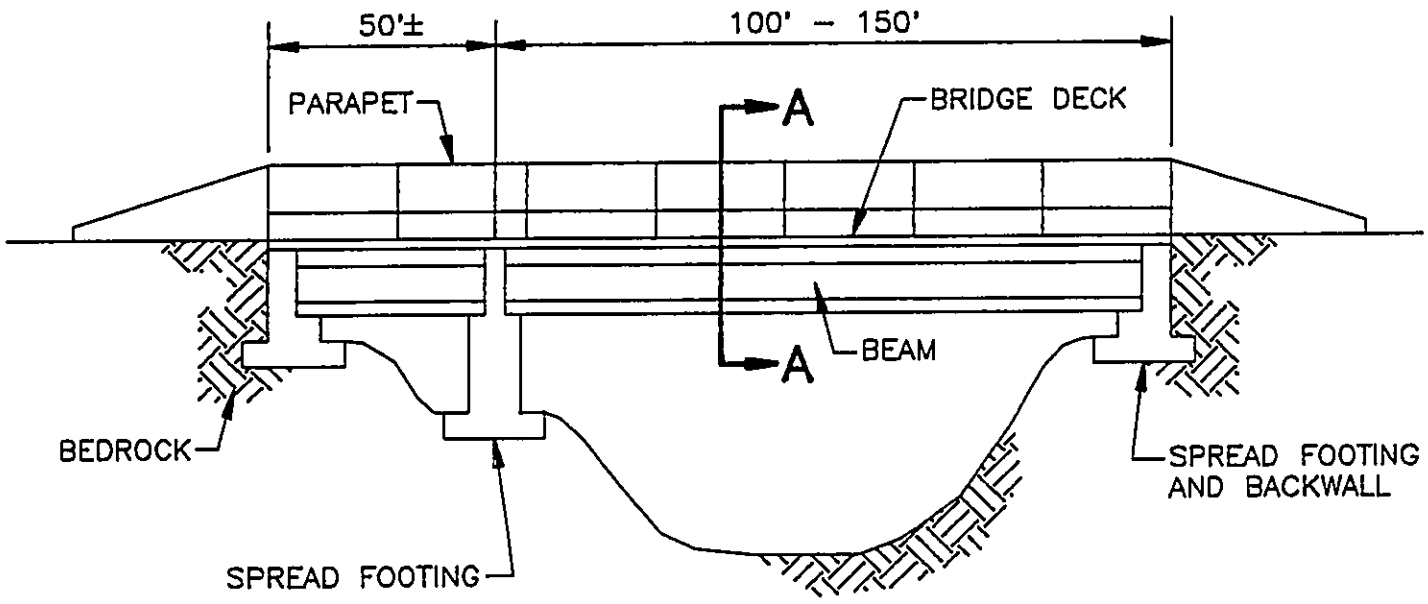

Kapehu Springs
Falls
Kapehu
N U A
Hookelekele
KALOHEWAHEWA DIVERSIONS
el. 1940
PENSTOCK AND
BRIDGE CROSSING
Pakaluahine
Falls
Stream
WATERSHED
W A T E R S H E D
48" PENSTOCK
& ACCESS ROAD
Kauwehu Falls
Pukamdui Falls
Wailuku
WAILUKU DIVERSION
el. 1940
PENSTOCK AND
BRIDGE CROSSING
Koakanini Falls
Wailoa Falls
Poakana Falls
Hawaii Falls
PENSTOCK AND
BRIDGE CROSSING
54" PENSTOCK
60" PENSTOCK
& ACCESS ROAD
Kaloama
FOREST RESERVE BOUNDARY
Lyman Spring
Tunnel
Olaa Flume Spring
2
0 1000 2000 4000
FEET
NORTH
KAHALA E
DEVELOPMEN
HONOLULU,
Drawn By: CREAME



KAHALA ENERGY DEVELOPMENT CORP. HONOLULU, HAWAII	WAILUKU RIVER HYDROELECTRIC PROJECT
Drawn By: CREAMER & NOBLE INC.	PROPOSED PROJECT FACILITIES EXHIBIT II-3

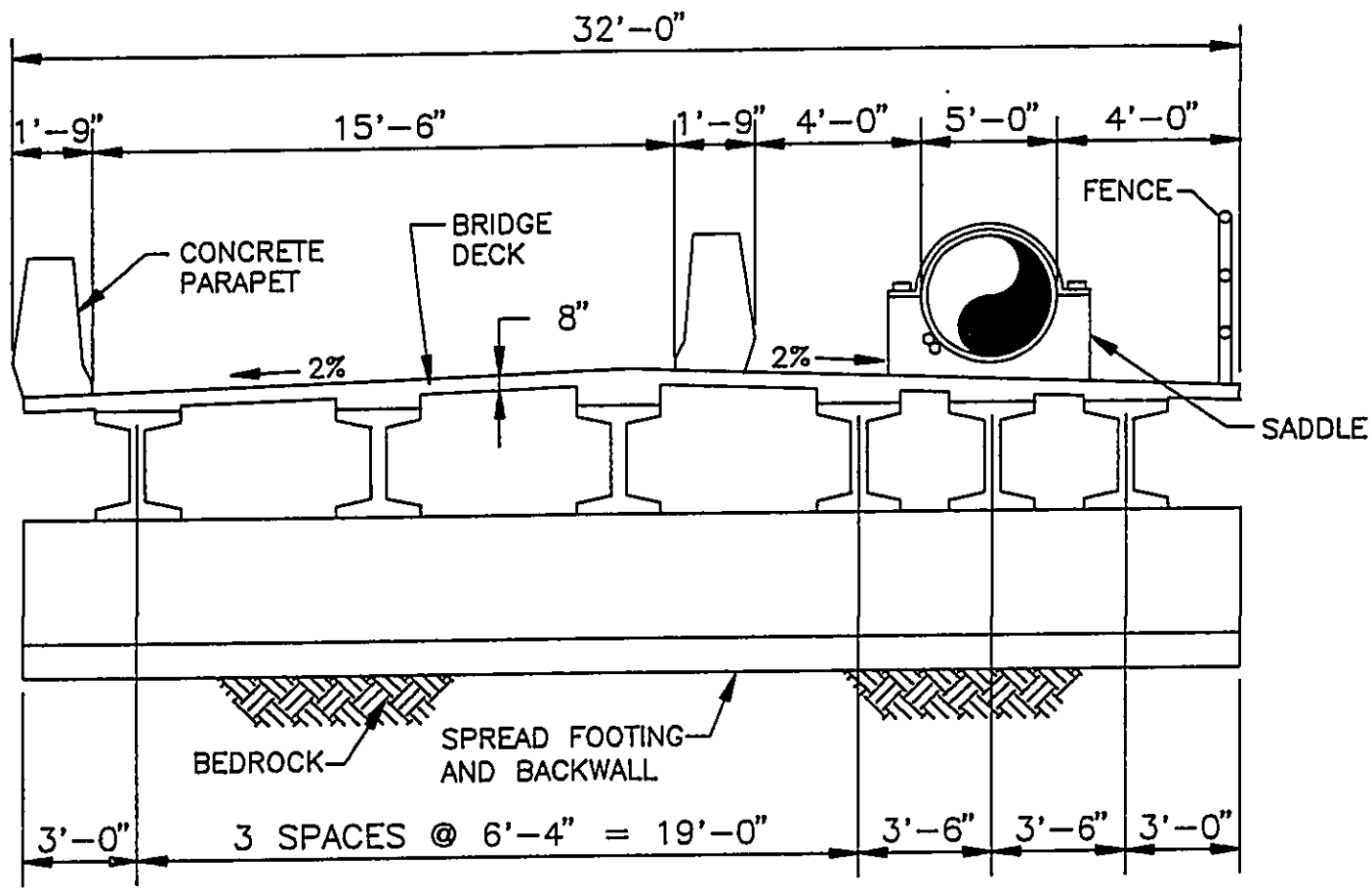


TYPICAL KALOHEWAHEWA AND
KAHOAMA STREAM CROSSINGS



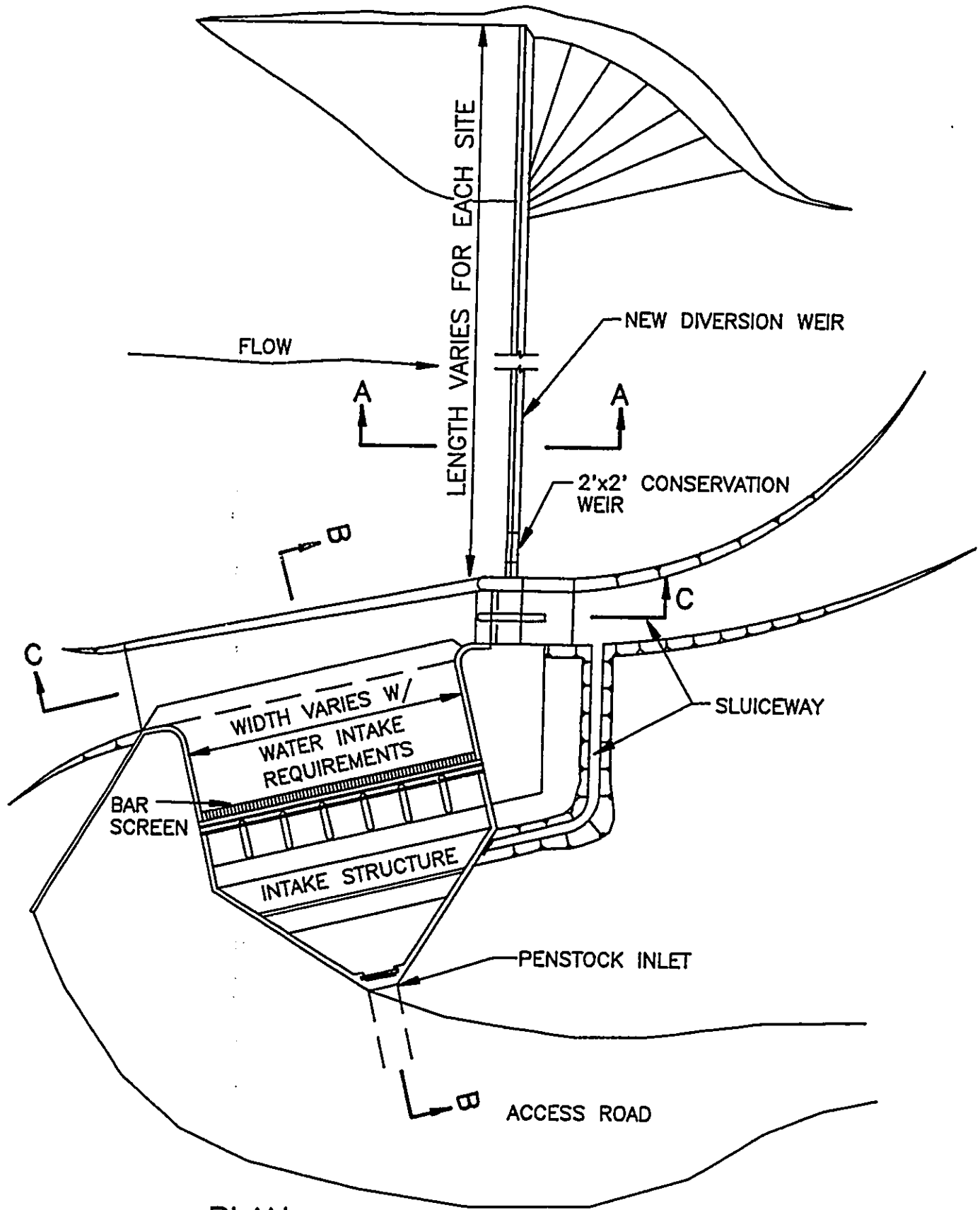
TYPICAL WAILUKU RIVER CROSSING

KAHALA ENERGY DEVELOPMENT CORP. HONOLULU, HAWAII	WAILUKU RIVER HYDROELECTRIC PROJECT
Drawn By: CREAMER & NOBLE INC.	RIVER CROSSING EXHIBIT II–3A



SECTION A–A

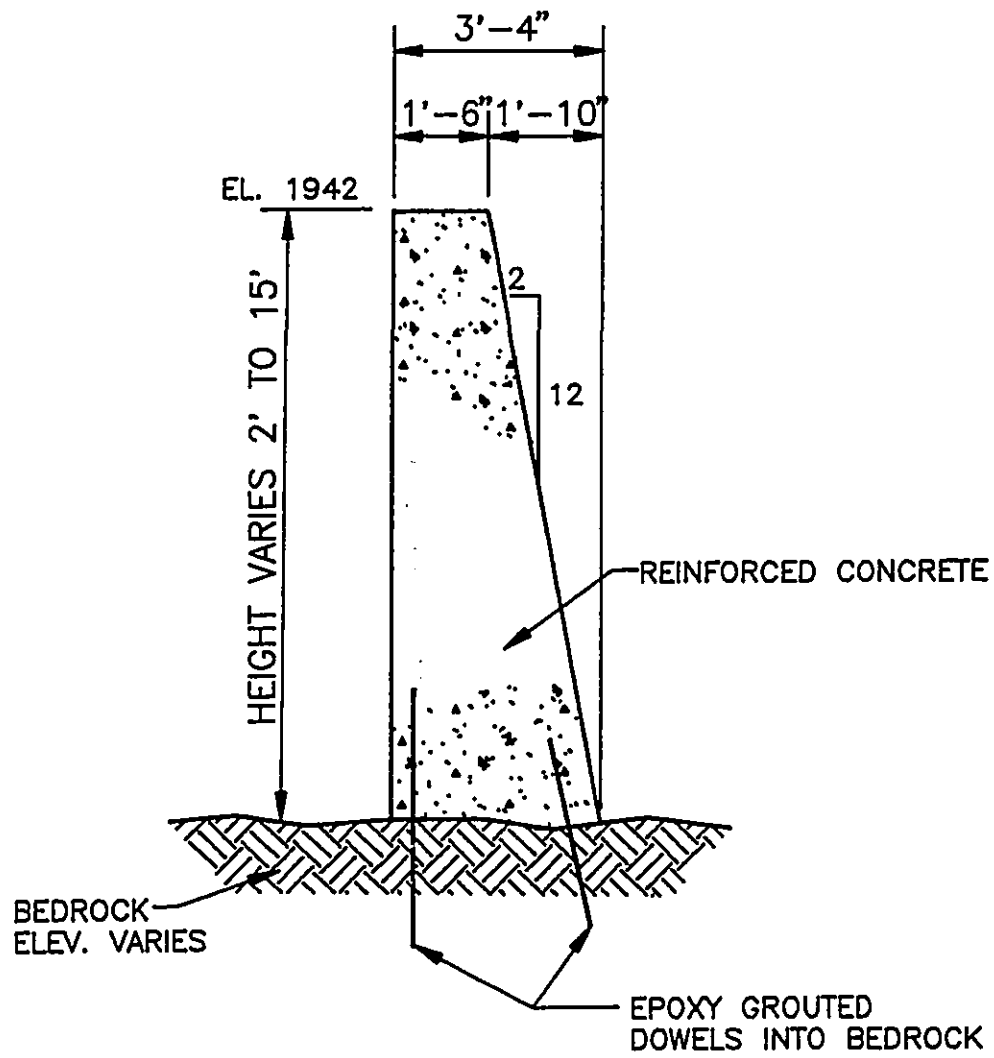
KAHALA ENERGY DEVELOPMENT CORP. HONOLULU, HAWAII	WAILUKU RIVER HYDROELECTRIC PROJECT
Drawn By: CREAMER & NOBLE INC.	SECTION A–A EXHIBIT II–3B



PLAN

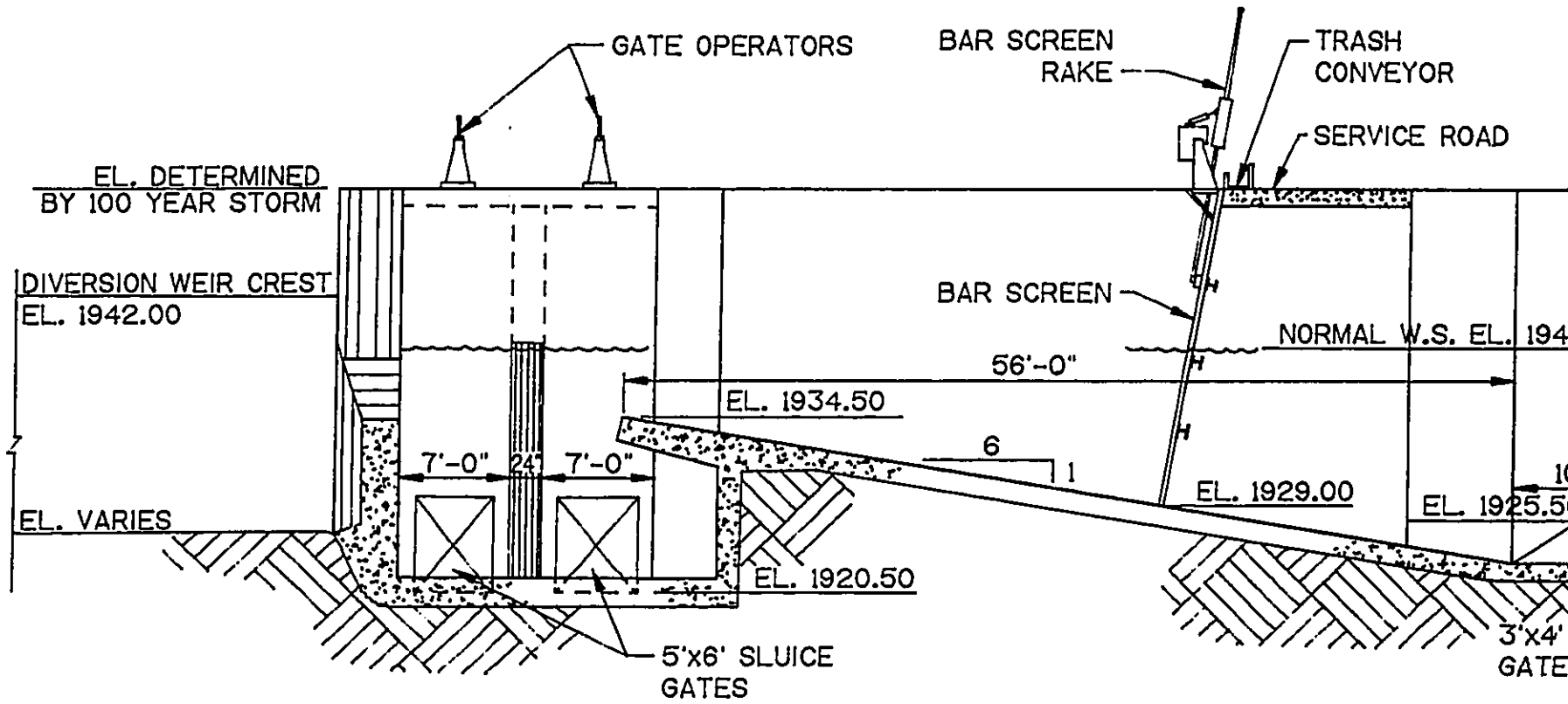
KAHALA
DEVELOPME
HONOLULU

Drawn By: CREAM

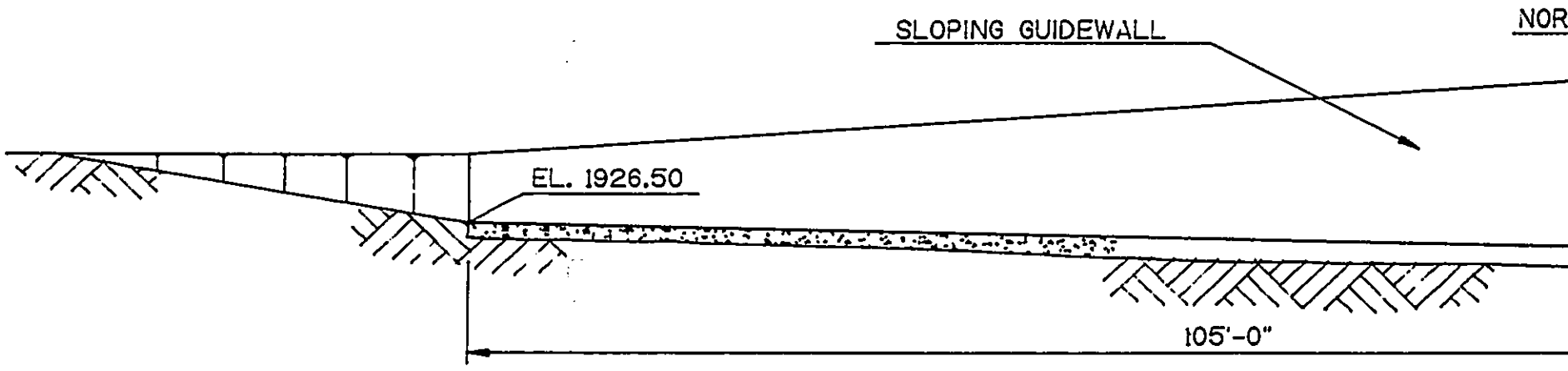


SECTION A-A

KAHALA ENERGY DEVELOPMENT CORP. HONOLULU, HAWAII Drawn By: CREAMER & NOBLE INC.	WAILUKU RIVER HYDROELECTRIC PROJECT TYPICAL DIVERSION DAM EXHIBIT II-4



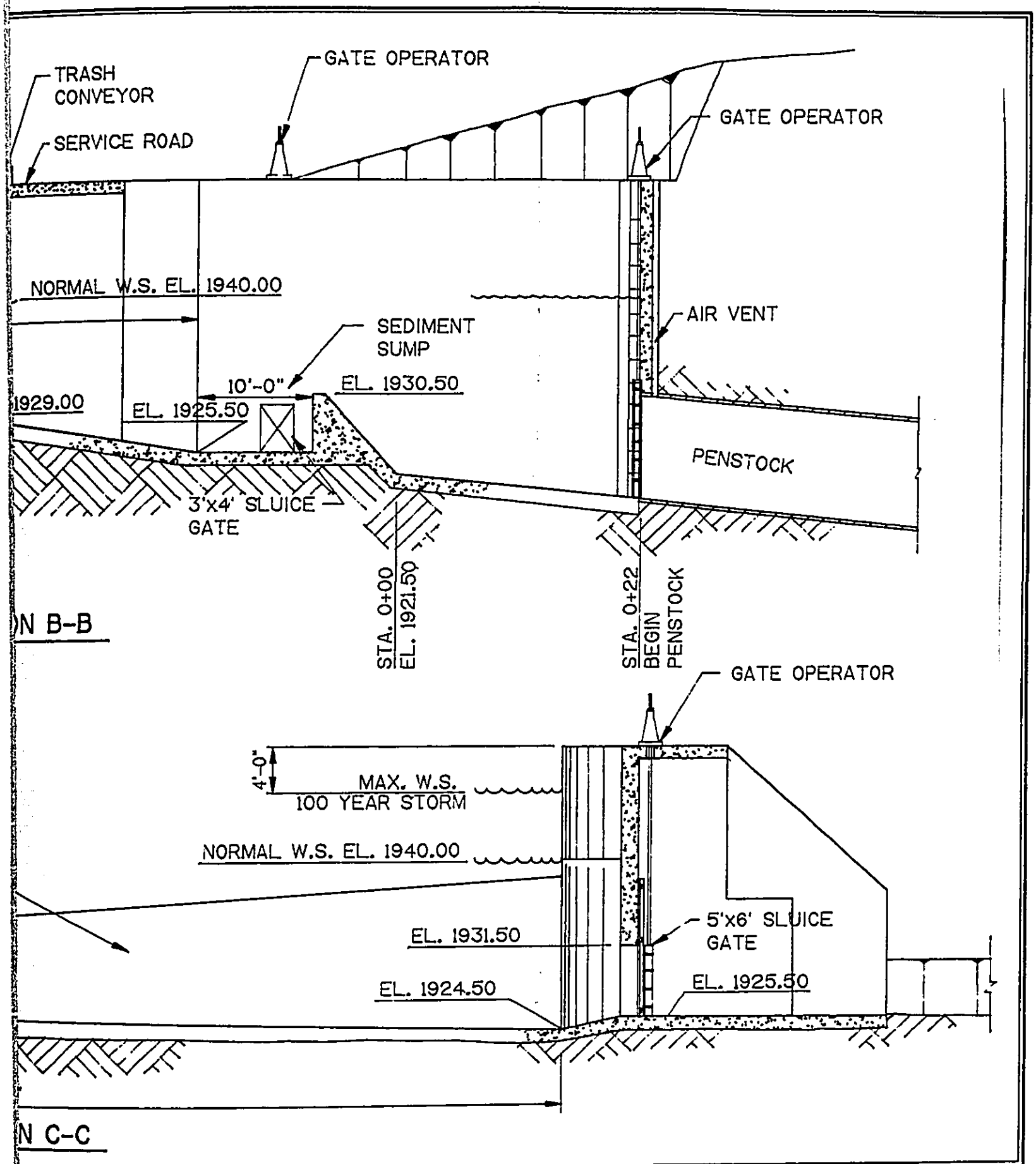
SECTION B-B



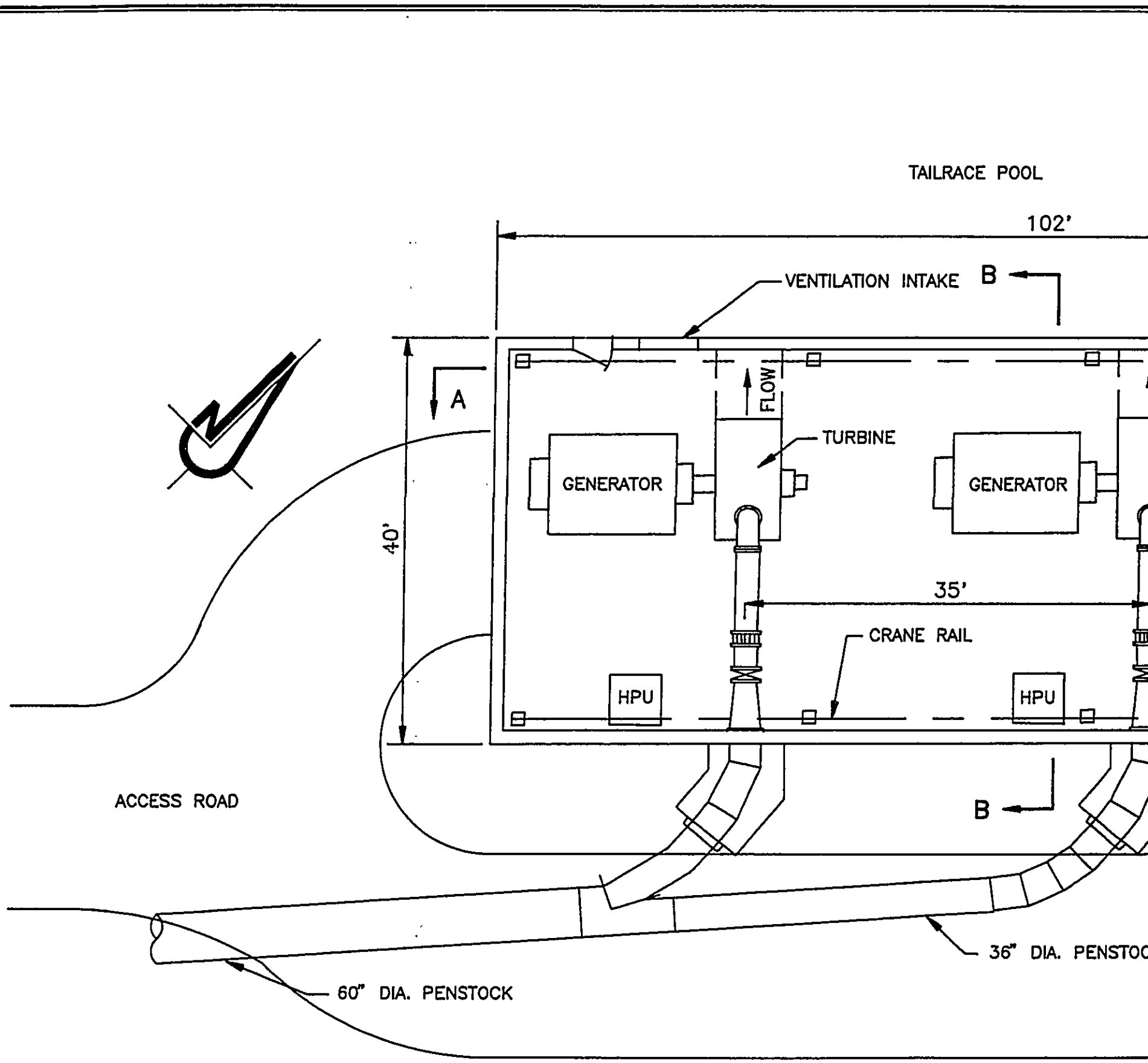
SECTION C-C

KAHALA
DEVELOPME
HONOLULU,

Drawn By: CREAM



	KAHALA ENERGY DEVELOPMENT CORP. HONOLULU, HAWAII	WAILUKU RIVER HYDROELECTRIC PROJECT
	Drawn By: CREAMER & NOBLE INC.	TYPICAL DIVERSION DAM – SECTIONS EXHIBIT II–5



KAHALA E
DEVELOPMEN
HONOLULU,

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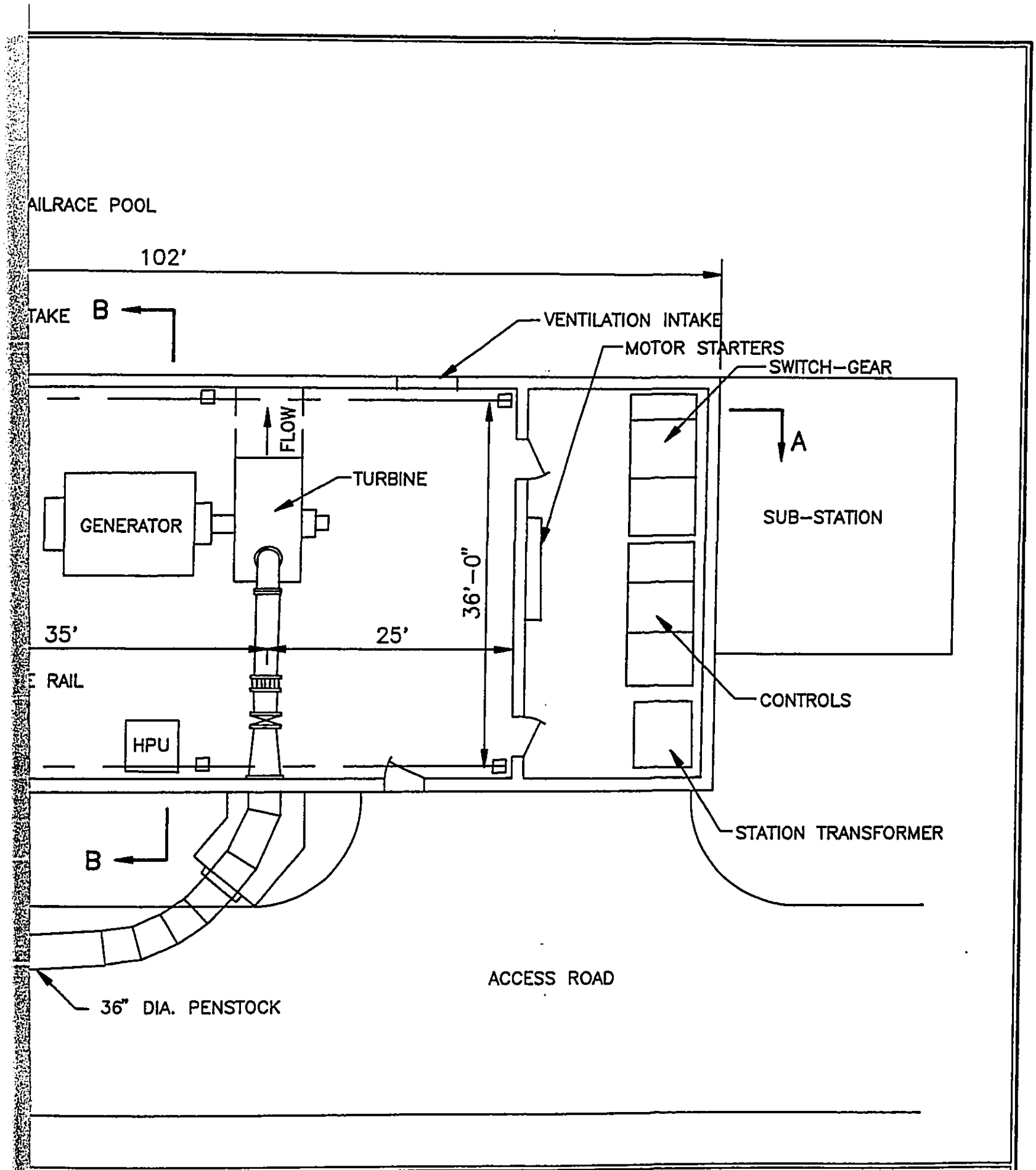
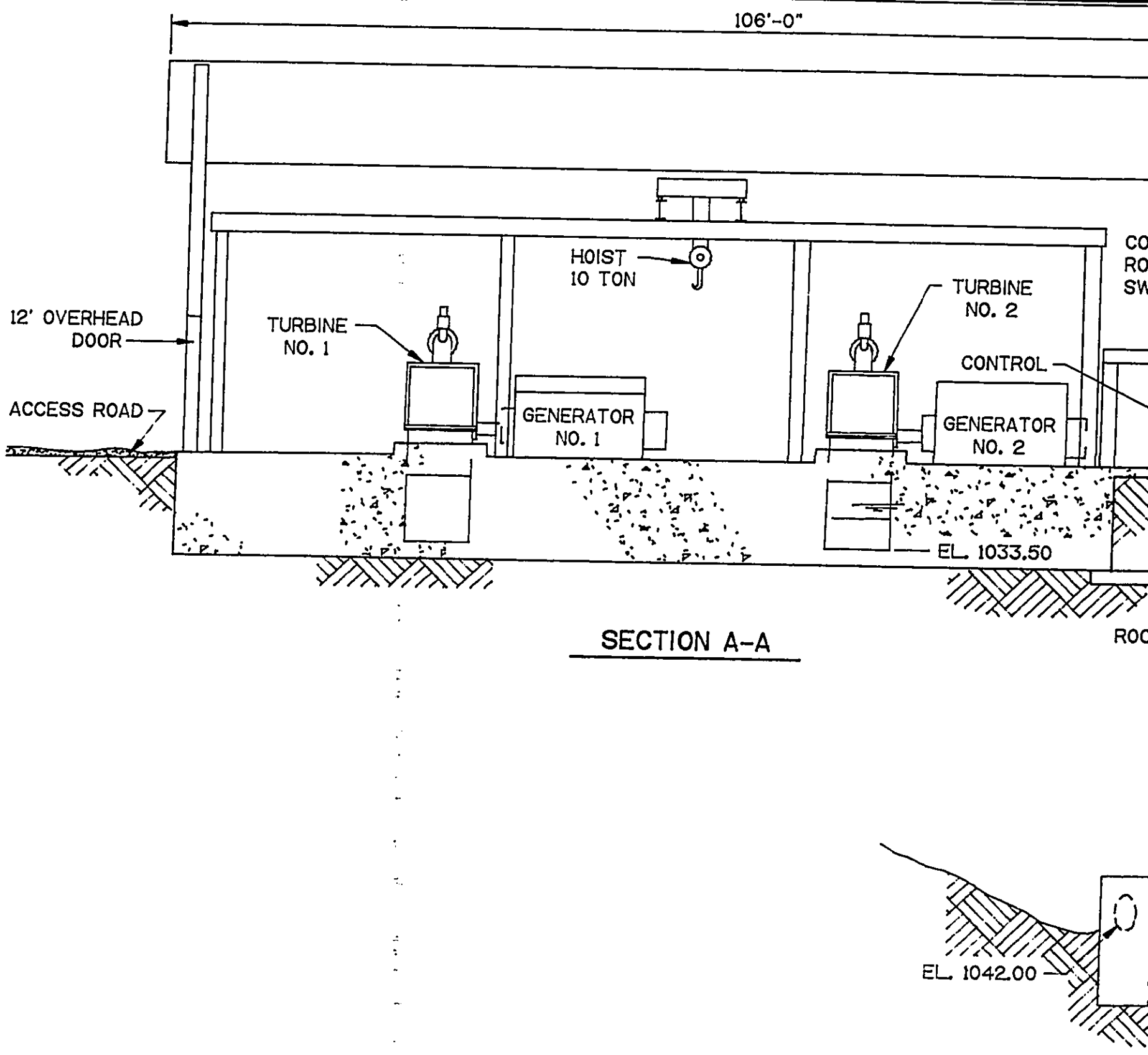


KAHALA ENERGY DEVELOPMENT CORP. HONOLULU, HAWAII	WAILUKU RIVER HYDROELECTRIC PROJECT
Drawn By: CREAMER & NOBLE INC.	POWERHOUSE PLAN EXHIBIT II-6



SECTION A-A

KAHALA E
DEVELOPMEN
HONOLULU,

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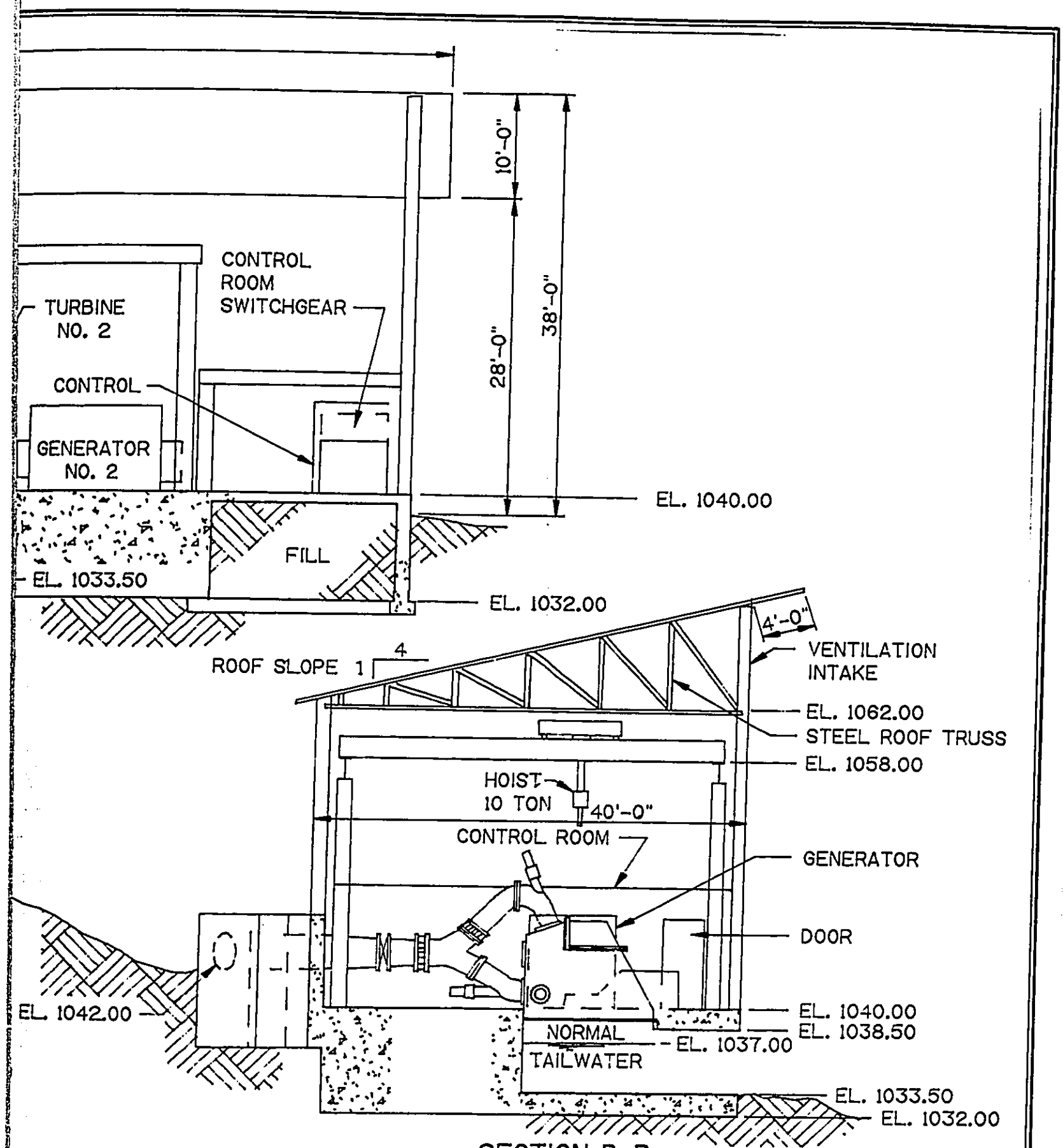


SECTION B-B

KAHALA ENERGY DEVELOPMENT CORP. HONOLULU, HAWAII	WAILUKU RIVER HYDROELECTRIC PROJECT
Drawn By: CREAMER & NOBLE INC.	POWERHOUSE SECTIONS EXHIBIT II-7

(The previously planned diversion lower on the stream was in a deep canyon setting, requiring a substantially higher and larger structure.) No pondage is planned on the Kalohewahewa except a minor amount within the channel itself.

The diversion on the Wailuku will be somewhat larger and higher extending up to 15 feet in height. Pondage of approximately 80 acre-feet will be provided requiring the use of 10 land acres.

Exhibit II-4 and II-5 detail the diversion structure and diversion works anticipated at all three sites. In the narrow channel locations chosen, concrete and rock diversion weirs will divert water into the diversion works which will be constructed on the south channel wall. A 2′ x 2′ weir will be constructed at each of the three locations to allow the proposed conservation flows to pass. Sediment, for the most part, will be kept within the channel by use of a sloping wall. Sediment that enters the diversion works will be released through sluice gates at two locations.

A bar screen will be installed for the removal of leaves and other debris. As no *Lentipes* nor any other variety of fish and very few atyid shrimp have been observed at this elevation, no effort will be made to preclude their entrance from the penstock. It is felt that the velocities in the channel will be such that the shrimp that are present can easily avoid entrance forces. The bar screen will be equipped with a mechanical rake and trash conveyor to effectively remove materials from the screen.

The water surface elevation will be maintained by use of sensors which will regulate water flows through the turbine needle valves. Telephone capability is required to facilitate this function.

Construction activities will require diversion of water flow through the construction zone by the temporary installation of a large diameter culvert and a coffer dam upstream from the construction zone. Some rock excavation will be required as part of the construction of the diversion works. Rock excavation will also occur for the installation of the first several hundred feet of the penstock.

PENSTOCKS

Water will be conveyed in either steel or concrete pipe from the diversion structures to a steel bifurcation structure at an approximate elevation of 1,900 feet. The pipeline from Kalohewahewa Stream will be 48-inches in diameter and 4,400 feet in length. The second pipeline from the Wailuku River diversion will be 54-inches in diameter and 1,400 feet in length. The steel bifurcation will be shop fabricated in a "Y" configuration with incoming pipe sizes of 48-inch and 54-inch, and an outgoing size of 60-inch. Steel reinforcement rings will be welded at strategic locations and the whole bifurcation unit will be encased in a reinforced concrete thrust block. The 60-inch diameter penstock, which will run in an easterly direction to the powerhouse, will be approximately 13,500 feet long. The penstock locations are shown in Exhibit II-3.

Penstocks will be installed underground at all locations where sufficient cover material is available. At locations where rock is on or near the surface, the penstocks will be supported on concrete saddles anchored to the rock at 20 to 40 foot intervals. Steel straps will be bolted to the saddles to secure the pipe in place. All concrete saddles will have reinforcing steel and a foundation below grade to a minimal depth of 3 feet.

The penstock alignment requires crossing the south fork of Kalohewahewa below the diversion and over the Wailuku River at an approximate elevation of 1,900 feet. The penstock also crosses the Kahoama Stream near the present Department of Water Supply intake at the termination of an existing access road. Penstock crossings will be either concrete supported and keyed into each embankment or included as part of the access road bridges.

Clearing for the penstock will be done at the same time as the access road clearing. A qualified botanist and biologist will be part of the survey team that establishes the exact route for the road and penstocks to insure minimal tree removal and disturbance of wildlife, with the specific assignment of avoiding any rare or endangered species.

The wall thickness of the penstock will vary from 1/4 inch at the intake to 5/8 inch at the powerhouse to accommodate the varying head on the pipeline from 0 to 900 feet. The penstock will be delivered in 40 foot sections with beveled ends to facilitate field welding of the sections.

Combination air release/vacuum valves will be provided at all high points and at intervals not to exceed two to three thousand feet. The air/vacuum valves are provided to allow entrapped air to escape which could restrict pipeline flow and also allows air to enter the penstock in the event of a penstock break or blockage to prevent collapse of the pipeline. The air/vacuum valves will be installed in conjunction with pipe access manholes which will allow access for maintenance and inspection of the penstock.

Two conduits will be installed along the penstock route, one for 3-phase 5 Kv cable, and the other for telecommunications to the diversion sites. This will provide for power to operate gates at the diversion dam and also provide for head level control.

POWERHOUSE

The powerhouse will be 40 feet by 102 feet in size, with a reinforced concrete foundation and pre-fabricated metal building as shown in Exhibits II-6 and II-7. It will be located approximately 1,000 feet downstream of the existing USGS gage. A tailrace will be constructed to dissipate the energy and direct the flows from the turbine back to the Wailuku River. An 18 inch pipe will be connected to the tailrace to convey a portion of the water to the County water system.

Twin-jet impulse turbines have been selected for the site. Due to the wide variability of flows, two identical turbines will be installed to provide for higher

efficiencies over the range of flows. Each turbine will have a name plate rating of 6,630 brake horse power operating under a net head of 850 feet and a flow rate of 80 cfs.

The turbines will be direct connected 3-phase, 60 cycle synchronous type generators generating at 4,160 volts. The generators will be rated at 5,000 kilowatts each for a total plant capacity of 10 megawatts.

The estimated average annual output of the facility is 35,000,000 kilowatt hours. The voltage will be boosted to 69,000 Kv at the substation adjacent to the powerhouse before transmitting to the HELCO network.

TRANSMISSION AND TELEPHONE LINES

The transmission line will follow a 75-foot wide corridor approximately 5,100 feet in length until it connects with the 69 Kv HELCO utility transmission line at Akolea Road approximately 1,900 feet south of the intersection with Waianuenue Avenue and Piihonua Road. The transmission line will be wood pole construction with raptor protection.

The telephone line will follow the same alignment and will be installed on the same poles.

ACCESS ROADS

Access roads to all components of the project are as shown on Exhibit II-3. The sole existing access to the project site is by a paved and graveled Hawaii County Department of Water Supply road. This road begins at Piihonua Road and traverses to the County's diversion facilities on the Kahoama Stream. Access to the power plant will be off this main road following the corridor of the transmission line and a water delivery pipeline from the power plant tailrace to the County water system. From the power plant, all access roads will be located along the penstock route except where it may be necessary to deviate from the penstock alignment because of steep terrain. Exhibit II-2 shows the proposed configuration between the access roads and the penstock.

Three bridges will be required. Typical sections for the bridges are shown in Exhibit II-3A and II-3B. The first crosses Kahoama Stream at the termination of the County Department of Water Supply Road. The second bridge will be over the Wailuku River at approximate elevation 1,900 feet. The third bridge will cross the south fork of the Kalohewahewa. The bridges at the Kahoama and the Kalohewahewa will be single span, 30 to 50 feet in length. The foundation will be spread footings constructed directly on bedrock. The Wailuku River bridge will be a two-span structure 150 to 200 feet in length. The foundation again will be spread footings supported on bedrock. It is intended that the major bridge span will provide free-flowing conditions for the Wailuku channel. Because that span will be 100 to 150 feet in length, the beams will be constructed of steel, delivered to the project in several sections, and field bolted together prior to installation. All other major components will be constructed of concrete.

Because of heavy rainfall and potential erosion problems, an alternative to constructing the access rod system above Kahoama Stream has been developed and investigated. This option, which utilizes a modified rail transport system, is displayed as Exhibit II-2A. This option calls for the removal of trees, brush, and other taller vegetation in a relatively narrow corridor to ground level leaving ground cover and root systems in place. The penstock is required to be constructed above ground supported by concrete pedestals spaced approximately 20 feet apart. Footings for the pedestals would be excavated to bedrock and concrete brought in by helicopter.

Between the concrete pedestals, two ASSHTO Type II prestressed concrete beams or equivalent would be placed to support the rail system. A motorized rail vehicle would be designed and built capable of carrying construction and maintenance personnel and equipment. The vehicle would be equipped with a hoise to allow it to transport pipe during construction and maintenance operations.

The penstock route would be essentially the same as shown in Exhibit II-3. The road access system below Kahoama Stream will be the same as previously proposed.

Except during construction, it is not anticipated that a large number of personnel will be using the access road system. A mutually agreeable arrangement will be made with the County Department of Water Supply to allow project personnel and equipment access as necessary. The lockable entries will remain, and control of access will continue to be retained by the County Water Supply Department and the State Department of Land and Natural Resources. A system will be developed in cooperation with the County and DLNR to provide access for hunters and other individuals interested in obtaining access to use the project access roads beyond Kahoama Stream.

The construction of the upper portion of the access road system west of the Kahoama Stream will require clearing and grading by a bulldozer and other road building equipment. Drainage culverts will be installed as necessary. To better support the construction and maintenance vehicular traffic, a 6-inch layer of crushed rock will be placed.

The total length of access roads for the project will be approximately 22,000 feet. The road system is vital to both the construction and maintenance activities of the project. After the construction phase, the road system will be maintained for maintenance of diversion structures and penstock and also for ongoing resource management activities in the area.

MAINTENANCE

Regular maintenance for the diversion works, forebays, and penstock will be at monthly intervals, with a two-man crew working approximately 20 hours each month. Additional labor may be necessary for emergency maintenance that may be required after major storms.

Regular maintenance and operation for the power plant will be on a scheduled and on call basis with a two-man crew. Additional labor will occasionally be required for routine and emergency maintenance.

HELCO is expected to maintain supervisory coordination with the facilities for monitoring and load dispatching of power. It is expected that HELCO will assume ownership and maintenance responsibility for the transmission line.

MANAGEMENT

The maintenance of conservation flows in the Wailuku River is the major management concern for this project. Measures to ensure maintenance of this flow will be incorporated into the design and operation features of the project.

In addition, the company will work with the Division of Forestry and Wildlife to develop programs to enhance the native habitats in the project area, such as providing opportunities for increased pig hunting.

CHAPTER III

ENVIRONMENTAL SETTING

PHYSICAL AND BIOLOGICAL CHARACTERISTICS

Regional Setting

The proposed hydroelectric project is located on the Wailuku River on the island of Hawaii, the largest of six major islands in the State of Hawaii. The project site is approximately 5 miles west of Hilo, the economic and political center of the island and its main port.

The Wailuku River has the greatest length and the largest drainage area of all the streams in the State of Hawaii. It begins at an elevation of approximately 10,830 feet near the summit of Mauna Kea and enters into the Pacific Ocean near Hilo, a distance of about 42.6 miles. The river drains approximately 256 square miles of forest reserve, agricultural, and urban lands. In this volcanic terrain, stream channels can diverge at cones and vents splitting surface runoff into different avenues at higher elevations. Complex geology such as lava tubes and intrusive dikes also result in gains and losses to stream flow from groundwater movement. The relatively high rainfall and moderate temperatures are conducive to heavy vegetation; grass, shrubs, ferns and trees are prevalent in the upper drainage basin. The hydroelectric site is in the central portion of the drainage basin. The Wailuku River basin is depicted in Exhibit III-1.

Climate

The Island of Hawaii has a semi-tropical climate with wide variations across the island in temperature and rainfall. Temperatures range from 58 to 90 degrees along the coastal plain to subfreezing in the mountains. The high altitudes of Mauna Loa, elevation 13,653 feet, and Mauna Kea, elevation 13,796 feet, block and force the rise of moisture-laden trade winds to create an orthographic rainfall pattern. Rainfall is highest between sea level and 6,000 feet elevation with the heaviest rainfall (over 300 inches annually) occurring on the slopes of Mauna Kea at 2,000 to 3,000 feet elevation, just north of the Wailuku River. Above this altitude, rainfall diminishes so that the upper slopes of Mauna Kea are semi-arid. Highest rainfall occurs during the winter months from October through April. Rainfall in the Wailuku River basin is shown in Exhibit III-2.

Geology

A geological reconnaissance survey of the project area was conducted in March 1986 to look for slope stability features and to observe bedrock geology for a landslide hazard analysis. The description of the geology of the area is based on that report and a geotechnical investigation made by the U.S. Army Corps of Engineers as part of their 1984 Wailuku/Honolii Hydropower Study (see Reference List at end of document).

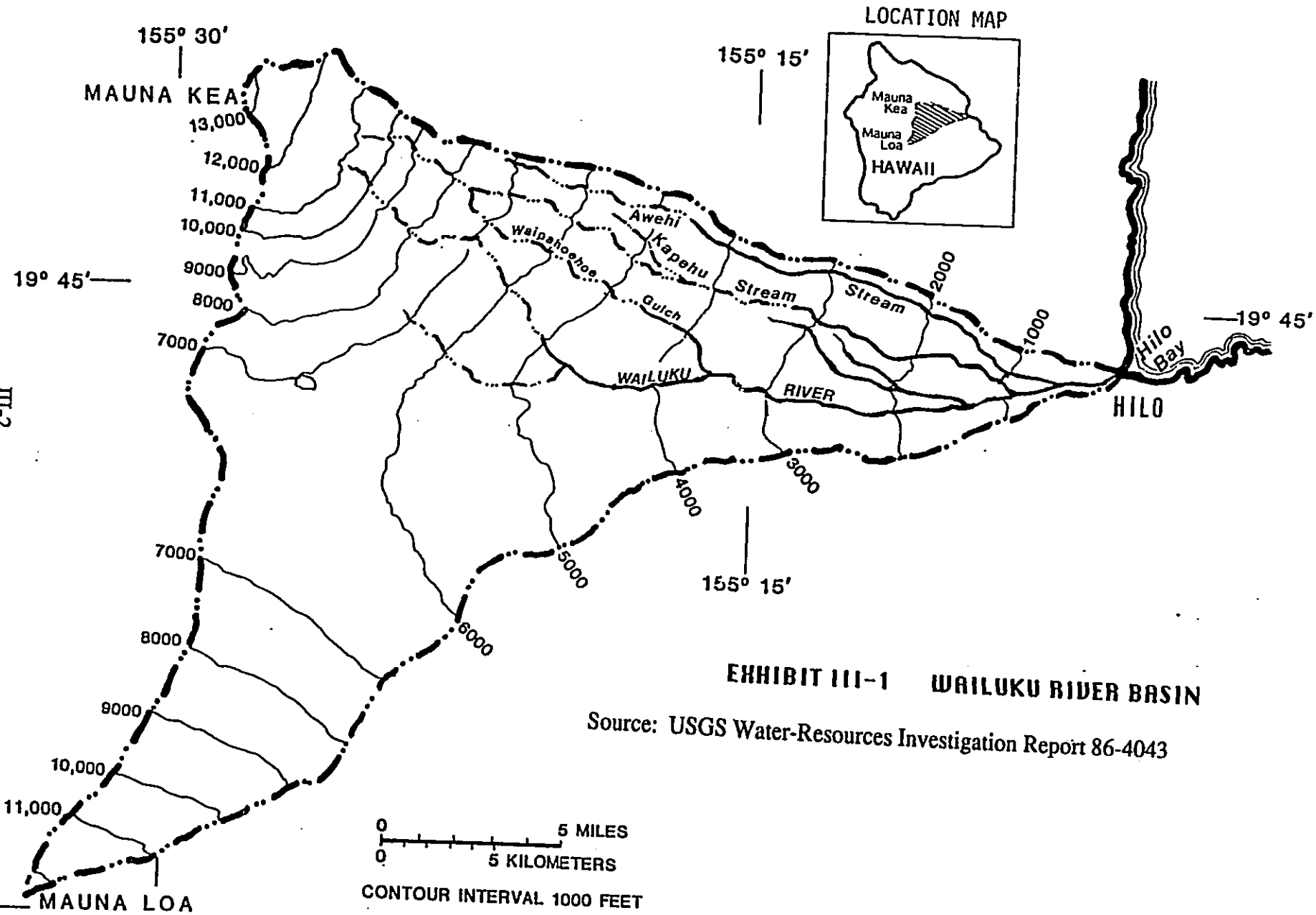


EXHIBIT III-1 WAILUKU RIVER BASIN

Source: USGS Water-Resources Investigation Report 86-4043

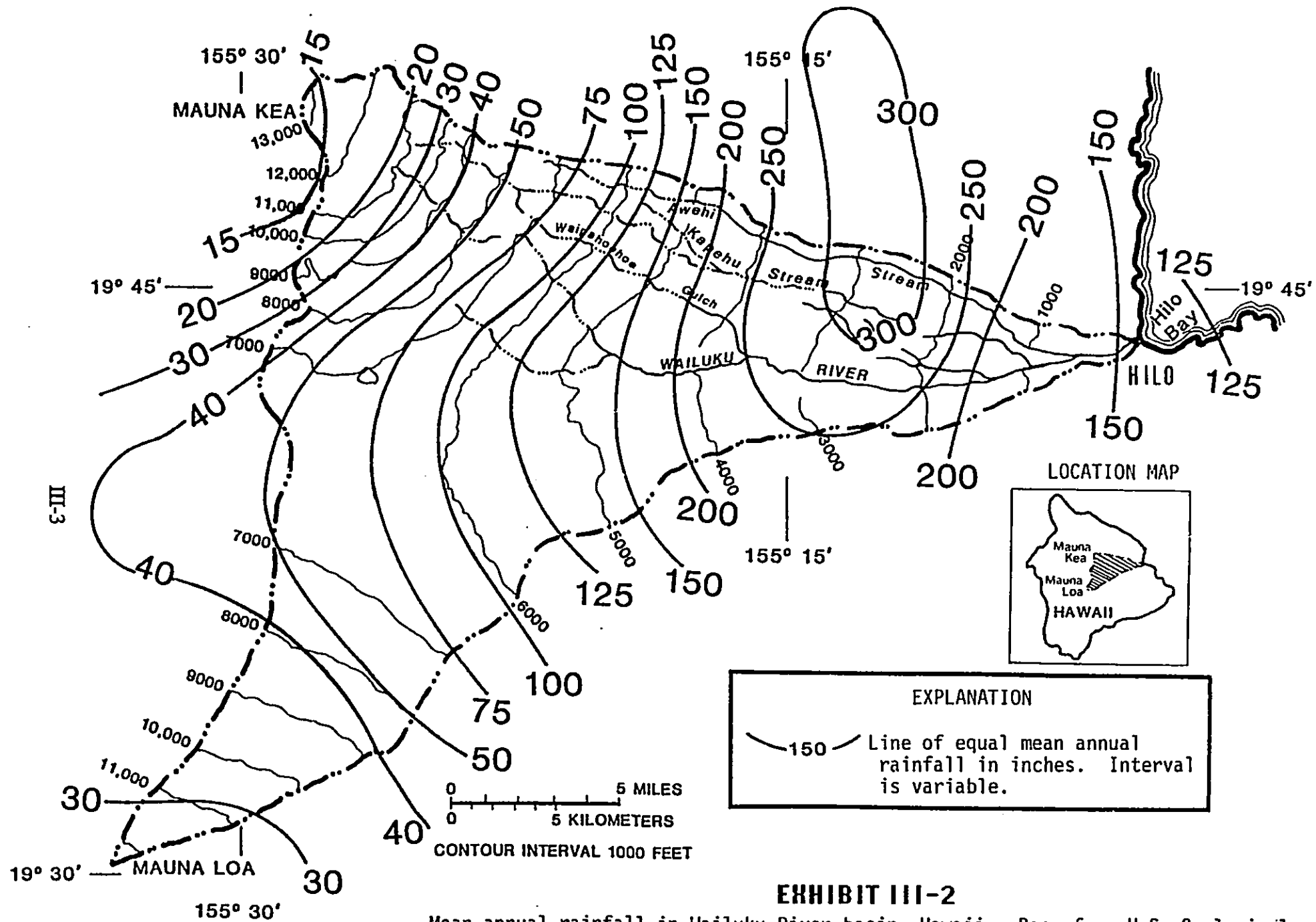


EXHIBIT III-2

Mean annual rainfall in Wailuku River basin, Hawaii. Base from U.S. Geological Survey; rainfall data from National Weather Service.

Source: USGS Water-Resources Investigation Report 86-4043

A physical division of the area's geological structure exists at the Wailuku River. Formations to the north of the river are those of Mauna Kea's volcano series, while the area to the south consists of Mauna Loa volcano formations, all of which date back to the Pleistocene Age.

The Mauna Kea's Hamakua volcanic series is a permeable basalt, but an overlying Pahala ash layer (up to 25 feet thick) and its derivative soil make the surface less permeable than normal for exposed basalts relative to other surrounding areas. As a result, stream flow from this area is substantial and flow in the Wailuku River, which originates on the ash-covered surface, averages several hundred million gallons per day. Slopes on the Mauna Kea surface are moderately steep, averaging 0.05 to 0.10, and are incised by numerous small streams. Rocks in the project area are of Pleistocene Upper Member of the Hamakua Series and consist of olivene basalt, andesite, and augite-rich picrite-basalt.

South and east of the Wailuku River the surface rocks consist of the Ka'u volcanic series of Mauna Loa, an extremely permeable basalt that is too recent in origin to have had formed a deep soil and saprolite top layer. Patches of Pahala ash lie on some older Mauna Loa lavas near the Wailuku River but are insignificant in contrast to the wide extent of bare Ka'u lava over the remainder of the area.

The Ka'u series, which erupted from Mauna Loa following the main deposition of Pahala ash, is relatively thin in section, perhaps 25 feet thick in the Hilo region. Beneath the ash is the initial Mauna Loa basalt formation -- the Kahuku series -- also extraordinarily permeable. The result of permeable surface and subsurface formations, even though a discontinuous strata of ash lies between them, is a lack of appreciable surface runoff and the occurrence of high infiltration and subsurface flow rates. Also contributing to the large infiltration rates are low slopes of Ka'u volcanics over much of the region, varying from 0.005 to 0.05.

The project site is within the Mauna Loa flows of the Ka'u series. These flows generally consist of prophyritic and non-prophyritic a'a and pahoehoe basalt. The flows average about 15 feet in thickness and are characterized by numerous lava tubes which transport large volumes of groundwater to the Hilo area. Rocks are olivene basalt.

Slope stability hazards in the project area range from low to high. A moderate to high rating is assigned to areas with known rock slides, to areas with suspected rock slides, and to areas with steep slopes. A low rating is assigned to all areas with no defined landslide features and gentle slopes. Slope stability is discussed further in the section on probable adverse environmental impacts and proposed mitigation measures.

Soils

The soils of Hawaii have been mapped by the U.S. Soil Conservation Service. Because the surveys of soils in the project area were made at a low-intensity or

reconnaissance level, the information must be considered preliminary. Soil samples will be taken during the design phase to verify the physical properties. According to the soil survey, the general soil classification of the project site is the Akaka-Honokaa-Kaiwiki association. According to the soil survey, these soils are deep, gently sloping to moderately well-drained and well-drained soils that have a moderately fine textured subsoil on uplands.

Soils are generally of the Kaiwiki Series (soil survey code KaE, KaD and KaC -- see Exhibit III-3). These soils consist of well-drained silty clay loams which form a series of volcanic ash layers and thus have a banded appearance. Typical mean annual soil temperature is 70 degrees and rainfall averages 150 to 200 inches annually. Slopes vary from 0 to 35 percent.

The deep valleys of the Wailuku River and other streams are classified as Rough Broken Land (soil survey code RB). RB is a miscellaneous land type that consists of very steep, precipitous land broken by many intermittent drainage channels. It occurs primarily in gulches, where slopes are dominantly 35 to 70 percent. The soil material ranges from very shallow to deep. Stones and rock outcrops are common in some areas.

Hydrology

Although the uppermost reaches of the headwater tributaries of the Wailuku River are considered intermittent, the mainstream flows continuously to the ocean year round. The Wailuku River drainage area is estimated to be approximately 230 square miles although only 149 square miles is thought to contribute to runoff. In this volcanic terrain, stream channels can diverge at cones and vents splitting surface runoff into different avenues at higher elevations. Also, complex geology such as lava tubes and intrusive dikes result in gains and losses to streamflow from groundwater. Thus, surface topology may not be indicative of the contributing drainage area for the Wailuku River (US Army COE, 1984). The Wailuku River drains through the Hilo Forest Reserve, agricultural lands and urban areas. Most of the area within the proposed project site is located on Hilo Forest Reserve with some agricultural lands located at the lower end.

The Wailuku River follows the approximate boundary between Mauna Loa and Mauna Kea volcanoes. The stream bed consists of lava flows from Mauna Loa which overlapped older Mauna Kea flows. The stream channel is stable due to the lava streambed. The streambanks are composed of fine to very coarse material and support dense vegetation growth. The dominate substrate in the river within the project area is bedrock and boulder. The river is characterized by a series of plunge pools at the higher elevations and by numerous waterfalls at elevations below 2,200 feet. There is an accretion of stream flow gradually downstream due to tributaries and discharge from large springs. A total of 13 tributaries enter the Wailuku River; two are found within the project site, the Hookelekele and Kalohewahewa Streams. The Hookelekele is joined by the Kalohewahewa at an elevation of approximately 1,420 feet and then enters into the Wailuku River at approximately 1,100 feet. At this point, the

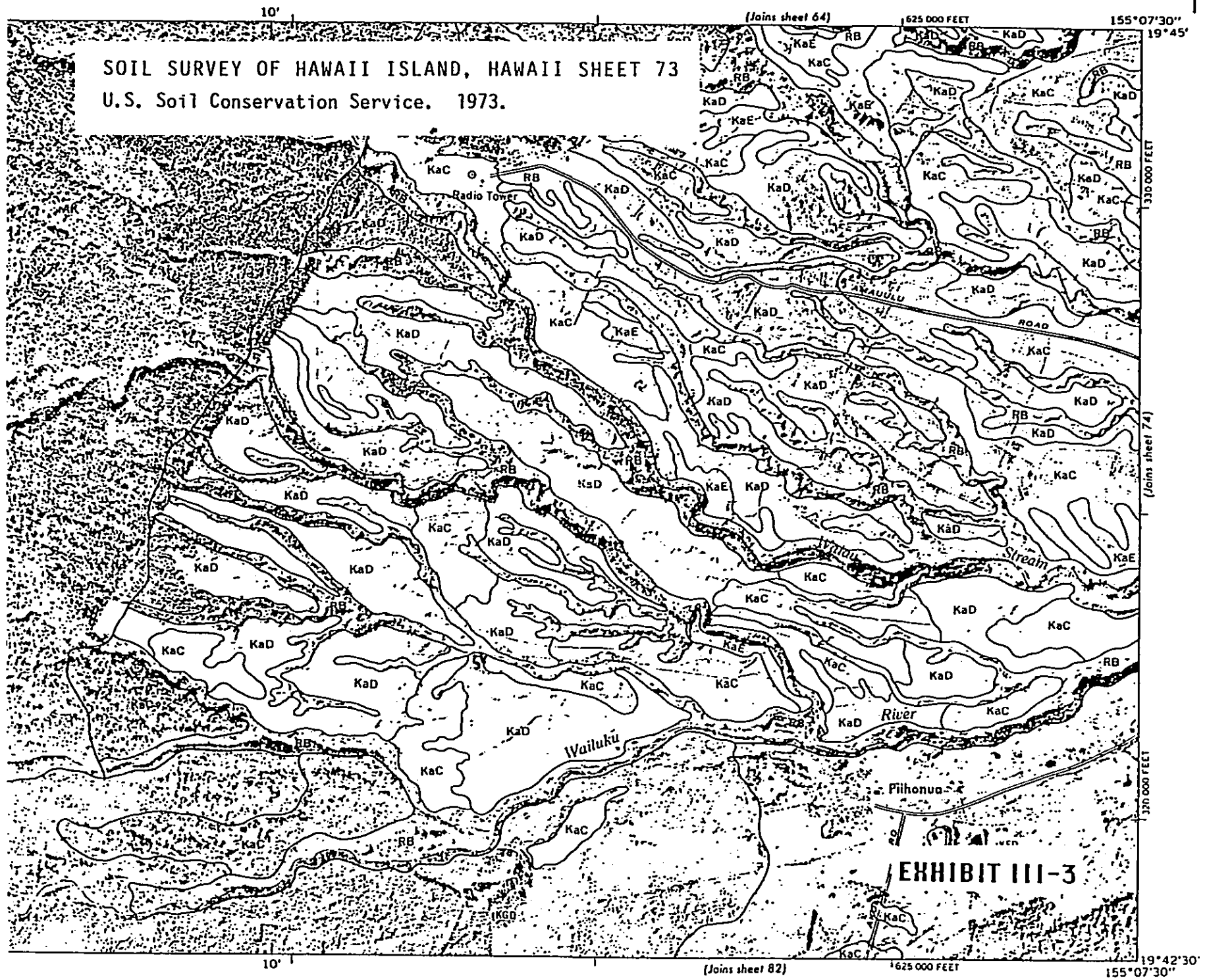


EXHIBIT III-3

Hookelekele contributes approximately 60% of the total flow in the Wailuku River (U.S. Army COE, 1984).

The Hookelekele is a second-order perennial stream that drains both the Hilo Forest Reserve and agricultural lands. Its headwaters are located near an elevation of 2,060 feet. The drainage area for the Hookelekele Stream is about 16 square miles and has an estimated average annual flow of 114 cfs (U.S. Army COE, 1984). A majority of the flow in the Hookelekele Stream comes from the Kalohewahewa Stream which is another second-order stream that flows entirely through the Hilo Forest Reserve. The headwaters for the Kalohewahewa Stream are located above 3,000 feet elevation.

The USGS has maintained a gaging station (No. 16704000) on the Wailuku River with daily stream records dating back to 1928. The gage is at an elevation of 1,090 ft and is located within the project area on the south bank of the river, 0.2 miles downstream from its confluence with Hookelekele Stream.

The average annual discharge during the period of record is 274 cfs. The Wailuku River exhibits a great variability in flow regime, both seasonally and over shorter intervals. Rapid fluctuations in discharge occur in response to rainfall. The highest daily mean discharge, 22,200 cfs was on January 8, 1975, and lowest, 0.31 cfs persisted for several days in February 1963. The lowest discharge recorded was 0.15 cfs and the highest was 80,200 cfs (Yee, *et al.* 1986).

Daily flow records for the period of record from 1928 through 1988 on the mainstem Wailuku River (station number 16704000) were used to establish mean monthly pre-project flow conditions within the study area. Partitioning of flows between the Wailuku River and the Hookelekele Stream were established as 40 percent and 60 percent of the gage readings based on the analysis presented by the U.S. Army Corps of Engineers (1984). Flows within the Kalohewahewa Stream were estimated as 60 percent of the Hookelekele Stream based on site reconnaissance of the channel morphology and observations made by the FWS (1984) and Archer (1989). Mean monthly flows based on the percent reallocations of the daily flow readings are presented in Table III-1.

The Hawaii County Department of Water Supply maintains three intake structures and pipelines in the area. The primary intake is at Kahoama, providing approximately 6 million gallons per day (MGD). The Pukamaui and Lauiole intakes provide 1.5 MGD. Projected demand is 10 MGD. During the dry season, Kahoama plus all of the water in the Wailuku River system cannot provide enough water for the City of Hilo and a well source supplies the additional water needed.

Water Quality

The Wailuku River has been proven to have relatively high quality water. As noted above, the city of Hilo diverts water from the Wailuku River for potable water. In

TABLE III-1

MEAN MONTHLY PRE-PROJECT FLOWS (cfs)
FOR THE WAILUKU RIVER PROJECT

	Wailuku Gage	Wailuku River[1]	Hookelekele Stream[2]	Kalohewahewa Stream[3]
Jan	283.0	113.2	169.8	101.9
Feb	310.8	124.3	186.5	111.9
Mar	412.6	165.0	247.5	148.5
Apr	411.1	164.4	246.6	148.0
May	230.0	92.0	138.0	82.8
Jun	123.4	49.3	74.0	44.4
Jul	193.4	77.1	115.6	69.4
Aug	296.3	118.5	177.8	106.7
Sep	153.9	61.6	92.4	55.4
Oct	173.0	68.9	103.4	62.0
Nov	352.2	141.0	211.4	126.9
Dec	351.8	140.8	211.2	126.7

1 = 40% of USGS Wailuku Gage
2 = 60% of USGS Gage between Wailuku River and Kalohewahewa Stream Confluence
3 = 60% of Hookelekele Stream Flow

March 1983, the State of Hawaii Department of Health tested the water in the Wailuku River and found no detectable levels of metals or pesticides. The only detectable substance was nitrates, at 0.2 parts per million (ppm), which is well within the state standard.

The Wailuku River is characterized as a clear unpolluted stream with low to moderate primary productivity, low phytoplankton concentration and low nutrient content. Water quality measurements were taken by the USGS (Yee, *et al.* 1986) from 1971 to 1980 at the USGS gaging station (1,090 ft elevation) on the Wailuku River. They found low specific conductance values (due to high rainfall over a terrain of fresh volcanic rock) that ranged from 20-75 (mean of 39.25), low dissolved solids, low turbidity (except during periods of heavy rainfall), low pH values that ranged from 5.7 to 7.8 (mean of 7.0) and high dissolved oxygen levels (due to numerous waterfalls in the basin). Water temperature fluctuated with ambient conditions and ranged between 14° and 23° C. During 1978, the water temperature in the Wailuku River increased only 1.4° C from 80 ft to 4,250 ft elevation.

A sediment station was established in 1977 on the Wailuku River at Hilo (80 ft elevation) by the USGS. Daily records are collected to monitor the suspended sediment load discharging from the basin into Hilo Bay and are published annually in "Water Resources Data for Hawaii and Other Pacific Areas." Based on records for the first 31 months of operation, the Wailuku River discharged a total of 58,000 tons of suspended sediment into Hilo Bay. On February 20, 1979, 14,100 tons were recorded, approximately 24% of the total suspended sediment load for the 31 month period of record (Yee, *et al.* 1986).

During periods of heavy rainfall, sedimentation can cause problems to the aquatic fauna. The erosion of forest soils caused by 'o'hia dieback and the activities of pigs have created problems in the upper watershed. Agricultural lands can contribute as much as 92% of the Wailuku's sediment load during high flow periods (FWS 1984). The lower reaches of the Wailuku River are subject to substantial sedimentation. The FWS (1984) observed thick deposits of terrigenous silt covering the streambed in the Rainbow Falls and Piihonua Road areas. Sediments completely covered gravels and small cobbles, coated boulders and filled rock interstices. They noted that sediment deposition did not appear as great in the reaches surveyed above the proposed project powerhouse.

While doing aquatic surveys of the proposed project area in March and June, 1986, Archer (1986) noted that the stream substrate was coated with a thick layer of sediment. He thought that it was an indication of an increased sediment load due to recent windstorm disturbance to the surrounding terrestrial environment. In the project area (during January 1989), sediments were observed entering the river from adjacent sugarcane fields during periods of heavy rainfall. Yee et al. (1986) reported that some atyid shrimp collected had necrotic lesions which Chan (1979) suggested were related to relatively high velocity and silt loads in the Wailuku River. This situation created an abrasive environment which may have led to the formation of these lesions.

Aquatic Habitat Within Project Area

Information on the aquatic habitat was obtained from site observations and from the FWS (1984) and Kelly Archer (1986, 1989). The habitat in the Wailuku River from 900 ft elevation to the confluence of Hookelekele Stream (1,100 ft elevation) as well as the Hookelekele Stream up to Kauwehu Falls (1,170 ft elevation) is characterized by strongly flowing water and frequent riffle areas separating large, deep pools. The substrate is predominantly boulder and cobble with intermittent stretches of bedrock. The habitat from the confluence of Hookelekele Stream to the base of Lauiole Falls (1,220 ft elevation) on the Wailuku River is composed primarily of deep, slow flowing pools. The stream channel is narrow with steep valley walls throughout much of this area. A very short riffle with a boulder-bedrock substrate is located in the middle of this section.

The habitat from the top of Lauiole Falls (1,310 ft elevation) to Koakanini Falls (1,500 ft elevation) on the Wailuku River ranges from areas with very narrow stream channels containing smooth bedrock substrate to wider stream channels characterized by deep, slow flowing pools with bedrock substrate. There are only infrequent and short riffle sections in this reach. The substrate is predominately bedrock with small aggregations of boulder and cobble. The area between Koakanini Falls and Hawaii Falls (1,775 ft elevation) is similar to the previous reach but contains more deep, slow flowing pools. Again, the substrate is dominated by bedrock, with infrequent, short riffle sections and small aggregations of boulder and cobble interspersed throughout the reach. From just above Hawaii Falls (1,800 ft elevation) to an elevation of 2,000 ft, the Wailuku River can be characterized as having a fairly narrow, well-defined channel. Short riffle areas leading into deep pools separated by swift cascades comprise the majority of the habitat in this reach. The substrate is dominated by bedrock with short segments of boulder and cobble occurring throughout the area. Upstream from this reach, the river channel broadens substantially leading to Poakana Falls (2,040 ft elevation). This area is dominated by slow flowing, deep pools. The substrate is almost exclusively bedrock.

The Hookelekele Stream between the top of Kauwehu Falls (1,240 ft elevation) and the base of the unnamed falls on the Kalohewahewa Stream (1,500 ft elevation) is comprised of two different types of habitat. The lower 1,000 ft consists of a narrow channel which supports a bedrock and large boulder substrate with swiftly flowing water. In the remaining 3,000 ft, the stream channel broadens and the stream is characterized by riffles and shallow pools. The substrate in this area is varied, consisting of boulders overlying bedrock, with cobble, gravel and sand found along the margins of the stream and in the pools. The majority of rocks in this reach are covered with a brown/golden diatom complex.

The habitat between 1,600 ft and 1,850 ft elevation on the Kalohewahewa Stream consists of cascades leading into narrow, deep pools. The stream channel is usually very narrow and steep throughout most of this section. The substrate is primarily

bedrock with incidental accumulations of boulders. At approximately 1,900 ft elevation, two tributaries join the Kalohewahewa Stream. The stream channel in these tributaries is broader and more open than downstream. The substrate is still dominated by bedrock, however, algae growth on the substrate is more apparent than downstream. The abundance of algae in this area is probably due to the presence of slower flows existing in the tributaries which are a result of the wider stream bed and lower gradient.

Aquatic Fauna

Three surveys of the Wailuku River fauna within the project area have been conducted in recent years (FWS 1984, Archer 1986, 1989). Direct, visual surveys using face masks and snorkels, along with observations from the stream bank, were employed to locate and identify aquatic fauna in these studies. Additionally, the (then) Hawaii Division of Fish and Game conducted a survey of the lower Wailuku River (near the ocean confluence) in 1966. This survey was conducted to evaluate the river in terms of suitable habitat for introduced sport-fishing species. A survey of the lower Wailuku River (below the proposed project site) was performed by the FWS in 1978. A list of the macrofauna, observed during all known aquatic surveys in the Wailuku River, appears in Table III-2. Also, the USGS (Yee, *et al.* 1986) collected data on benthic invertebrates, periphyton, phytoplankton and coliform bacteria from the Wailuku River between 80 and 6,840 ft elevation.

In July 1983, the FWS surveyed five reaches on the Wailuku River between an elevation of approximately 900 ft (above Rainbow Falls) and 1,400 ft (above Lauiole Falls). In April 1984, they surveyed two reaches on the Hookelekele Stream between 1,200 ft (above Kauwehu Falls) and 1,500 ft elevation (near the Kalohewahewa Stream confluence). The introduced poecilid fishes (swordtails and guppies) were ubiquitous in all reaches sampled except for the areas above Lauiole Falls on the Wailuku River and Kauwehu Falls on the Hookelekele Stream. These exotic fishes, the introduced Louisiana crayfish and the bullfrog were the most frequently observed species in the Wailuku River.

The most frequently observed native species was the endemic atyid shrimp, opae kala'ole (*Atyoides bisulcata*). Large aggregations of these shrimp were found along the vertical walls of plunge pools below each waterfall. It was the only diadromous species observed above Lauiole Falls on the Wailuku River. The aquatic fauna above this elevation are generally known to be dominated by insects (FWS 1984). In the Hookelekele Stream, the atyid shrimp were common along the walls of the channels and under boulders and larger cobble. High density pockets of atyids were found at the base of small falls. Gravid females were common. No juvenile atyids were seen in this reach.

The only native fish found during the FWS surveys was the rare endemic goby, 'o'opu alamo'o (*Lentipes concolor*). This was the first recorded sighting of this species in the Wailuku River or Hookelekele Stream. A total of 15 *L. concolor* (all adults) were

TABLE III-2

AQUATIC MACROFAUNA RECORDED FROM THE WAILUKU RIVER, HAWAII BETWEEN 1966 AND 1989
(* denotes species observed in Hookelekele Tributary)

Organism	Common Name	Zoogeographic Status	HFG 1966	FWS 1978	FWS 1983/1984	Archer 1986 1989
SPONGE						
Meyeninae						
Heteromyenia balleyi	Freshwater Sponge	Indigenous			X	
INSECTS						
Trichoptera						
Cheumatopsyche analis	Caddisfly	Introduced			X	
Coleoptera						
Dytisidae	Water Beetles	Endemic		X		
Heteroptera						
Hebridae	Velvet Water Bugs	Indigenous			X	
Veliidae	Small Water Strider	Indigenous			X	
Diptera						
Chironomidae	Riffle Midges	Endemic	X	X		
Culicidae	Mosquitos	Exotic	X	X		
Tipulidae	Crane Flies	Endemic			X	
Ephydridae	Brine Flies	Indigenous			X	
Odonata						
Anax junius	Green Darner	Indigenous	X			
A. strenuus	Giant Hawaiian Dragonfly	Endemic	X(?)			
Pantala flavescens	Globe Skimmer	Indigenous			X	
Megalagrion spp.	Hawaiian Damselflies	Endemic	X	X		
Enallagma civile	Bluet	Indigenous			X	

TABLE III-2 (continued)

Organism	Common Name	Zoogeographic Status	HFG 1966	FWS 1978	FWS 1983/1984	Archer 1986	1989
MOLLUSKS							
Gastropoda							
Erinna aulacospira	Hawaiian Pond Snail	Endemic			X		
E. newcombi	Hawaiian Pond Snail	Endemic			X		
Pseudisidora rubella *	Hawaiian Pond Snail	Endemic			X	X	
CRUSTACEANS							
Decapoda							
Atyoides bisulcata *	Opae Kala'ole	Endemic	X	X	X	X	X
Procamparus clarkii	Louisianna Crayfish	Exotic	X	X	X		
Macrobrachium lar	Tahitian Prawn	Exotic			X		
FISHES							
Gobiidae							
Sicyopterus stimpsoni	O'opu Nopili	Endemic	X				
Lentipes concolor	O'opu Alamo'o	Endemic			X	X	
Awaous stamineus	O'opu Nakea	Endemic (?)	X				
Poeciliidae							
Xiphophorus helleri	Swordtail	Exotic	X	X	X	X	
Poecilia reticulata	Reticulated Guppy	Exotic	X	X	X	X	
Cobitidae							
Misgurnus anguillicaudatus	Oriental Weatherfish	Exotic	X	X	X		
AMPHIBIAN							
Ranidae							
Rana catesbiana *	Bullfrog	Exotic	X	X	X	X	

observed during the surveys. Two were observed in the splash pool below Lauiole Falls on the Wailuku River and four in a pool at the base of Kauwehu Falls on the Hookelekele Stream (just upstream from the Wailuku River confluence). Nine *L. concolor* were found in the Hookelekele Stream between 1,200 ft and 1,500 ft elevation. Of the nine collected in the upper reach, five were males and four were females. The males were brightly colored. The females were usually seen in the general areas that males were found in. No overlapping size classes were observed. No females were found spawning nor were any eggs found.

This FWS survey (1984), like the one performed in 1978 (FWS 1978), failed to find either of the endemic gobies 'o'opu nakea (*Awaous stamineus*) or 'o'opu nopili (*Sicyopterus stimpsoni*) that were collected in 1966 by the (then) Hawaii Division of Fish and Game. Since neither of the FWS surveys included the mainstream below Rainbow Falls, a definite statement about presence or absence of these two gobies in the Wailuku River would be speculative. The FWS (1984) noted that two factors may play a major role in the exclusion of 'o'opu nopili from the Wailuku River: exotic species and heavy sedimentation of the stream bed. This species is not commonly observed living sympatrically with any of the introduced fishes. It is possible that ecological interactions between species restrict the establishment of 'o'opu nopili populations throughout most of the Wailuku River. Also, excessive sedimentation has buried suitable habitat in the lower reaches of the Wailuku River. The FWS (1984) further noted that a third factor may account, in part, for the low numbers of all the endemic, diadromous fishes: a large proportion of the stream bed over relatively long reaches within the Wailuku River is solid bedrock. Bedrock provides little shelter against strong currents, abrasive particulates and predators, and is probably unsuitable as spawning habitat for most species of native fishes.

The FWS (1984) however, reported that in contrast to the Wailuku River, the stream bed in the Hookelekele Stream is mainly boulder and cobble overlying bedrock. This substrate heterogeneity provides low velocity zones for fishes, even during high flow periods. Boulders and cobbles provide breeding and egg-laying sites for females, display areas for the territorial males, feeding sites, and protection from suspended particulates. The substrate complexity and the resulting microhabitats in the Hookelekele Stream provide relatively good habitat for supporting goby populations. These observations enabled the FWS (1984) to list the Wailuku River as a Resource Category 4: the habitat to be impacted is of medium to low value for the evaluation species (native stream species) and the Hookelekele Stream as a Resource Category 2: the habitat to be impacted is of high value for the evaluation species and is relatively rare or becoming scarce on a regional basis or in the ecoregion setting.

The FWS Mitigation Policy (Dept. Interior, *Federal Register*, "USFWS Mitigation Policy; Notice of Final Policy," Vol. 46, No. 15, January 23, 1981) has four resource categories and mitigation planning goals:

Resource Category	Designation Criteria	Mitigation Planning Goal
1	High value for evaluation species and is unique and irreplaceable	No loss of existing habitat value.
2	High value for evaluation species and is scarce or becoming scarce.	No net loss of in-kind habitat value.
3	High to medium value for evaluation species and is relatively abundant on a national basis.	No net loss of habitat value while minimizing loss of in-kind habitat value.
4	Medium to low value for evaluation species.	Minimize loss of habitat value.

The purpose of the FWS Mitigation Policy is to "(1) ensure consistent and effective Service recommendations; (2) allow federal and private developers to anticipate Service recommendations and plan for mitigation needs early; (3) reduce Service and developer conflicts as well as project delays."

Kelly Archer surveyed several reaches within the project area on the Wailuku River, Hookelekele Stream and Kalohewahewa Stream in 1986 and 1989. In 1986 he surveyed three reaches on the Wailuku River between 900 ft and 1500 ft elevation (to Koakanini Falls) and one reach on the Hookelekele Stream above Kauwehu Falls (1,240 ft elevation) to the base of the unnamed falls near the confluence of Hookelekele Stream and Kalohewahewa Stream (1,500 ft elevation). The atyid shrimp and bullfrog were the most frequently observed species in these study reaches. The guppy and swordtail were observed at all reaches on the Wailuku River below 1,500 ft elevation. Although uncommon, the pond snail *(Pseudisidora rubella)* was observed in all reaches surveyed during 1986. Two *L. concolor* were observed in the Wailuku River at the confluence with the Hookelekele Stream (1,130 ft elevation). None were observed in the Wailuku River above this point. With the exception of the atyid shrimp, population sizes of aquatic fauna observed during the 1986 survey were quite small in both the Wailuku River and Hookelekele Stream.

No exotic species were observed in the Hookelekele Stream. A total of eight adult *L. concolor* were seen in the Hookelekele Stream, all between 1,240 ft and 1,500 ft elevation. Archer (1986) stated "given the large area sampled during this survey, the 10 *Lentipes* collected indicate that a very small population of this goby inhabits the

Wailuku River and Hookelekele Stream in the study site. *Lentipes* would be considered uncommon in the two streams according to Timbol et al. (1980)."

In 1989 Archer surveyed two reaches on both the Wailuku River and Kalohewahewa Stream. On the Wailuku River he surveyed between Koakanini Falls (1,500 ft elevation) and Hawaii Falls (1,800 ft elevation) and between Hawaii Falls and 2,100 ft elevation. No *L. concolor* were found above 1,300 ft elevation on the Wailuku River. The atyid shrimp was the only macrofauna found inhabiting the Wailuku River in this study area. The shrimp was found in small groups which decreased in size and number as the elevation increased. The groups seldom numbered more than 10-15 individuals and were located in the boulder/cobble/riffle areas which comprised a small percent of the total substrate above 1,500 ft elevation. On the Kalohewahewa Stream, Archer surveyed between 1600 ft elevation (just above the confluence of the Hookelekele Stream) and 1,800 ft elevation and between 1,850 ft and 2,100 ft elevation. No Lentipes were found in the Kalohewahewa Stream. The atyid shrimp was the only macrofauna observed in this stream. The shrimp was found in isolated, very small groups, mainly in the riffle areas between pools. As with the Wailuku River, their number decreased as the elevation increased.

In 1989, Archer also surveyed a short section of the Hookelekele Stream just above its confluence with the Kalohewahewa Stream and made the following comments.

> "The stream is of completely different character than the Wailuku River or Kalohewahewa Stream. The substrate is almost entirely cobble and boulder. The flow is very significantly less than its neighbors and the vegetation growth indicates that the range of flow is probably very limited, no huge, substantial flow fluctuations, as is evidenced in both of the other, larger streams. Even within the very short sampling time I devoted to this stream, it was obvious that the population size of atyid shrimp was much greater in this small stream. Substrate and stream size appear to be the critical factors which improve the streams' ability to support populations of native fauna."

This section of the Hookelekele Stream appears more similar to other streams that support larger populations of *Lentipes* compared to the Hookelekele Stream below its confluence with the Kalohewahewa Stream or the Wailuku River. The proposed project will not divert any water from this section of the Hookelekele Stream.

The Wailuku River does not fit the definition of a "typical *Lentipes* stream" as determined by Timbol *et al.* (1980) and Kinzie and Ford (1982). Abundance of *Lentipes* is very low in both the Wailuku River and Hookelekele Stream, aquatic surveys to date have located only 25 individuals. All of the *Lentipes* observed have been adults; no evidence of overlapping size classes or evidence of spawning or recruitment has been observed in the Wailuku River or Hookelekele Stream. The elevation at which most of the Lentipes have been observed is at the upper limits (1,500 ft elevation) of the range that this species is known to exist (Maciolek 1977, Timbol *et al.* 1980).

The Wailuku River lacks suitable substrata, while the Hookelekele Stream (below the Kalohewahewa confluence) contains suitable habitat only in less than 3,000 feet of stream. The Wailuku River and Hookelekele Stream are large systems that are subject to tremendous fluctuations in daily and seasonal flows which could limit abundance and affect various life history functions of the Lentipes. The scouring of the stream bed in both the Wailuku River and Hookelekele Stream (below the Kalohewahewa confluence) by large freshets, drastically reduces the ability of these streams to support native fauna. The Lentipes appear to favor smaller streams with heterogeneous substrate which would allow for shelter during these freshets (Archer 1989). Compared to other Lentipes streams, the water temperature, benthic invertebrate abundance and primary and secondary production tend to be lower in the Wailuku River system (Timbol *et al.* 1980, Yee *et al.* 1986, Archer 1989). These factors probably contribute to the less-than-optimal habitat values in the system (Archer 1989).

Additionally, the lower Wailuku River may present numerous obstacles to upstream migration of *Lentipes* fry to the upper Wailuku River and Hookelekele Stream and the downstream drift of eggs to the ocean. There is no terminal waterfall at the mouth of the Wailuku River to prevent exotic and native species from gaining access to the lower sections of the river. Competition and predation from exotic species (and some native species) is a major factor limiting *Lentipes* abundance (Timbol *et al.* 1980, Kinzie and Ford 1982). Streams with terminal falls tend to have more abundant populations of *Lentipes* and the species is found closer to the ocean (Kinzie and Ford 1982). Human activities in the lower reaches of the Wailuku River such as water removal for domestic use, residential and agricultural runoff and operation of an existing hydroelectric plant probably affects the upstream migration and downstream movement of Lentipes. As noted previously, sedimentation presents problems to the native aquatic fauna in the lower Wailuku River (FWS 1984). The algal mat growth that covers a substantial portion of the substrate in the lower river may also be a factor limiting native aquatic fauna (Kinzie and Ford 1982).

Based upon this information, the FWS should consider reanalyzing the Hookelekele Stream as it relates to their Mitigation Policy. The Hookelekele Stream should more realistically receive a resource category rating of three or four since the habitat of the evaluation species (*Lentipes concolor*) is probably of medium value.

Aquatic Species of Concern Within the Project Area

There are five species of stream fishes that comprise the entirety of the native freshwater fish fauna of the Hawaiian Islands, four gobies (*Stenogobius genivittatus, Sicyopterus stimpsoni, Awaous stamineus,* and *Lentipes concolor*) and one electrid (*Eleotris sandvicensis*). The *Awaous, Sicyopterus* and *Lentipes* are endemic to the Hawaiian Islands. The *Lentipes* is considered a candidate species for listing as an endangered species by FWS (Kinzie, 1988).

The *Awaous* and *Sicyopterus* were found in the lower Wailuku River near its confluence with the ocean in 1966 (FWS 1978). Neither species has been reported in or near the project area.

Lentipes concolor

The common name for *Lentipes concolor* is 'o'opu alamo'o; 'o'opu is a Hawaiian term for gobioid fishes and alamo'o means lizard-like (Lau 1973). In Hawaiian folklore, to find this species in a net when fishing for other fish was considered bad luck because it kept the other fish away and was regarded as kapu (forbidden) by Hawaiians who believed it related to the Mo'o (lizard god).

Lentipes is the rarest of the four Hawaiian gobies and is the species with the most limited distribution (Kinzie and Ford 1982). It was originally described from collections made from Oahu and Hawaii in the 19th century. Based upon surveys conducted during 1979 and 1980, Timbol *et al.* (1980) determined that *Lentipes* were found in 24 streams on Maui, 15 streams on Hawaii, 10 streams on Kauai and 7 streams on Molokai. It was not found on Oahu and is presumed to be extinct from that island. The island of Hawaii contained about 27% of all the known *Lentipes* streams. Timbol et al. (1980) did not sample the Wailuku River, however, they stated "qualitative knowledge of the stream drainages indicates that no additional *Lentipes* streams will be found." Maciolek (1977) suggested that not all streams containing *Lentipes* have viable populations. In some streams only a few individuals were collected which is indicative of marginal populations that are dependent on reproduction elsewhere. He indicated that critical habitat streams (those where all aspects of the life history is occurring) may comprise fewer than half of the total number of streams in which *Lentipes* resides. It is possible that the Wailuku River (and Hookelekele Stream) is one of these streams where reproduction is absent or very rare and the population depends on recruitment from other streams.

Like other gobies, *Lentipes* is diadromous, meaning it is a fish that resides in a stream but its larvae must reach the ocean to develop and later reenter the stream as a fry. Adult *Lentipes* characteristically reside in middle to upper stream reaches at elevations ranging between 150 and 1,500 ft (Maciolek 1977). The adults tend to be absent in lower reaches, particularly in small streams with estuaries. In large streams or streams with terminal falls, adults do occur closer to stream mouths (Kinzie and Ford 1982). *Lentipes*, like other gobies, have fused pelvic fins that form a strong suction disk, enabling them to cling to rocks and climb up large waterfalls.

Males are larger than females reaching 100 mm (SL), while females attain a length of 85 mm (Kinzie 1988). The species exhibits diverse sexual dimorphisms in their external morphology to the extent that original taxonomic descriptions indicated two species of *Lentipes* occurred, however it was later determined that the descriptions reflected differences in males and females and that only one species of *Lentipes* existed (Lau 1973). The adult males can be recognized by their distinctive red or orange coloration pattern (Maciolek 1977, Timbol *et al.* 1980, Nishimoto and Fitzsimons 1986).

The adults exhibit very little in-stream movement. Kinzie and Ford (1982) observed only downstream movement, which was probably a result of displacement by high water. They noted that, once displaced, the adult will probably stay in this new location for the remainder of its life.

Adult male *Lentipes* are strongly territorial and aggressive during feeding and breeding periods (Lau 1973, Maciolek 1977, Nishimoto and Fitzsimons 1986). *Lentipes* are omnivorous, exhibiting preferential food habits that change from herbivorous to carnivorous as they increase in size. The larger *Lentipes* tend to eat more animal material, primarily shrimp and insect larvae, while the smaller fish appear to consume more algal material (Lau 1973). The availability of food in a stream apparently is an important determining factor in the *Lentipes* food habits. Food habits and food preference are interdependent upon location of stream, season of year, and standard length and sex of fish.

Lau (1973) reported that *Lentipes* attain sexual maturity after about one year of life. Maciolek (1977) noted that females are sexually mature when they reach 50 mm total length (TL) and that breeding takes place in defined areas. The males undergo a conspicuous change in color during courtship (Nishimoto and Fitzsimons 1986). Information is lacking on the seasonality of *Lentipes* breeding (Kinzie 1988). Maciolek (1977) collected ripe females from August to May and suggested that they may spawn year-round (depending upon freshets) and possibly peak in early fall with the onset of the wet season. Timbol et al. (1980) reported that spawning may possibly take place in the fall and winter months while Kinzie (1988), suggested that spawning may take place in the spring. Substrate, cover and perhaps velocity and depth all very likely play a role in determining the suitability of nesting sites. The females attach thousands (Maciolek 1977, found 7,000 and 14,000 eggs in two females examined) of demersal eggs (less than 1 mm in diameter) to the surface of rocks where they are fertilized by an attendant male. Within a short time (as little as 24 hours) the eggs hatch and the microscopic larvae (1-2 mm in length) are swept downstream passively to the ocean (Maciolek 1977, Kinzie and Ford 1982). To survive, the larvae must reach the ocean quickly, the larvae can not live in freshwater more than four or five days (Dr. Kinzie, personal communication). *Lentipes* are adapted to in-stream signals as cues for spawning and recruitment (Kinzie and Ford 1982). Spawning may be tied in to periods of high flows (freshets or normal runoff) to insure that the larvae reach the ocean.

Once in the ocean, the larvae mature as part of the marine zooplankton community. No information is available on where *Lentipes* larvae spend their marine life stage or the length of time that they are in the ocean. Based upon information from related species, the length of time could be from 30 to 180 days (Lau 1973, Maciolek 1977, Timbol *et al.* 1980, Dr. Kinzie, personal communication). It is hypothesized that *Lentipes* larvae drift with the current throughout the islands of Hawaii and represent the principal form of dispersal between streams and islands in Hawaii (Timbol *et al.* 1980, Dr. Kinzie, personal communication). The larvae then locate a freshwater stream, metamorphose and settle into the stream. This process is probably triggered by contact with waters of reduced salinity near stream mouths (Kinzie and Ford 1982). No

evidence of homing in freshwater gobies has been recognized. Probably larvae from any stream may ascend other streams and if these streams prove unsuitable, the larvae die (Timbol *et al.* 1980).

Returning post-larvae (fry) are less than 20-25 mm (TL) and are transparent except for relatively large eyes and heads (Maciolek 1977, Kinzie and Ford 1982, Kinzie *et al.* 1984). Pigmentation first appears after several hours in freshwater (Maciolek 1977). Post-larvae *Lentipes* have been collected in spring, winter and fall, but never in large numbers (Maciolek 1977, Kinzie and Ford 1982).

The fry life stage determines the longitudinal distribution of adults in streams. They must surmount steep gradients and cascading waterfalls to reach their adult habitat. These migrants demonstrate superb climbing abilities. They have been observed climbing up a smooth vertical surface at a rate of 18 inches in 20 seconds and have been known to surmount single waterfalls 300 ft high (Maciolek 1977, Kinzie and Ford 1982). Once reaching suitable habitat, the fry stops migrating and grows into an adult. The juvenile *Lentipes* has an adult body form but is not sexually mature (Kinzie 1988). *Lentipes* over 50 mm in length are considered adults and those under 50 mm are considered juveniles (Dr. Kinzie, personal communication). Kinzie *et al.* (1984) defined juveniles as individuals that had full pigmentation but which did not exhibit adult coloration.

Kinzie *et al.* (1984) collected habitat preference information on substrate, depth and velocity for juvenile and adult *Lentipes* from two streams on Maui and two streams on Kauai. The transferability of this information from one stream to another has been questioned by Kinzie and Ford (1986). Although these streams are much smaller than the Wailuku River and contain considerably more *Lentipes*, it is the only information available that was collected specifically for use in the FWS IFIM analysis that will be discussed later. The following optimum habitat preferences for *Lentipes* were reported:

	Adult	Juvenile
Velocity (ft/s)	0.00-0.45	0.00-0.60
Depth (ft)	1.13-1.38	0.63-1.38
Substrate	Boulder/Bedrock	Boulder

Timbol *et al.* (1980) compared *Lentipes* microhabitat in 10 *Lentipes* streams versus 37 non-*Lentipes* streams. They found that *Lentipes* streams had lower mean width, depth and flow velocities and higher pH and conductivity and lower turbidity measurements. They concluded that *Lentipes* streams are more likely to be small to moderate in size, moderately deep, fast flowing, with clear water and bedrock-boulder-cobble substrate. The substrate in the microhabitat consisted of boulder and less frequently of bedrock, cobble and plant material.

The microhabitat values for *Lentipes* streams were:

Microhabitat	Mean	Range
Width (m)	0.61	0.23-.5
Depth (cm)	10.9	6.5-14.4
Velocity (cm/s)	86	43-137
Water Temp. (C)	22.4	21.1-23.0
pH	7.3	6.2-7.9
conductivity (umhos)	134	68-201

Kinzie and Ford (1982) noted that *Lentipes* in larger streams or pools of smaller streams (where velocity and turbulence are relatively low and uniform) appeared to spend more time in midwater than other Hawaiian gobies. Lau (1973) reported that *Lentipes* primarily live in streams that have a constant, rapid flow rate with temperatures ranging from 19 to 20 C.

Atyid Shrimp

Like *Lentipes*, the atyid shrimp (*Atya bisulcata*) is an endemic diadromous species. It is the most common and abundant, native macrofaunal element in Hawaiian streams (Kinzie and Ford 1982). They attain a size up to 50 mm (TL), with females slightly larger than males (Timbol *et al.* 1980). The species is capable of breeding year-round (Couret 1976). Eggs are carried on swimmerets of females until they hatch. The larvae are swept downstream to the ocean where they spend up to three months as part of the marine zooplankton community. The postlarvae enter a stream where they take on adult morphological characteristics. These postlarvae are usually less than 2 mm POCL (Couret 1976). The postlarvae migrate upstream, climbing waterfalls over 300 ft high. Kinzie and Ford (1982) observed postlarvae creeping up the face of waterfalls by using wet mosses and ferns as ladders.

The atyid shrimp is more abundant at higher elevations than native fishes and is characteristic of torrential streams (Timbol *et al.* 1980). Although reported from elevations up to 3,300 ft (Kinzie and Ford 1982), it probably does not extend that far up in the Wailuku River system. Yee *et al.* (1986) collected aquatic samples from six different areas on the Wailuku River and found the atyid shrimp abundant at the 1,090 ft elevation, rare at 80 ft and 880 ft elevations and absent at 3,520 ft, 4,250 ft and 6,840 ft elevations. Archer (1989), noted that they were rare at the 2,100 ft elevation on the Wailuku River and Kalohewahewa Stream.

Habitat preference information was collected for the atyid shrimp by T.R. Payne and Associates (1987) from the Lumahai River, Kauai. They found that the shrimp utilized shallow depths between 0.25 and 1.5 feet, very slow water velocities almost entirely less than 0.5 feet per second, and a range of substrates (boulders being the dominant substrate utilized).

The FWS (1984) found large aggregations of the atyid shrimp along vertical walls of plunge pools below each waterfall in the Wailuku River. In the Hookelekele Stream high densities were found at the base of small falls, while they were also common along the walls of channels and under boulders and larger cobble.

Archer (1989) observed the atyid shrimp in association with boulder-cobble-riffle substrate in the Wailuku River and Kalohewahewa Stream above 1,500 ft elevation. They were not found associated with bedrock substrate which dominated the habitat in these study reaches.

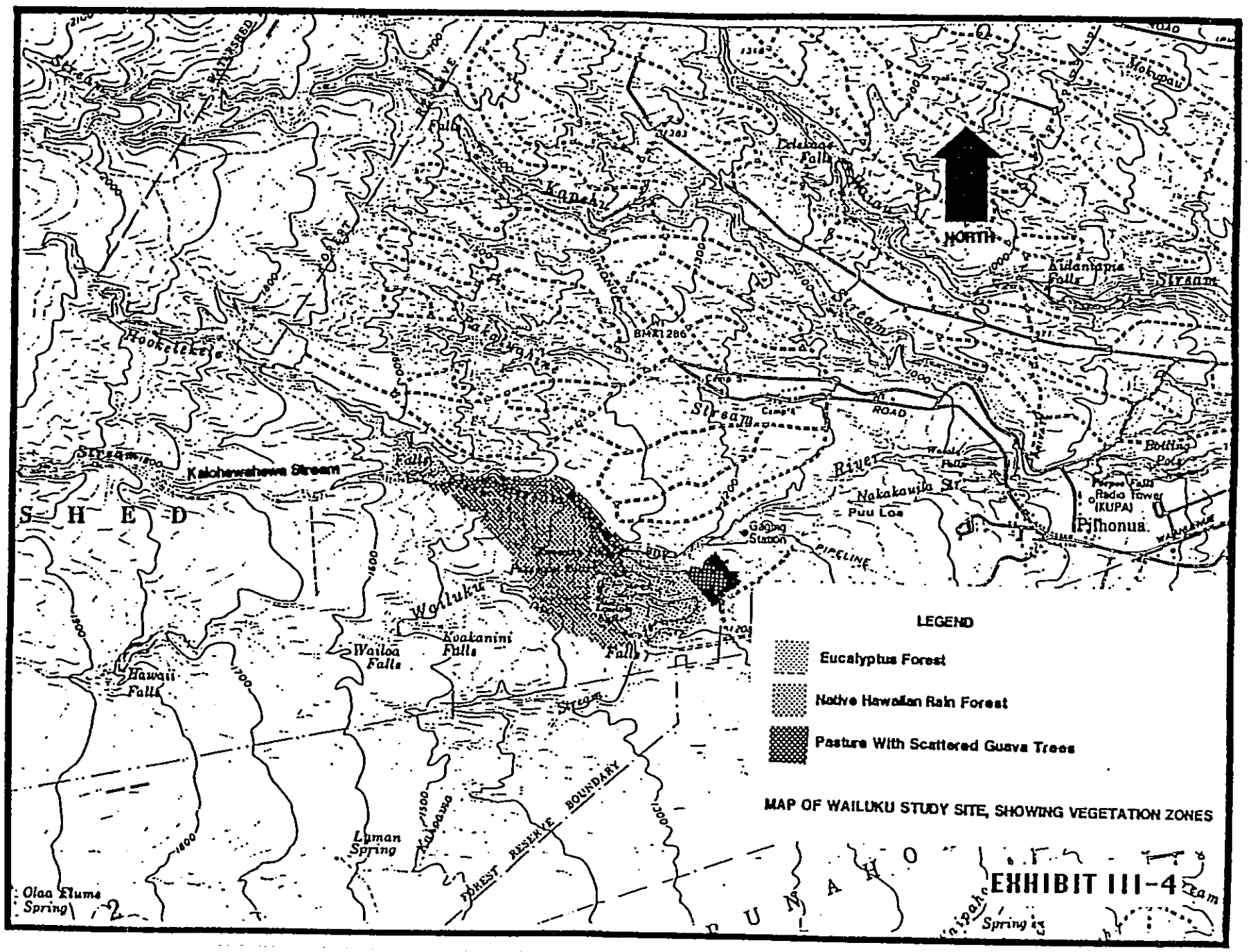
Vegetation

A botanical reconnaissance of the area of the proposed project was conducted between 8 and 13 December 1985 to document the plant life, and in particular to determine the presence of rare, endangered or other notable plants, and to investigate potential environmental problems. This was followed by a more thorough survey in May and June of 1986 (A. Kepler, July 1986). Portions of the revised and redesigned project -- the diversion structures on Kalohewahewa Stream and the Wailuku River -- are outside the limits of the survey boundaries. A qualified botanist will be included on the project design team when plans are finalized to ensure that all of the site is surveyed. This is discussed further in the section on probable impacts and mitigation measures.

The survey report describes the vegetation in the project area as composed of native 'ohi'a-koa forest, exotic eucalyptus forest, pasture, and riparian plants along the stream beds. The area receives ample rainfall throughout the year and is lush and thickly vegetated with a relatively high species diversity. The location and variety of vegetation types are described as follows (see Exhibit III-4):

The 'Ohi'a-Koa forest fringes the sugarcane fields in the eastern half of the study area, extending northwest up Hookelekele Stream. It forms part of a large tract of native rainforest that extends along the entire Hamakua Coast of the Big Island and is composed primarily of 'ohi'a lehua (*Metrosideros collina*) and koa (*Acacia koa*). Beneath these dominants grow a rich understory of treefern (*Cibotium*), shrubs, vines, ferns, herbs, epiphytes, and other small plants. Because of its low elevation and disturbance by feral pigs, both native and exotic species are present. The exotics range from obviously planted anthuriums to naturalized Alexandra palms, common over a wide area of Big Island rainforests.

A discrete area planted primarily in swamp mahogany (*Eucalyptus robusta*), extends west along the Wailuku River above Lauiole Falls, covering most of the western half of the study site between its upper and lower stream boundaries. Due to high rainfall, its understory is unusually lush, containing both native and introduced species. It is here that pigs reach their greatest abundance. No endangered species were found in this habitat.



MAP OF WAILUKU STUDY SITE, SHOWING VEGETATION ZONES

EXHIBIT III-4

The lower portion of the project area is typical lowland pasture composed of a variety of grasses and sedges, primarily introduced, and dominated by *Digitaria decumbens, D. adscendens,* and *Paspalum* spp.

The riparian habitats show the greatest diversity. The riparian habitats are generally richest within the native forest, typically consisting of uluhe (*Dicranopteris linearis*), with a scattering of treeferns, *Cordyline terminalis, Pisonia umbellifera,* and the King Palm, *Archontophoenix alexandrae.* A complete plant list is attached as Appendix A.

One endangered plant was found in this habitat, a rare variety of 'ohi'a lehua (*Metrosideros collina* p. *newellii*) or Newell's 'ohi'a lehua, frequenting rocky banks beside, along, and within the streams. This plant is a Category 1 Candidate Endangered Species for the Federal Register, known to be found only in a few locations along the Wailuku River before this survey. A total of 101 Newell's 'ohi'a were located and mapped (see Exhibit III-5). Tree sapling heights ranged from 4 inches to 25 feet, averaging 4.4 feet. Most were scrubby and small. A pure variety over 15 feet tall was unusual.

The botanists conducting the survey noted slight to severe pig damage throughout both native and eucalyptus forests. In areas of severe damage, virtually no ground cover remained. In addition to damaging native vegetation, the destructive "rototilling" activities of feral pigs can cause erosion and sedimentation in watershed areas, negatively affecting water quality and aquatic habitats.

Protection of the rare Newell's 'ohi'a lehua and proposals for controlling feral pigs and reversing damage caused by their activities is discussed further in the section on probable impacts and mitigation measures.

Birds

An ornithological reconnaissance was conducted of the project area from December 9 through 13, 1985, from dawn until after dark each day (A. Kepler, July 1986). During the scheduled counts, a total of 291 birds of four species were recorded. One or two individual birds of four other species were spotted outside normal counts. The Japanese White-eye and the Northern Cardinal, both introduced species, accounted for 99 percent of all birds recorded. The Spotted Dove and Barn Owl were also observed.

Very few native species were observed during the survey period, with each sighting limited to one or two individual birds. These included two indigenous migrants, the Pacific Golden Plover (*Pluvialis fulva*) and the Wandering Tattler (*Heteroscelus incanus*). A Black-crowned Night Heron (*Nycticorax nycticorax*) was also observed.

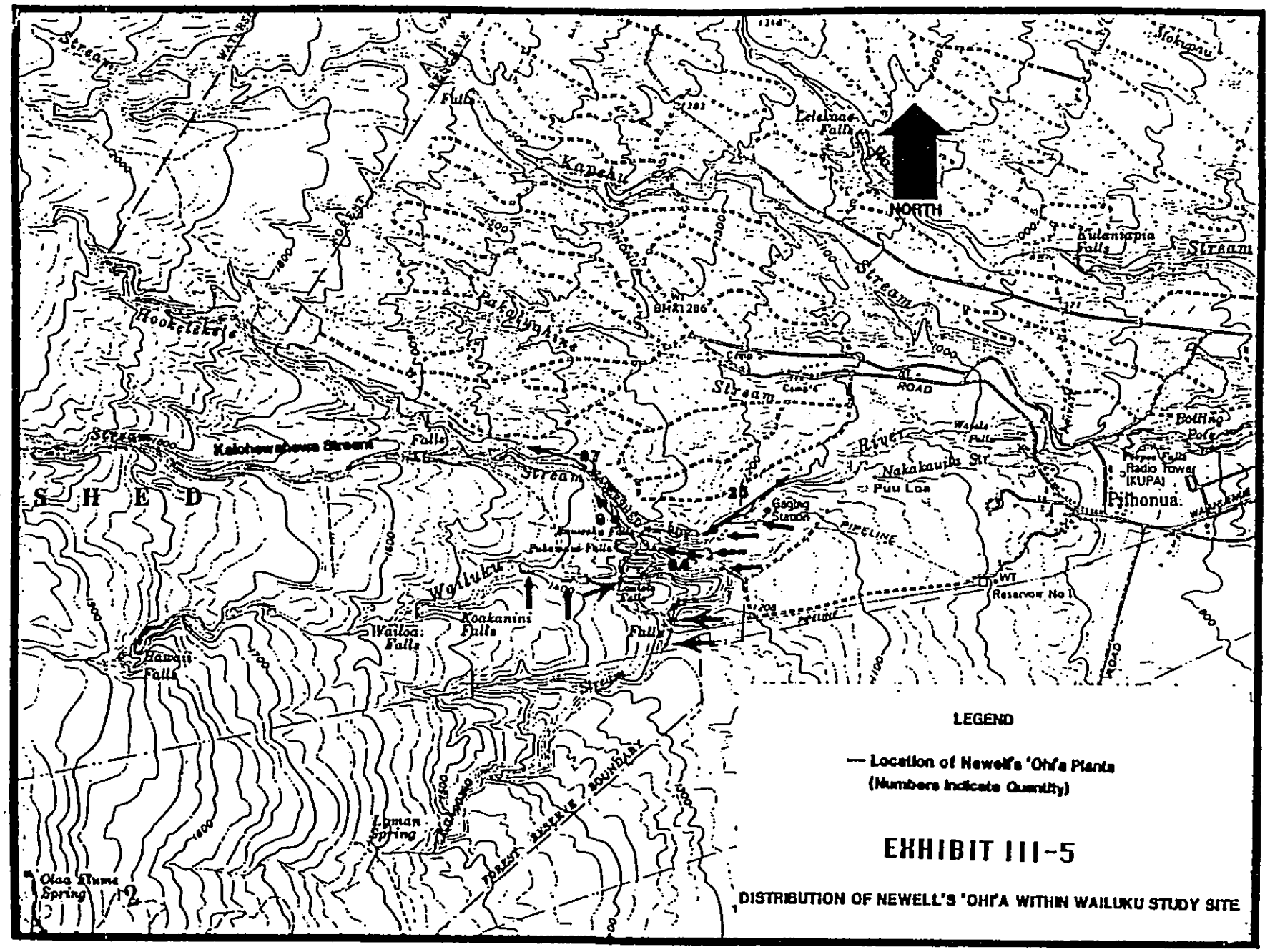


EXHIBIT III-5

DISTRIBUTION OF NEWELL'S 'OHI'A WITHIN WAILUKU STUDY SITE

The most important sighting was of the Hawaiian Hawk or 'Io (*Buteo solitarius*). This bird species is listed as endangered by the State of Hawaii and as threatened by USFWS.

A second survey was conducted from May 28 through June 2, 1986. Only one additional native bird species was observed, the indigenous White-tailed Tropicbird (*Phaethon lepturus Daudin*). The 'Io was the only species of native bird recorded in the first survey to be also observed in the second survey.

The Hawaiian Duck or Koloa (*Anas wyvilliana*), listed as endangered by the State of Hawaii and threatened by USFWS, could be expected to be found in the area because of its distribution and habitat requirements. Another threatened species, Newell's (Townsend's), formerly Manx, Shearwater or A'o (*Puffinus auricularis newellii*) could also possibly inhabit the study area in extremely low numbers. Neither species was recorded during either reconnaissance study. Table III-3 provides a summary description of the ranges and preferred habitat of the three bird species of concern. Additional surveys are planned prior to construction of the project. These are described in Chapter IV.

Mammals

Mammal reconnaissance surveys were conducted at the proposed site at the same time as the vegetation and ornithological studies in 1985 and 1986 to document the presence and effects of feral and native mammals, and in particular to determine whether the endangered Hawaiian Hoary Bat was present.

The Hawaiian Hoary Bat or 'ope'ape'a (*Lasirius cinereus semotus*), Hawaii's only native terrestrial mammal, is considered rare and endangered by both federal and state governments, although this status is being questioned by some biologists. Two bats were seen during the December survey, one on each of two nights. Each was in a different location, about one-quarter mile apart on the eastern edge of the study area, occupying both the eucalyptus and 'ohi'a-koa habitats. They were not observed further upstream above Lauiole Falls, which was checked at prime flying hours. No bats were seen during the second survey.

Other mammals in the study area included rats, mice, mongooses, feral pigs, and domestic dogs and cattle. Of these, the feral pigs are of concern because of the damage they cause to all types of forest and the threat they pose to this watershed area. The damage caused by wild pigs is discussed further in the paragraphs on vegetation and in the section on impacts and mitigation.

Table III-3

Threatened/Endangered Birds That May Be In Project Area

Koloa (Hawaiian Duck):	Known range on Hawaii:	5000-6000' elevation in Hilo Forest Reserve
	Possible range on Hawaii:	2000-5000' Hamakua Coast
	Lowest elevation where actually sighted:	3600' (1981)
	Highest project elevation:	1940
	Preferred type of habitat:	Hookelekele Stream
	Environmental Concern:	Ground Nests -- Nesting birds should not be disturbed
Newell's Shearwater:	Known range on Hawaii:	1 to 5 birds sighted offshore yearly
	Possible range on Hawaii:	Near or within dense rain forest on Hamakua Coast
	Nearest locations where actually sighted:	Papaikou at 100', 9 miles from project (1972-77); Wailuku River at 2600" (1980)
	Highest project elevation:	1940'
	Preferred type of habitat:	Hookelekele Stream
	Environmental Concern:	Burrows should not be disturbed during nesting season (April thru summer)
I'o (Hawaiian Hawk)	Known range on Hawaii:	Sea level to 8000' elevation
	Elevation where actually sighted:	In Eucalyptus forest at project site
	Preferred type of habitat:	Nests in trees
	Environmental Concern:	Birds should not bedisturbed during nesting season (March-September)

From Kepler, Angela Kay. July 1986. Avifauna: Wailuku River Hydropower Site, Hawaii Unpublished report for Associated Engineering Consultants.

Air Quality

The air quality within the proposed project area is good. There are no sources of industrial air pollution. Volcanic fumes, agricultural fires, and vehicle exhausts are the major sources of air pollution.

Noise

The proposed project area is in a quiet, mostly forested area, with no sources of noise except those created by nature and some distant vehicle sounds.

NATURAL HAZARDS

Volcanic

The project site is located in a high risk volcanic area exposed to lava flow threats, earthquakes and subsidence. The risk generally decreases with distance from the northeast rift zone of Mauna Loa volcano. During the past 15 years, the island of Hawaii has experienced 11 earthquakes with Richter magnitudes of 6 or more. The 1975 earthquake resulted in an estimated $4 million dollars in damages island-wide. Most lava flows from Mauna Loa have stopped short of the proposed project area and the suburbs of Hilo, but public fears of volcanic damages and losses are still significant. The most recent flow, in March 1984, came no closer than about 5 miles from the Wailuku River.

Flood

The streambed of the proposed project site lies at the bottom of relatively steep, deep channels which are able to contain flows much higher than the average flow. However, heavy rains can cause flows greater than 200 times the average. These rare peak flows may cause flooding in some areas where the channel is more shallow. However, because the proposed project area is located in state watershed land and no housing development is allowed, potential flood damage is minimal.

SOCIAL AND ECONOMIC CHARACTERISTICS

Archaeology

A walk-through archaeological reconnaissance survey of the proposed project site conducted in December 1985 revealed no evidence of significant archaeological or historical remains (W. Barrera, September 1986). The purpose of the work was to determine the presence or absence of sites of archaeological or historical interest that might be located within the project area, and to assess the significance of any sites that

might be found. There are no sites currently listed or proposed for either the State or National Register of Historic Places.

No cultural features were found with the exception of an irrigation ditch (indicated on the USGS Piihonua Quadrangle as a dashed black line running from Hookelekele Stream to Wailuku River) which was probably constructed for irrigation by the Mauna Kea Sugar Company. It is no longer in use and has fallen into disrepair.

The archaeologist states that the ditch is not eligible for either the State or Federal Historic Registers because there are much better examples of early historic irrigation ditch technology on the island. Additional archaeological surveys will be conducted once the exact alignment of penstocks, access roads and transmission lines is determined.

Demography and Employment

Sixty percent of the population on the island of Hawaii is centered in the Hilo area. Over a 20-year period, the population in this area has increased 43 percent, from 39,076 in 1960 to 55,708 in 1980. Hawaii County experienced a population increase of 50 percent from 1960 to 1980, nearly equaling the State of Hawaii's overall increase of 52 percent for the same period.

The County of Hawaii has primarily a two-sector economy based on farm products and tourism and, to a lesser extent, fishing, manufacturing, and scientific research. Farming and tourism are important to Hawaii's economy not only because they are the major economic activities but also because they stimulate and generate employment in outside industries.

Tourism is the number one industry. Visitor expenditures for Hawaii County grew from $50 million in 1969 to $172 million in 1979. Although Hilo is not recognized as a common destination area for tourists, its role as the second gateway to and from the State of Hawaii should continue to increase visitor activity.

Sugarcane, beef cattle, and coffee are the three most important farm products of the island. In addition to sugarcane and coffee, agricultural crops include melons, papaya, and other fruits, macadamia nuts, taro and other vegetables; and floral products. Hilo is known as the Orchid Capital of the world, as flowers are grown extensively throughout the vicinity. In addition to orchids, anthuriums have been making remarkable progress in marketability.

Several kinds of manufacturing operations are located in Hilo, including the processing of food, fruit, sugar, livestock, and garment manufacturing. There is also small scale lumber milling. The forest reserves represent a large, virtually untapped economic resource.

With the establishment of the Hilo campus of the University of Hawaii there is potential for additional research and development industries in the city. Already established in Hilo are the Cross-Cultural Center for Research and Training, the University of Hawaii Cloud Physics Laboratory, and agricultural experiment stations. Table III-4 summarizes the demographic, general social and economic characteristics of the county.

TRANSPORTATION AND UTILITIES

Transportation

Interisland transportation facilities to the island of Hawaii are good. Deep-water harbors at Hilo and Kawaihae serve each end of the island for exports of sugar, cattle, and other commodities.

Hilo accommodates interisland as well as commercial jet flights to the mainland from General Lyman Field. Other airport facilities serving the island are located in Kona and Kamuela.

The Hawaii Belt Highway is the primary traffic artery for the Hilo area. Augmenting this highway is the trans-island Saddle Road. Access to the project area is via Piihonua Road and through several locked entrance gates controlled by the County Department of Water Supply.

Utilities

Electrical power. The Island of Hawaii is provided a network of generation facilities presented in Exhibit III-6. Generally, all bagasse-burning and hydroelectric power plants are privately owned by the sugar plantations. An exception is in Hilo where two hydroelectric plants, the Waiau and the Puueo facilities (installed capacity 3.4 MW), are owned by the public utility. All other facilities are owned by the Hawaii Electric Light Company (HELCO). HELCO accounts for 59 percent of the total electric generating capacity while the privately owned facilities account for 41 percent. The total HELCO generation capability in 1983 was 185.2 MW. Over 95 percent of the total electric generating capacity was provided by petroleum products and biomass conversion while hydropower, geothermal, and wind generation provided for the remaining capacity (see Table III-5).

There are no existing electrical utilities located directly on the project site, but HELCO's transmission lines are located approximately one mile to the east. A 69 Kv line runs east of Hilo in a north and south direction and a 12 Kv line runs northeast and southeast of Piihonua.

TABLE III-4

ECONOMIC & DEMOGRAPHIC CHARACTERISTICS OF HAWAII COUNTY

Resident Population of County and Districts: 1970, 1980, and 1986

County and district	April 1, 1970	April 1, 1980	July 1, 1986	Percent change 1970 to 1980	Percent change 1980 to 1986
State total	769,913	964,691	1,062,300	25.3	10.1
Hawaii County	63,468	92,053	111,800	45.0	21.4
Puna	5,154	11,751	18,400	128.0	56.6
South Hilo	33,915	42,278	45,000	24.7	6.4
North Hilo	1,881	1,679	1,500	-10.7	-10.4
Hamakua	4,648	5,128	5,300	10.3	3.6
North Kohala	3,326	3,249	3,500	-2.3	8.3
South Kohala	2,310	4,607	6,700	99.4	44.5
North Kona	4,832	13,748	19,700	184.5	43.1
South Kona	4,004	5,914	7,100	47.7	20.3
Ka'u	3,398	3,699	4,600	8.9	24.7

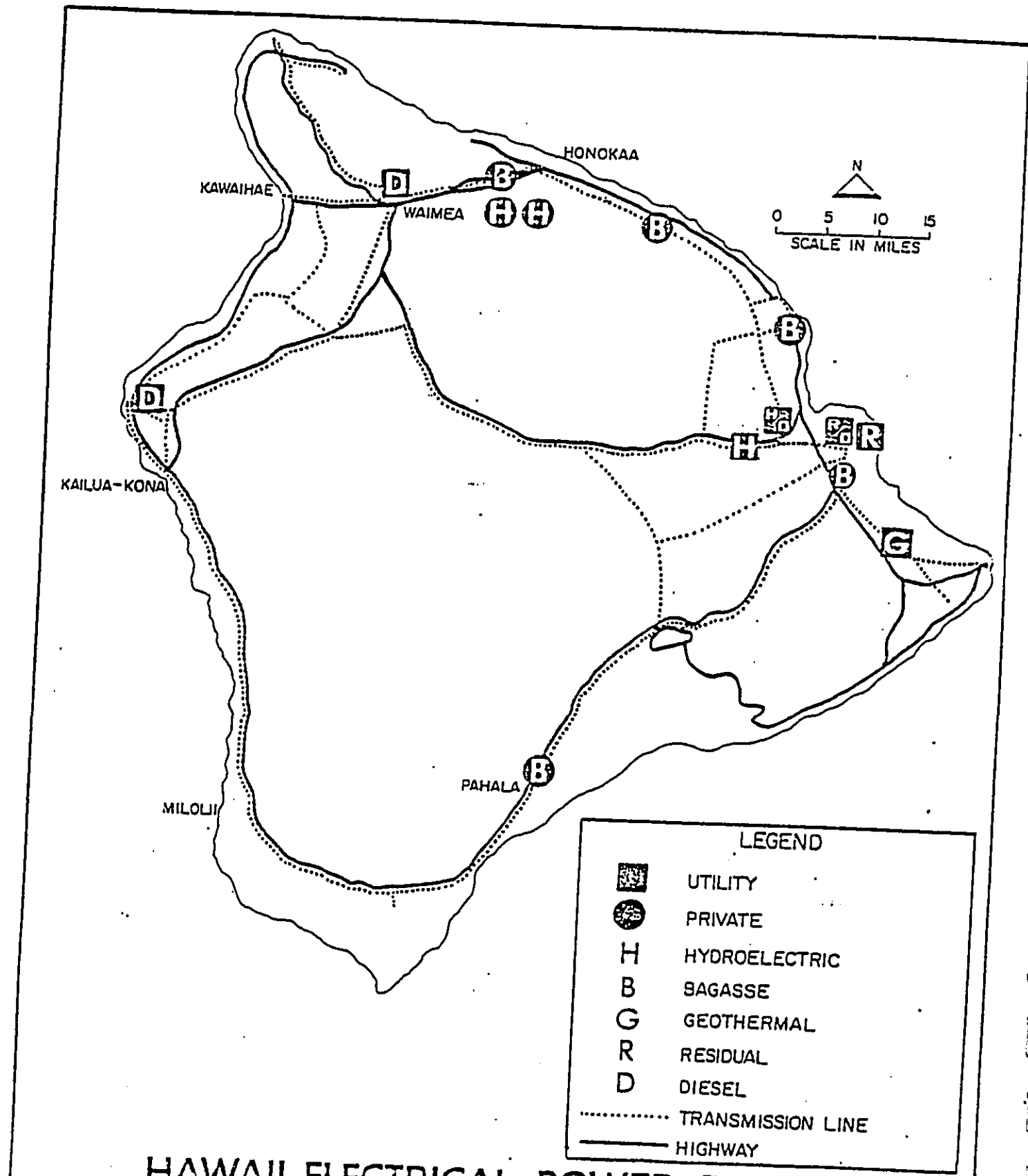
Source: Hawaii State Department of Business and Economic Development, The Population of Hawaii, 1980-1986 (Statistical Report 201, September 21, 1987), table 9.

INCOME, LABOR FORCE, AND EMPLOYMENT

	1960	1970	1980
Personal Income ($ Millions)	100	241	650 2/
Per Capita Income ($)	1,630	3,785	7,760 2/
Civilian Labor Force	22,270 1/	28,300	35,450
Civilian Employment	21,520 1/	27,050	33,050
Unemployment (%)	3.4	4.4	6.7
Subcount by Industry			
Total Job (Non-Agriculture)	16,040	28,870	28,400
Construction	820 1/	1,500	1,650
Manufacturing	3,300 1/	2,960	2,750
Transporation, Communication, and Utilities	970 1/	1,380	1,900
Trade	3,100 1/	5,010	7,000
Finance, Insurance and Real Estate	250 1/	900	1,100
Services	1,640 1/	3,730	7,450
Government	3,050 1/	4,370	6,550
Agriculture	2,910 1/	3,610	3,250

1/ Hawaii State Department of Labor and Industrial Relations
2/ 1979 Estimate

Source: State of Hawaii Data Book, 1981; County of Hawaii Data Book, 1980 and 1979, Department of Research and Development.



HAWAII ELECTRICAL POWER SYSTEM

Source:: Wailuku/Honolii Hydropower Study
June 1984.

EXHIBIT III-6

TABLE III-5

HELCO GENERATION CAPABILITY IN 1983

HELCO Generators				
Location (1)	Name (2)	Type (3)	Firm Capability (KW) (4)	Nonfirm Capability (KW) (5)
Kanoelehua	Hill 5	Steam	14,800	
	Hill 6	Steam	23,000	
	Gas Turbine	Gas	10,600	
	Diesel 11	Diesel	2,000	
	Diesel 15	Diesel	2,750	
	Diesel 16	Diesel	2,750	
	Diesel 17	Diesel	2,750	
Keahole	Diesel 18	Diesel	2,750	
	Diesel 19	Diesel	2,750	
Ookala	Jacobs	Wind		300
Puueo	Hydro 1	Hydro		1,500
	Hydro 2	Hydro		750
	Diesel 5	Diesel	1,000	
	Diesel 6	Diesel	1,000	
	Diesel 7	Diesel	1,000	
Puna	HGP-A	Geothermal		2,600
Waiakea	Shipman 1	Steam	4,000	
	Shipman 2	Steam	4,400	
	Shipman 3	Steam	7,500	
	Shipman 3	Steam	8,000	
Waiau	Hydro 1	Hydro		750
	Hydro 2	Hydro		350
Waimea	Diesel 8	Diesel	1,000	
	Diesel 9	Diesel	1,000	
	Diesel 10	Diesel	1,000	
	Diesel 12	Diesel	2,750	
	Diesel 13	Diesel	2,750	
	Diesel 14	Diesel	2,750	
	Subtotal		102,300	6,250
Plantation Generators with HELCO Contract				
Location (1)	Name (2)	Type (3)	Firm Capability (KW) (4)	Nonfirm Capability (KW) (5)
Honokaa	Davies-Hamakua	Steam		1,500
	Sugar	Steam	1/	7,500
		Steam		6,000
		Hydro		800
Pepeekeo	Hilo Coast Processing Co.	Steam	16,000	23,800
Keaau	Puna	Steam	6,000	15,000
	Subtotal		22,000	54,600
	TOTAL		124,300	60,850

1/ 10,000 KW total starting in 1985

Source: Wailuku/Honolii Hydropower Study Table 3. June 1984.

Water supply. The Hilo Water System utilizes both surface and well water sources. These sources are: Piihonua, Lyman Spring, Waiakea Uka Spring and Panaewa Well. The county water supply system in the project area is described in the section on hydrology in this chapter.

LAND OWNERSHIP AND USE

The proposed project lies within the Hilo Forest Reserve and Hilo Closed Watershed land and is owned by the State of Hawaii. Designated as Conservation District Lands, the project area is in subzone "P" (Protected) and "L" (Limited) and shown in Exhibit III-7.

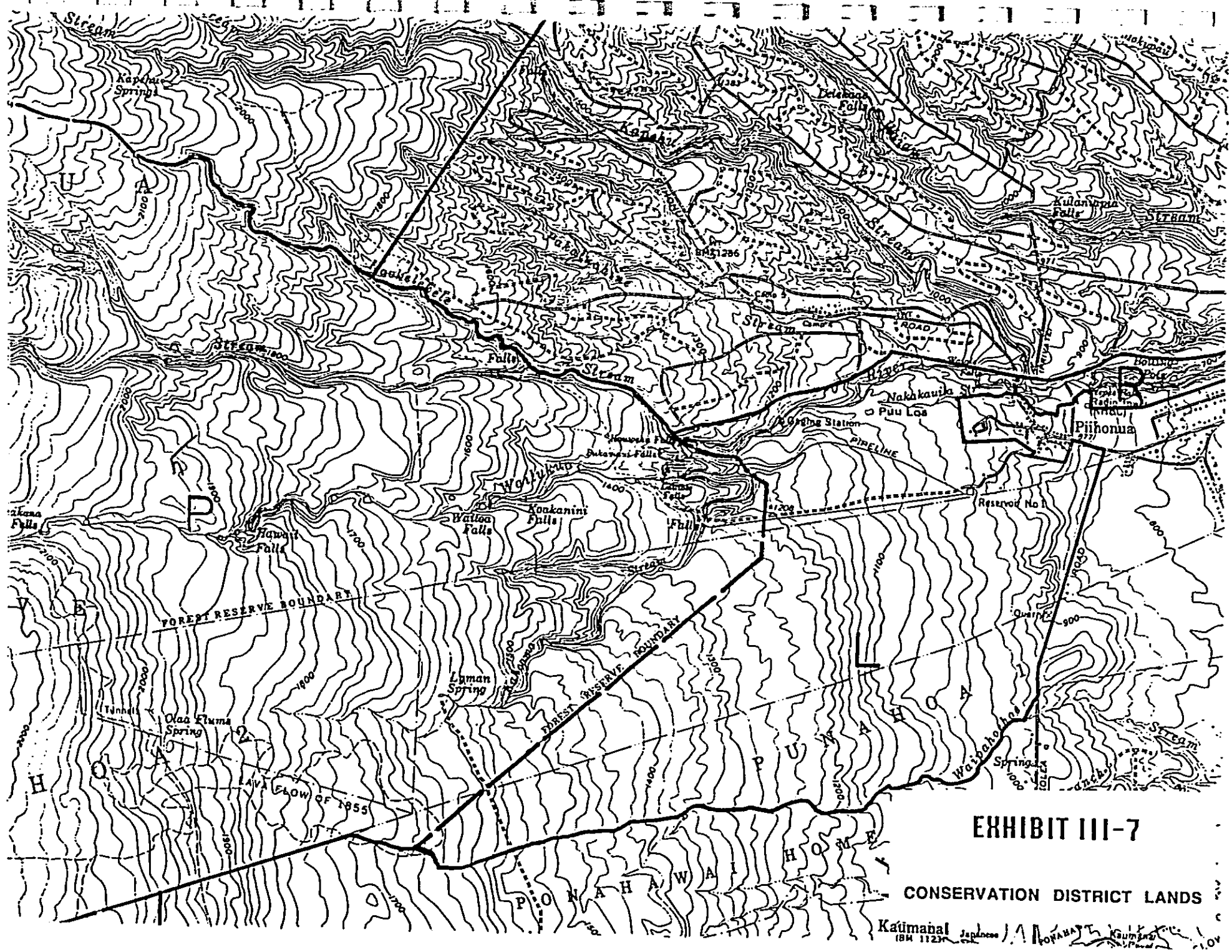
From 1928 to the present year, U.S. Gaging Station No. 16704.000 has been maintained for the purpose of providing streamflow discharge measurements for the Wailuku River. The gaging station is located on the right bank 0.2 miles downstream from the confluence of the Wailuku River and Hookelekele Stream.

The Department of Water Supply of the County of Hawaii maintains two intake structures on the Wailuku River to provide the city of Hilo with domestic water when the preferred source is inadequate. Because most of the area is watershed land, access is restricted by the Department of Water Supply and no stream-related recreation is permitted. Hunting for wild pigs occurs, but only with the permission of the county which maintains locked access gates into the area.

RECREATION AND SCENIC RESOURCES

The forest reserve area in which the project is located offers limited wilderness recreation opportunities because it is a closed watershed. Hunting is the primary activity. Hunters must obtain permission from the Division of Conservation and Enforcement (DOCARE) of the Department of Land and Natural Resources. Access from Piihonua to the south side of the river for vehicles is prevented by locked gates controlled by the Department of Water Supply. Most hunters enter the area from the Saddle Road.

The natural beauty of the South Hilo district is dominated by Mauna Kea. From various locations in the area there are magnificent views of the mountain. The land gently slopes upward from Hilo towards Mauna Kea and Mauna Loa. Because of the gentle slopes, most of the many beautiful waterfalls throughout the district, such as the famous Akaka Falls and the falls in the project area, are not visible from a distance except from the air. Waiale Falls and Peepee Falls are downstream of the project area near Piihonua. Scenic attractions in the area include the Wailuku River State Park which encompasses Rainbow Falls and the Boiling Pots, Kaimukanaka Falls, Peepee Falls, viewpoint from Lower Wailuku Bridge, Keakanini Falls, and Hawaii Falls. The proposed project will not affect any of these scenic attractions.


Stream
Kapohai Springs
Kaaleleia
Falls
Stream
Kaaleleia
Stream
Kaaleleia
Stream
Kulaniapia Falls
Stream
Stream
Stream
Nakakauila
Puu Loa
Pipeline
Piihonua
Reservoir No 1
Wailua Falls
Konkanini Falls
Hawaii Falls
Stream
Forest Reserve Boundary
Lyman Spring
Forest Reserve Boundary
Tunnel
Olaa Flume Spring
Lava Flow of 1955
Waiakaohai
Spring
Stream
P U N A H O A
P O N A H A W A I H O M E
EXHIBIT III-7
CONSERVATION DISTRICT LANDS
Kaumahal

CHAPTER IV

PROBABLE IMPACTS AND MITIGATION MEASURES OF THE PROPOSED ACTION

SHORT-TERM IMPACTS

Alteration of Landforms

A corridor approximately 25 feet wide will be cleared by bulldozing along the penstock and diversion pipeline alignments from the diversion sites to the grazing land near Kahoama Stream. The initial impact of penstock, access roads and bridge construction will be the removal of vegetation within the corridors. The natural terrain will be disturbed through common earthwork operations (clearing, grubbing, grading, trenching, excavating, and backfilling).

The penstock will be supported on concrete saddles buried in the soil to the depth of a minimum of 3 feet. The bridge and penstock crossing will have reinforced concrete abutments keyed into the sides of the stream banks. Penstocks will be installed underground at all locations where sufficient cover material is available. At locations where rock is on or near the surface, the penstocks will be supported on concrete saddles anchored to the rock at 20 to 40 foot intervals. Steel straps will be bolted to the saddles to secure the pipe in place. All concrete saddles will have reinforcing steel and a foundation below grade to a minimal depth of 3 feet. Following installation of the penstock, all holes and trenches will be backfilled and compacted to existing grade to allow the regrowth of vegetation. With the exception of trees, regrowth should cover most construction scars within 1 to 2 years.

An area of approximately one acre at the power plant site will be disturbed by the construction of the powerhouse building. Apart from the land occupied by the concrete powerhouse building, transformer and switch yard, and the maintenance roads up to the points of diversion, all disturbed land at the site will be revegetated.

Construction of the access road and penstock will be limited in location to the natural ground or cut. Fills will be avoided to the extent possible as a way of reducing slope stability problems. The use of cuts may invite some potential stability problems, but these can be mitigated by adjusting cut slope, and reinforcing the slope materials as required. The project design will incorporate the most economical alignment of the access road and penstock with the long-term stability of slopes.

Trenches will be backfilled to grade and compacted to stabilize soil conditions. Areas left bare after construction will be seeded with an appropriate plant form, except those areas within and immediately adjacent to the deep gulches where native plants are in greater abundance. In these areas, regrowth by exotic species will not be encouraged, but the soil will be stabilized to prevent the onset of erosion.

CORRECTION

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

CHAPTER IV

PROBABLE IMPACTS AND MITIGATION MEASURES OF THE PROPOSED ACTION

SHORT-TERM IMPACTS

Alteration of Landforms

A corridor approximately 25 feet wide will be cleared by bulldozing along the penstock and diversion pipeline alignments from the diversion sites to the grazing land near Kahoama Stream. The initial impact of penstock, access roads and bridge construction will be the removal of vegetation within the corridors. The natural terrain will be disturbed through common earthwork operations (clearing, grubbing, grading, trenching, excavating, and backfilling).

The penstock will be supported on concrete saddles buried in the soil to the depth of a minimum of 3 feet. The bridge and penstock crossing will have reinforced concrete abutments keyed into the sides of the stream banks. Penstocks will be installed underground at all locations where sufficient cover material is available. At locations where rock is on or near the surface, the penstocks will be supported on concrete saddles anchored to the rock at 20 to 40 foot intervals. Steel straps will be bolted to the saddles to secure the pipe in place. All concrete saddles will have reinforcing steel and a foundation below grade to a minimal depth of 3 feet. Following installation of the penstock, all holes and trenches will be backfilled and compacted to existing grade to allow the regrowth of vegetation. With the exception of trees, regrowth should cover most construction scars within 1 to 2 years.

An area of approximately one acre at the power plant site will be disturbed by the construction of the powerhouse building. Apart from the land occupied by the concrete powerhouse building, transformer and switch yard, and the maintenance roads up to the points of diversion, all disturbed land at the site will be revegetated.

Construction of the access road and penstock will be limited in location to the natural ground or cut. Fills will be avoided to the extent possible as a way of reducing slope stability problems. The use of cuts may invite some potential stability problems, but these can be mitigated by adjusting cut slope, and reinforcing the slope materials as required. The project design will incorporate the most economical alignment of the access road and penstock with the long-term stability of slopes.

Trenches will be backfilled to grade and compacted to stabilize soil conditions. Areas left bare after construction will be seeded with an appropriate plant form, except those areas within and immediately adjacent to the deep gulches where native plants are in greater abundance. In these areas, regrowth by exotic species will not be encouraged, but the soil will be stabilized to prevent the onset of erosion.

Cut and fill sections will be promptly revegetated with native plant species, and in such a way as to insure their growth and survival. Road cuts and fills will be graded, bermed or diked in a manner that will prevent sediment-laden rainwater runoff from discharging directly into the streams.

Construction activities will be strictly limited to the designated corridors and sites to minimize the disturbance of soil and vegetation.

Water Quality

Construction of the proposed project will likely result in short-term effects on water quality in the form of periodic increases in turbidity and sediment load downstream of the disturbance.

Construction of the diversion structures will take place in the streams within a dewatered area between cofferdams. Construction and removal of these cofferdams will add some fine sediments downstream of the action for a few days. The diversion structures will be located in an area where no *Lentipes concolor* occur and where the atyid shrimp is rarely observed. The temporary increase in sedimentation from this action in the Kalohewahewa Stream will have a negligible impact on the *Lentipes* population in the Hookelekele Stream due to the distance from the proposed action and due to increased flows in the Hookelekele Stream. Should overtopping occur during construction of the diversion structures, turbidity may increase for the duration of the high flow, however it is not expected to be significant compared to the high turbidity which occurs naturally during high flows.

The existing access road to the Lauiole and Kahoama intakes will be improved to allow access by heavy construction vehicles. The roadbed drainage will be improved and additional gravel will be added to the surface if necessary to support the vehicles. An access road along the penstock alignment will be constructed by cut and fill operation. The bulldozing will alter the existing grade and disturb the topsoil.

During penstock and access road construction, exposed areas will be susceptible to erosion during rainy periods which could also temporarily increase the fine sediment load entering the stream and result in a short-term change in water quality. Any potential increase in turbidity is not expected to be significant compared to the normal high turbidity which occurs in the stream due to sediment entering the stream during high flow periods. This action should have no effect on the *Lentipes* population in the Hookelekele Stream and only minimal short-term impacts to the *Lentipes* and atyid shrimp populations in the Wailuku River. To minimize any impacts, construction will occur during drier periods and removal of riparian vegetation will be minimal. Due to the thick vegetative cover in the project area, it is anticipated that the effected areas will revegetate quickly. Measures will be taken to insure that no rare or endangered flora will be affected by construction (see discussion under **Vegetation** below).

Stream crossings will require the installation of bridges and penstock supports. These activities will also temporarily increase the fine sediment load entering the streams. Excavation of cut sections and fill placement are not expected to contribute to long-term changes in water quality because engineered cuts and fills in erodible materials will revegetate rapidly. Erodible spoil piles will be placed above normal high water and away from stream valleys. Powerhouse and tailrace construction will only produce a minor temporary increase in turbidity due to their distance from the stream.

Aquatic Fauna

Potential impacts on the stream fauna during the construction phase of the project will be temporary and not significant. The *Lentipes* population in the Hookelekele Stream is not located near any construction related activities. Short-term impacts (such as sedimentation or dewatering) from upstream construction in the Kalohewahewa Stream should not have any significant impacts on the *Lentipes* population because flows from the Hookelekele Stream above the Kalohewahewa Stream will not be effected.

The few *Lentipes* occurring in the Wailuku River in the project area should not be impacted by construction related activities. The diversion structure on the Wailuku River is located a considerable distance upstream from these few individuals and the penstock route will not be located in the riparian zone of the Wailuku River. Dewatering in the upper Wailuku River during construction should not present any problems to the *Lentipes* since the majority that occur in the Wailuku River are located below the confluence of the Hookelekele Stream. Since the atyid shrimp populations are very low in the areas of primary construction activities, construction related impacts will not have a significant effect on this species.

Direct impact to existing stream fauna will be minimized by locating the proposed diversion structures on the bedrock substrate (which is the dominant substrate) in the Wailuku River and Kalohewahewa Stream. The bedrock substrate is not productive or suitable habitat for the atyid shrimp, the only macrofauna species found in these areas (Archer 1989).

The principal short-term effect of construction on aquatic fauna is increased turbidity and sedimentation. These impacts were discussed in the previous section on water quality. These impacts will be minimized by locating only the diversion structure and initial portion of the penstock immediately adjacent to, or in, the stream. The access roads, most of the penstock, and the powerhouse and tailrace will be located away from the Hookelekele Stream.

Vegetation

The vegetation in the project area is composed of native 'ohi'a-koa forest, exotic eucalyptus forest, pasture, and riparian plants along the stream beds. One endangered plant was found in this habitat, a rare variety of 'ohi'a lehua (*Metrosideros collina* p.

newellii) or Newell's 'ohi'a lehua, frequenting rocky banks beside, along, and within the streams. This plant is a Category 1 Candidate Endangered Species for the Federal Register, known to be found only in a few locations along the Wailuku River before this survey.

Portions of the revised and redesigned project are at a higher elevation than the area covered by previous surveys. The principal area of concern for vegetation is where the roads and penstock cross the streams. A qualified botanist will be included on the project design team when plans are finalized to ensure that all of the site is surveyed, and particularly to ensure that the populations of Newell's 'ohi'a lehua are not disturbed. The botanist will identify any rare plants on the site for the topographic survey crew doing the detailed mapping for construction drawings. The corridor for the access roads and penstock will be placed to avoid the 'ohi'a lehua. The rare plants will be marked in the field and located on the topographic map, and temporary fencing or other suitable protection will be installed as appropriate to protect plants that may be in the vicinity.

In addition to the specific attention that will be given to the 'ohi'a lehua, the penstock and power lines will be aligned to minimize disturbance to native forest habitat and to avoid the areas of particular scientific or aesthetic value identified in the botanical surveys. Areas left bare after construction will be seeded with appropriate plant forms as recommended by the botanist, except those areas within and immediately adjacent to the deep gulches where native plants are in greater abundance. In these areas, regrowth by exotic species will not be encouraged, but soil conditions will be stabilized to prevent the onset of erosion.

Terrestrial Fauna

The only mammal of note known to inhabit the project area is the Hawaiian Hoary Bat or 'ope'ape'a (*Lasirius cinereus semotus*). The Hoary Bat, Hawaii's only native terrestrial mammal, is considered rare and endangered by both federal and state governments, although this status is being questioned by some biologists. Two bats were seen during the December survey, one on each of two nights. Each was in a different location, about one-quarter mile apart on the eastern edge of the study area, occupying both the eucalyptus and 'ohi'a-koa habitats. They were not observed further upstream above Lauiole Falls, which was checked at prime flying hours. No bats were seen during the second survey.

Individuals of five native bird species were observed during two surveys of the project area. These are the Pacific Golden Plover (*Pluvialis fulva*), the Wandering Tattler (*Heteroscelus incanus*), the Black-crowned Night Heron (*Nycticorax nycticorax*), the White-tailed Tropicbird (*Phaethon lepturus Daudin*), and the most important, the Hawaiian Hawk or 'Io (*Buteo solitarius*). This bird species is listed as endangered by the State of Hawaii and as threatened by USFWS. The 'Io was the only species of native bird recorded in the first survey to be also observed in the second survey.

The Hawaiian Duck or Koloa (*Anas wyvilliana*), listed as endangered by the State of Hawaii and threatened by USFWS, could be expected to be found in the area because of its distribution and habitat requirements. Another threatened species, Newell's (Townsend's), formerly Manx, Shearwater or A'o (*Puffinus auricularis newellii*) could also possibly inhabit the study area in extremely low numbers. Neither species was recorded during either reconnaissance study.

A third survey is planned to be conducted during the shearwater nesting season (April and May) which will cover the non-surveyed area between 1500' and 2000' elevation. The major concern is disturbing nesting birds. A biologist will also be consulted during the design phase of the project and immediately prior to construction to ensure that disturbance to any possible native species in the area is either avoided or minimized. If any shearwaters or koloa are found, DLNR's Division of Forestry and Wildlife and the USFWS will be notified immediately.

Even though nesting areas are not disturbed, there will be some unavoidable impacts on birds which will occur during the construction phase. The noise and concentrated human activity in the normally undisturbed upstream areas will temporarily disrupt the habitat for the various species of birds that are known to exist in the area. Wildlife is expected to retreat from the area while construction is taking place but will return after the project is in operation.

Air Quality

Vehicle emissions will increase in the area due to construction equipment and trucks bringing in supplies and labor. Vehicle emissions will be minimal and will be rapidly dissipated by the trade winds. Construction will be in an undeveloped area so there will be no impact on residents or businesses. Upon completion of the construction phase, there will be no significant dust or combustion emissions during operation of the hydropower plant.

Noise

Noise levels in the project area will increase significantly during the construction phase. Residents of Piihonua will be affected by traffic noise and the construction of the powerhouse.

Traffic

Construction equipment and transportation of construction personnel will impact Waianuenue Avenue and Piihonua Road to some extent and will be sharply restricted during the periods of peak traffic loads. Highway signs will be posted and regular public notice will be given to clearly indicate to travelers the dates and times of heaviest expected truck traffic.

The arrival and departure of the construction work force will add to the normal traffic load during morning and afternoon peak hours. Some additional traffic can be expected throughout the working day as a result of the need to transport machinery and materials. Overall traffic impact is expected to be negligible.

Historic/Archaeological Resources

A recent reconnaissance survey concluded that the Wailuku River Hydroelectric Project would have no adverse effects upon sites of archaeological or historic importance or significance.

Additional archaeological surveys of the transmission line and access road corridors will be conducted when their locations are fixed, unless they follow existing roads. If any archaeological sites are found, the State Historic Preservation Office will be contacted to ensure that appropriate mitigation measures are taken.

Social and Economic Conditions

The proposed project at this stage of development is estimated to cost $15,000,000 and produce approximately 35,000,000 KwHr/year of clean, renewable energy.

The project planning schedule provides for a state permitting period of six months and a construction period schedule of 14 months. It is anticipated that construction on the project could be started in mid-1990.

Several major project cost categories are identified below. It is anticipated that direct economic expenditures in the Hilo area during project construction would amount to:

		$ Million
1)	Subcontracts and specialty items	0.5 to 0.7
2)	Material of construction, permanent materials & local equipment rentals	1.1 to 1.5
3)	Labor/Professional, skilled, semi-skilled and unskilled	1.9 to 2.3
4)	Other services & job expenditures	0.8 to 1.0
ESTIMATED TOTAL LOCAL COST EXPENDITURES		4.3 to 5.5

During construction it is anticipated that up to a maximum of 50 people will be employed; of these 75 percent are expected to be present local state residents.

The entire project is located within the State Conservation District and will displace neither residences nor business establishments.

LONG-TERM IMPACTS

Water Quality

No significant long-term adverse change in water quality of the Wailuku River system is expected as a result of the proposed project. The reach of the streams between the diversion structures and the powerhouse will experience reduced flow by the amount diverted for power production. Over the long term, this may result in temporary periods when the proposed project will affect water quality. This will probably be noticeable during extended dry periods or during the time of the year when rainfall is low. This could result in limited increases in water temperature and pH and decreases in dissolved oxygen from the diversion points down to the confluences of the Wailuku River and Kalohewahewa Stream with the Hookelekele Stream.

These changes in water quality should not impact the aquatic fauna in the Wailuku River system. Fish are absent from the affected area on the Kalohewahewa Stream and they are rare in the affected area on the Wailuku River. The *Lentipes* population in the Hookelekele Stream should not be affected since flows are not being diverted from this stream. This slight change in water quality should not have any significant impact on the atyid shrimp population in the Wailuku River system. Atyid shrimp numbers are low in most of the areas that will be affected (Archer 1989).

A slight increase in water temperature, even as much as two degrees Celsius, will not have any adverse affects on the aquatic community (Archer 1986). Also, the water temperature in the Wailuku River system tends to be lower than water temperatures found in other streams supporting abundant *Lentipes* populations (Timbol *et al.* 1980). Archer (1989), noted that the low water temperatures in the Wailuku River system is probably one of the factors limiting *Lentipes* abundance.

Additionally, during planning and construction, care will be taken to remove as little vegetation alongside the streams as possible so that near natural water temperatures can be maintained by the shading of riparian vegetation. This will also help to reduce any potential increase in siltation during construction and during rainy periods. The program for increased control of feral pigs proposed in the section on vegetation should also have the effect of reducing present levels of siltation.

Aquatic Fauna

The primary technique used to analyze the potential impacts under consideration was the Instream Flow Incremental Methodology (IFIM) developed by the U.S. Fish and Wildlife Service (Bovee 1982). This methodology uses hydraulic modeling in conjunction with known habitat preferences of fish to develop an empirical relationship between flow and weighted usable habitat within a particular stream section. Habitat is weighted by the combined suitability for factors such as depth, velocity and substrate/ cover on a per area basis.

The IFIM requires several steps, including selection of representative stream segments micro-habitats, field collection of the hydraulic characteristics of the stream segments, development of fish criteria curves, hydraulic simulations, and the integration of the species data with the simulation data to develop the functional relationship between available habitat and flow. Each step in the process must be coordinated to achieve a reliable and biologically meaningful analysis.

Hydraulic Field Measurements

The Wailuku River drainage to be affected by the proposed hydroelectric project was divided into three separate section: 1) the Wailuku River above the confluence with the Kahoama and Hookelekele Streams up to the 2000 foot elevation; 2) the Hookelekele Stream below its confluence with the Kalohewahewa Stream; and 3) the Kalohewahewa Stream above its confluence with the Hookelekele Stream. Each of these river segments were surveyed from the air for potential access sites as well as for the types and distribution of available habitats. Based on these aerial reconnaissance surveys a total of six transects each were identified for the Hookelekele and Kalohewahewa Streams and twelve transects within the Wailuku River. Transect placement within micro-habitats was apportioned between pool, pocket pool/run and run habitats at each station where access was possible. Field collection techniques were followed according to Trihey and Wagner (1981). Each station was sampled at only one flow, wherein estimates of the discharge were 36 cfs for the Kalohewahewa, 27 cfs for the Wailuku and 33 cfs for the Hookelekele.

Hydraulic Simulation

Because only a single stage-discharge measurement was available for each study site, these data were utilized to calibrate the MANSQ hydraulic simulation model to generate the state-discharge relationship for each transect. The simulated water surface elevations were then utilized within the IFG4 hydraulic simulation program in the production runs for the determination of individual cell velocities. Although additional stage-discharge measurements would permit higher discharges, these data are considered adequate for an assessment of the project impacts as the range of simulated flows within 0.4 and 2.2 percent of the calibrated discharges encompass most of the mean monthly flows for each of the study sites. The velocity adjustment factors within this range were generally good to fair (Milhous *et al.* 1984). Furthermore, an

examination of the Weighted Usable Area (WUA) plots for the target species within this range of discharges show that maximum WUA occurs below about 50 cfs and rapidly diminishes at higher flows and is consistent with the known biology of the target species and characteristics of the high gradient cascade fall/pool habitats of these rivers. Based upon these observations, the range of flows simulated were extended to higher discharges to facilitate an analysis of pre- and post-project flow scenarios.

Suitability Curve Development

At present, no known site specific suitability index (SI) curves have been developed for the Wailuku River or its tributaries for *Lentipes* and the atyid shrimp, opae kala'ole. To date only 25 individuals of *Lentipes* have been observed within the entire Wailuku River System with all but 4 of these observations occurring within the Hookelekele Stream. Kinzie and Ford (1988) note that S.I. curves developed from a particular system are not likely to be transferable to other streams in Hawaii. However, given the fact that no Lentipes have been observed from the mainstem Wailuku River above Lauiole Falls or within the Kalohewahewa Stream, the development of site specific curves for these waters is not possible and additional field efforts in this regard are unlikely to yield sufficient field data to develop these curves. For the known observations of *Lentipes* within the Hookelekele Stream, no site specific recordings of depth, velocity, substrate and cover are available for use in the development of site specific S.I. curves in this stream. Therefore, a literature review, an interview with several species experts, and data from Kinzie *et al.* (1984) were utilized to construct S.I. curves for the adults and juveniles of *Lentipes* and adults of the atyid (Figures 1 through 9, Appendix B) for the use of the Habitat Simulation Analysis.

Pre-Project Hydrology

Daily flow records for the period of record from 1928 through 1988 on the main stem Wailuku River (station number 16704000) at the 1,090 feet elevation were used to establish mean monthly pre-project flow conditions within the study area. Partition of flows between the Wailuku River and the Hookelekele Stream were established as 40 percent and 60 percent of the gage readings based on the analysis presented in U.S. Army Corp. of Engineers (1984). Flows within the Kalohewahewa Stream were estimated as 60 percent of the Hookelekele Stream based on site reconnaissance of the channel morphology and from observations made by the FWS (1984) and Archer (1989). Mean monthly flows based on the percent reallocations of the daily flow readings are presented in Table III-1.

Post-Project Hydrology

Mean monthly post-project flows at each of the stations were derived by imposing the following plant operating regime on a daily basis for the period of record from 1928 to 1988. First, it was assumed that a combined flow of 70 percent of the pre-project Wailuku daily gage readings were available for power generation at the Wailuku River and Kalohewahewa Stream diversions. If the adjusted daily flow available for

diversion was less than 13 cfs, then no water was diverted for power generation and post project flows equaled pre-project flows on that day at all station. If 70 percent of the Wailuku River daily gage flow fell between 13 cfs and 168 cfs then the flow below the diversion within the Wailuku River was set at 5 cfs, flow below the diversion within the Kalohewahewa Stream was set at 3 cfs and the combined flow of the Kalohewahewa and Hookelekele Streams equaled 30 percent of the Wailuku River gage for that day. This means that the difference between 8 cfs and 70 percent of the Wailuku River daily flow reading was diverted for power generation. If 70 percent of Wailuku River daily gage reading exceeded 168 cfs, then 160 cfs was assumed to be diverted to the penstock and the remaining flow was apportioned as 62.50 percent within the Wailuku River below its diversion and 37.50 percent within the Kalohewahewa Stream below its diversion. Flow within the Hookelekele Stream was set such that the combined flow of the Kalohewahewa and Hookelekele Stream equaled 30 percent of the Wailuku River gage reading on that day. An illustrated example is present in Table IV-1. The resulting summary of pre- and post-project mean monthly flow at each station based on the daily flows are presented in Table IV-2. The pre- and post-project flow duration curves based on mean daily flows for the Wailuku River gage, Wailuku River Hookelekele and Kalohewahewa Streams are presented in Figures 10 to 13, Appendix B.

Habitat Simulation

Habitat availability was determined from aggregation of the hydraulic simulation results and the developed SI curves by use of the Physical Habitat Simulation system model HABTAT (Milhous *et al.* 1984). The functional relationships of WUA versus discharge for each station are presented in Figures 14 through 16, Appendix B. In the assessment of pre- and post-project impacts, WUA at discharges greater than the maximum discharge in these figures was set to the WUA occurring at the maximum discharge simulated. This is considered a reasonable assumption given the asymptotic properties of these curves and the high gradient narrow canyon topography of the stream channels at each station. An assessment of "community responses" was facilitated by development of single aggregated curves as the mean percent deviation (MPD) from the normalized individual WUA functions for each target species at each station as shown in Figure 17, Appendix B (Geer 1986).

Impact Analysis

The available habitat for each species as well as the MPD's based on daily pre- and post-project flows over the period of record from 1928 to 1988 were calculated and utilized to compute the mean monthly percent change in available habitat. These data are summarized for each target species at each station in Table IV-3 and presented graphically in Figures 18 through 20, Appendix B. The mean monthly percent change for the MPD's are provided in Table 6 and Figure 21, Appendix B. The habitat duration curves for pre- and post-project conditions for the respective target species at each of the three stations are presented in Figures 22 through 30, Appendix B.

TABLE IV-1

Example of post-project flow determinations based on daily flow readings at the Wailuku River gage and proposed operating criteria for the Wailuku and Kalohewahewa diversions

Pre-Project Daily Gage	70 Percent of Gage	Amount Diverted	Wailuku River		Kalohewahewa		Hookelekele		Wailuku Gage	
			Pre	Post	Pre	Post	Pre	Post	Pre	Post
12.0	8.4	0.0	4.8	4.8	4.3	4.3	7.2	7.2	12.0	12.0
93.0	65.1	57.1	37.2	5.0	33.5	3.0	55.8	30.9	93.0	35.9
305.0	213.5	160.0	122.0	33.4	109.8	20.1	183.0	111.6	305.0	145.0

TABLE IV-2

AVERAGE ANNUAL AND MONTHLY PRE- AND POST-PROJECT FLOWS AND DIVERSION FOR THE WAILUKU RIVER PROJECT (cfs)

	Wailuku Gage			Wailuku River*			Hookelekele Stream**			Kalohewahewa Stream***		
MONTH	Pre	Post	Net	Pre	Post	Net	Pre	Post	Net	Pre	Post	Net
JAN	283.00	228.10	54.90	113.20	89.40	23.80	169.80	138.70	31.10	101.90	53.90	48.00
FEB	310.80	254.00	56.80	124.30	100.40	23.90	186.50	153.60	32.90	111.90	60.50	51.40
MAR	412.60	329.60	83.00	165.00	128.60	36.40	247.50	201.00	46.50	148.50	77.30	71.20
APR	411.10	312.20	98.90	164.40	118.00	46.40	246.60	194.20	52.40	148.00	70.90	77.10
MAY	230.00	145.30	84.70	92.00	47.70	44.30	138.00	97.60	40.40	82.80	28.70	54.10
JUN	123.40	70.30	53.10	49.30	20.80	28.50	74.00	49.60	24.40	44.40	12.70	31.70
JUL	193.40	125.60	67.80	77.10	42.20	34.90	115.60	83.40	32.20	69.40	25.40	44.00
AUG	296.30	226.20	70.10	118.50	85.80	32.70	177.80	140.40	37.40	106.70	51.60	55.10
SEP	153.90	99.70	54.20	61.60	33.40	28.20	92.40	66.30	26.10	55.40	20.20	35.20
OCT	173.00	112.70	60.30	68.90	38.00	30.90	103.40	74.80	28.60	62.00	23.00	39.00
NOV	352.20	269.10	83.10	141.00	102.10	38.90	211.40	167.00	44.40	126.90	61.40	65.50
DEC	351.80	280.40	71.40	140.80	109.20	31.60	211.20	171.20	40.00	126.70	65.70	61.00
Annual Average	274.29	204.43	69.86	109.68	76.30	33.38	164.52	128.15	36.37	98.72	45.94	52.78

* = 40% of USGS Wailuku Gage

** = 60% of USGS Gage between Wailuku River and Kalohewahewa Stream Confluence

*** = 60% of Hookelekele Stream Flow

TABLE IV-3

Mean monthly percent change in available habitat for the opae, *Lentipes* adult and *Lentipes* juvenile within the Wailuku River, Hookelekele and Kalohewahewa Streams

MONTH	Wailuku River			Hookelekele Stream			Kalohewahewa Stream		
	Opae	Adult	Juven.	Opae	Adult	Juven.	Opae	Adult	Juven.
JAN	363.1	33.3	-11.8	365.4	29.4	11.5	411.7	237.4	203.8
FEB	337.1	31.2	-6.6	373.2	31.8	14.1	497.5	290.0	203.8
MAR	491.8	46.1	-5.3	594.3	50.3	24.2	779.5	431.6	308.8
APR	653.5	58.8	-6.2	735.5	67.1	33.8	818.4	483.7	351.4
MAY	684.4	59.0	-13.5	729.3	62.7	31.0	483.9	323.2	246.9
JUN	534.0	42.3	-22.3	338.8	35.3	14.1	242.4	164.8	115.1
JUL	597.5	49.5	-17.7	483.7	46.8	20.8	329.6	232.5	172.8
AUG	558.1	47.3	-18.6	467.3	43.4	19.0	434.2	273.2	193.4
SEP	508.2	41.1	-21.2	360.2	34.6	14.1	314.4	204.6	140.2
OCT	539.2	43.8	-18.1	384.7	39.6	17.2	380.0	236.6	167.0
NOV	569.9	51.5	-10.5	648.0	53.3	25.5	591.2	361.2	268.1
DEC	454.6	42.0	-10.9	444.0	40.5	17.3	693.8	384.0	266.7

These data demonstrate that the proposed operating regime and bypass flows result in a net increase of available habitat at all stations over all time periods based on mean monthly percent change in the available composite habitat (Table IV-4 and Figure 21). This is also supported by the habitat duration curves (Figures 22 through 30). The only reduction in available habitat is found in the juvenile *Lentipes* in the Wailuku River. This is noted in the mean monthly percent change in available habitat analysis (Table IV-3 and Figure 18). No juvenile *Lentipes* have been observed in the Wailuku River and habitat conditions necessary to support this species are generally lacking. The FWS (1984) stated "lengthy reaches of the Wailuku River between Hawaii Falls (1,775 ft elevation) and the proposed power plant are underlain by solid bedrock and deep pools which are not considered productive fishery habitat."

The FWS (1984) however, reported that in contrast to the Wailuku River, the stream bed in the Hookelekele Stream is mainly boulder and cobble overlying bedrock. This substrate heterogeneity provides low velocity zones for fishes, even during high flow periods. Boulders and cobbles provide breeding and egg-laying sites for females, display areas for the territorial males, feeding sites, and protection from suspended particulates. The substrate complexity and the resulting microhabitats in the Hookelekele Stream provide relatively good habitat for supporting goby populations. These observations enabled the FWS (1984) to list the Wailuku River as a Resource Category 4: the habitat to be impacted is of medium to low value for the evaluation species (native stream species) and the Hookelekele Stream as a Resource Category 2: the habitat to be impacted is of high value for the evaluation species and is relatively rare or becoming scarce on a regional basis or in the ecoregion setting.

Based on recommendations from the FWS (1984) and Archer (1986), diversion structures will be located on the Kalohewahewa Stream near the 2,000 ft elevation area. This will prevent entrainment of *Lentipes* (since no fish have been observed in this area) and insure that good habitat values are maintained by not diverting water from the Hookelekele Stream. Also, the penstock will be located a considerable distance from Hookelekele Stream, therefore, the *Lentipes* population will not be affected by penstock construction or maintenance activities.

The other diversion structure will be located near the 2,000 ft elevation on the Wailuku River. Since no fish have been observed in this area (Archer 1989), entrainment will not be a problem. Since the population of atyid shrimp is so rare at both diversion locations (Archer 1989), it is not necessary to screen for this species. Additionally, the diversion structures will be built in bedrock areas where the atyid shrimp have not been observed (Archer 1989).

The intake weirs will have a self-regulating notch on the crest to allow downstream passage of continuous flows during peak power development. The intake structures will allow passage of all flows in surplus of power generation needs. It will not be necessary to design the intake structures with vortex preventers to minimize the risk of excessive dissolved gas pressure, since no fish species are found in the area. The potential for gas bubble disease in fishes near the power plant tailwaters will be

TABLE IV-4

Mean monthly percent change in the available composite habitat in the Wailuku River, Hookelekele and Kalohewahewa Streams

MONTH	WAILUKU	HOOKELEKELE	KALOHEWAHEWA
JAN	28.5	23.9	328.5
FEB	26.6	24.6	424.4
MAR	38.9	38.1	637.3
APR	49.4	50.6	678.1
MAY	49.3	49.1	389.3
JUN	36.6	30.2	181.0
JUL	42.3	37.8	267.2
AUG	40.6	35.5	353.2
SEP	35.5	29.5	256.5
OCT	37.7	32.6	304.1
NOV	43.5	41.5	484.5
DEC	36.0	31.9	572.8

minimal, since the fish experience far greater discharges at the base of each waterfall with no apparent problems.

Additionally, design features in the diversion structure to allow for migration of aquatic species, does not seem necessary. No fish occur in the area and the atyid shrimp is very rare. Also, migration of the atyid shrimp over the diversion structure should present no problems compared to the numerous waterfalls the species had to surmount just to reach the 2,000 ft elevation area.

Operation of the project should not affect the life history requirements of the diadromous species. Migration of the *Lentipes* fry up the Wailuku River, into the Hookelekele Stream, should not be affected by operation of the project. The water will be diverted back to the Wailuku River a short distance (approximately 0.3 miles) downstream from its confluence with the Hookelekele Stream. The project will not affect the high flows (freshets, etc.) in the Wailuku River or Hookelekele Stream which may be required to transport the larvae downstream to the ocean.

Flora and Fauna

Except for the limited areas cleared for construction, adverse impacts on vegetation within the project area will be short-term. While clearing of access roads into the area and construction of facilities will permanently destroy some vegetation, regrowth and revegetation of the other project areas will occur after the construction phase is completed. The presence and operation of the proposed project is not anticipated to have an adverse long-term impact on native fauna or their habitat.

Existing access roads will be upgraded and new access roads and bridges will be built to accommodate logging trucks and equipment for use by the Division of Forestry and Wildlife in forest and watershed management and the County Department of Water Supply for maintenance of its system.

Pig hunting will be encouraged. A management plan will be developed in cooperation with the Division of Forestry and Wildlife to improve plant and bird habitats, as well as water quality, within the project area through control of feral pigs and such other measures as may be deemed appropriate.

Air Quality

Once in operation, the project will have no adverse effect on air quality. In fact, on Hawaii in general, air quality will be benefited by displacing an amount of fossil fuel used to generate electricity at HELCO's power plants.

Noise

Upon completion of construction, only the area near the powerhouse will be subject to increased noise levels. Usually, the noise of water flowing from a

powerhouse will not be significantly different than the natural sound of water flowing in the river. Sounds made by the turbines and other machinery in the powerhouse will be different and louder than present noise levels, but will be audible only in the near vicinity of the powerhouse.

Public Facilities and Services

Water Supply

The Hawaii County Department of Water Supply maintains three intake structures and pipelines in the area. The primary intake is at Kahoama, providing approximately 6 million gallons per day (MGD). The Pukamaui and Lauiole intakes provide 1.5 MGD.

The primary intake at Kahoama will be unaffected by the proposed project. The planned diversions will affect the Pukamaui and Lauiole intakes. The project design includes the construction of a new 18-inch pipeline to convey water from the power plant tailrace to the County Water system to ensure that the municipal water supply will not be reduced during periods of low water conditions. The amount provided will be equal or greater than it is at present.

Traffic

The major traffic impacts will occur during construction. Long-term impacts on traffic are expected to be negligible. The new access roads will facilitate resource management activities of the State Division of Forestry and Wildlife such as forest management, feral animal control and fire suppression.

Social and Economic

The project will employ two full-time plant operators. During the low rain season approximately 24 man-months of ongoing maintenance, with repairs and site work, is estimated to be required each year. This will be in addition to the full time plant operators. It is anticipated that immediately after large storm events short-term employment opportunities will be available for weekly periods.

The project is not expected to have a significant adverse effect on present subsistence or recreational activities in the area. Waters used for domestic use will continue to supply the residents of Hilo. Hunting activities will be impacted only during the construction period. No new recreation opportunities will be created by the project.

Aesthetics

Structures to be built for the proposed project will not be readily visible except from certain close vantage points. Almost the entire penstock for the Wailuku River site will be in thick forest, only visible from a short distance away. The powerhouse and

switching yard next to the open pasture land will only be visible from nearby locations. There are no scenic lookouts or similar vistas within the proposed project area. The general effect on the quiet wooded areas will be minimal, especially after the penstock becomes overgrown with understory vegetation.

Relationship Between Short Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

The project will utilize a renewable resource to provide "clean" energy, a public goal of both the State and the County of Hawaii. Potential adverse impacts on the stream environment appear to be manageable and should not negatively impact the stream system's long-term productivity. The growth of native vegetation will be enhanced in the long term because improved access will increase opportunities for resource management, particularly control of feral animals.

Irreversible and Irretrievable Commitments of Resources

The proposed project will utilize wood, concrete and steel in constructing the project that will be irreversibly committed and which not be available for other uses. The structures themselves -- weirs, penstocks, and the powerhouse -- could be removed in the future, in which case the streams would revert to their pre-project flow regimes. Access roads not utilized or maintained would become overgrown with vegetation.

The capital investment in the facilities will be virtually irreversible, as will the commitment of manpower and energy to sustain operations, procurement of supplies, and replacement of defective equipment that will be required over the long term.

Probable Adverse Effects Which Cannot be Avoided

Adverse impacts will be most pronounced during construction. Dust, noise, and traffic disruption will be the most noticeable irritants. Despite mitigation measures such as scheduling construction traffic during off-peak hours, there will be some unavoidable adverse impacts on residents on Waianuenue Avenue and Piihonua Road.

Flows in the Kalohewahewa and Hookelekele Streams and the Wailuku River below the diversion points will be reduced as long as the project is in place. Waterfalls between the diversion points and the power house will be diminished, and portions of the stream habitat will be negatively affected.

SUMMARY OF UNRESOLVED ISSUES

Assuming that the mitigation measures proposed in this document are acceptable to approving authorities, the only unresolved issue is whether the Federal Energy Regulatory Commission (FERC) has jurisdiction over the project and whether a FERC permit will be issued.

CHAPTER V

ALTERNATIVES TO THE PROPOSED ACTION

SITE ALTERNATIVES

A reconnaissance survey report prepared for the State of Hawaii in February 1981 evaluated alternative hydropower potential in the state, including the island of Hawaii (Hirai & Associates, 1981). Although rainfall is abundant in many areas of the Big Island, geological conditions do not favor abundant surface waters in some places. The rock strata of the relatively young volcanoes of Kilauea, Mauna Loa, and Hualalai are very porous, and rainfall is absorbed rapidly into the ground. Most streams flow only during periods of heavy rainfall. The only perennial streams are found in Kohala, and along the Hamakua Coast, where the older soils are somewhat more impervious to water, and rainfall is abundant throughout the year.

The survey report found a small amount of hydropower potential in the Ka'u District, on the leeward flank of Mauna Loa. A number of water development tunnels have been constructed to tap water perched at high elevations for irrigation and domestic use. These water development tunnels produce tremendous heads which offset the relatively low flows. At Ka'u Sugar Company, a hydropower capacity of 280 KW is possible from waters which drop a total of 1,870 feet in elevation from Keaiwa Reservoir to the sugar factory.

The report cites an earlier study conducted by a state task force on alternative energy in 1974. This group, the Governor's Committee on Alternative Energy Sources in Hawaii, studied the Kohala area for potential hydropower. It found the Wailoa River, Awini Falls, and Honokane Nui Stream have a combined hydropower potential of nearly 4,500 KW. The Kohala Ditch system once fed two hydropower plants with a combined capacity of 800 KW near Hawi. The prospect of reactivating these two plants has been investigated by HELCO and the Corps of Engineers. Since the cessation of sugar operations in 1975, there is only limited irrigation of truck farms in the area. The Kohala Ditch has deteriorated significantly so that major repairs would be needed to restore flow to the Union Mill hydro plant. Continued maintenance of the Kohala Ditch would be feasible only if the ditch water were sold for irrigation use as well as for hydropower use.

The Hamakua Ditch system has also been considered as an alternative source for hydropower. The survey states that water is collected from the headwaters of Waipio Valley, and is transported via two ditches, the Upper and Lower Hamakua Ditches, to the Honokaa area, a distance of about 10 miles. It is the chief source of water for the Davies-Hamakua Sugar Company factory in Haina. Theo H. Davies & Company, Ltd., is considering ways to utilize Hamakua Ditch water to increase the hydropower capacity at the Haina mills, which is currently 800 KW.

The reconnaissance survey found the Hamakua Coast, which stretches from Hilo to Honokaa, a distance of 40 miles, to be a good prospect for hydropower potential. The 20-mile stretch from Hilo to Laupahoehoe is the wettest region of the Big Island, with rainfall averaging 300 inches annually at the 3,000-foot elevation. Rainfall drops off rapidly between Laupahoehoe and Honokaa, but is still as great as 75 inches annually on the slopes above Honokaa. Except for the Kohala Mountains, the Hamakua Coast is the only area on the Big Island where perennial streams reach the sea. Springs fed by perched groundwater proliferate along the coast between sea level and the 2,000-foot elevation.

Because of the abundant rainfall, numerous springs, and relatively easy access, the Hamakua Coast is a good prospect for hydropower development. The Wailuku River currently is the only Hamakua Coast stream with an operating hydropower plant. However, at least four other hydropower plants, which ranged from 60-150 KW, have been in operation over the years, at the Wainaku, Papaikou, Pepeekeo, and Hakalau sugar mills. These plants utilized excess water from cane fluming operations. Trucking has replaced fluming as a means of transporting cane, and all but the Pepeekeo mill are now closed, although the water collection system for the Papaikou hydropower plant is still partially intact.

In concluding the overview of hydropower potential on the Big Island of Hawaii, the reconnaissance survey reported that additional hydropower potential exists on the Wailuku River. Honolii Stream was also identified as having significant power potential.

A reconnaissance hydropower study conducted by the Corps of Engineers, Honolulu District, in 1984 evaluated 11 streams along the Hamakua Coast. The study provided an analysis of the electrical energy needs and the alternatives available to meet the needs for the island of Hawaii. The report provided a definition of the problem, description of alternative solutions, evaluation of the technical, economic and environmental characteristics, and documentation of the costs and benefits associated with the solutions. The Wailuku River and Honolii Stream were ranked first and third, respectively, in potential for hydropower development. Umauma Stream was ranked as second. However, unlike the Wailuku River and Honolii Stream, Umauna is not gaged by USGS. Its flow regime is not well known and difficult to estimate accurately. Extensive flow records are available for the Wailuku River and Honolii Stream.

After the two streams were selected for more detailed studies, several alternatives were developed for each stream. The reconnaissance study selected one alternative for each study area to be evaluated for the Environmental Assessment (EA) included in the reconnaissance report.

The Wailuku site was designated in the National Economic Development Plan because it would provide the greatest benefit. According to the report, development of the Wailuku site would cause minimal adverse environmental impact because there are no known archaeological or significant historical or cultural sites or features in the

study area. Further, the Wailuku River is not especially productive biologically, and USFWS has placed it in Category 4 (habitat is of medium to low value for the evaluation species) for the Mitigation Policy. The report cautions that the terrestrial habitat in the vicinity of the project site may contain several endangered animal species and a candidate plant specie and that formal consultation with USFWS will be required pursuant to Section 7 of the Endangered Species Act of 1963. The report states that significant impacts to the endangered species can be avoided in the project area, and no impacts are likely which cannot be mitigated satisfactorily.

Alternative diversion sites and penstock alignments at lower elevations that have been evaluated in previous project proposals are described in the section on the project's history in Chapter I. Alternative penstock alignments were also investigated for the proposed project. These are shown in Exhibits V-1 and V-2. The point of diversion is the same in all three options, the preferred, and the alternatives.

Alternative "A" shown on Exhibit V-1 asks for penstock alignment between the Wailuku and the Kalohewahewa. At elevation 1560 and below, the penstock follows the alignment previously proposed in the environmental assessment. The alignment calls for a penstock crossing near the convergence of the Wailuku and the Kahoama Stream. The power house would be located at the same site as the preferred option. Access to project facilities west of the Kahoama Stream would be at the road joining the penstock alignment as soon as physically possible. A bridge will be required over the Wailuku as part of this option.

While the penstock is somewhat shorter for Alternative "A" than the preferred option, it was not selected because of potential sandstone problems near Lauiole Falls. It was felt that construction and maintenance of access in this area would be difficult and that other alignment were available to avoid these potential problems.

Alternative "B" shown on Exhibit V-2 also utilizes a penstock alignment situated by the Wailuku and the Kalohewahewa. This alignment proceeds to the east, crossing the Hookelekele just above the falls. At this location the Hookelekele is in a deep narrow gorge which provides a solid rock foundation for both the access road bridge and the penstock crossing. The penstock alignment parallels the Wailuku or alternatively follows a canehaul road dropping into the Wailuku at a location opposite the preferred option site on the north side of the river. With the power plant on the north side, the 18" pipeline to that County Water System would cross the Wailuku requiring excavation of rock through the river bottom extending to the connection point previously proposed. Also with the power plant on the opposite side of the river, an entirely new access to the project facilities would be required. Access would be obtained by coming south off of Piihonua Road and following an existing canefield road extending off the existing road to the plant site.

Alternative "B" would provide several benefits to the project not the least of which would be to decrease the 60" penstock and access road length by 1,000 feet. It would also require one less bridge and penstock crossing. Negative impacts include

CORRECTION

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

study area. Further, the Wailuku River is not especially productive biologically, and USFWS has placed it in Category 4 (habitat is of medium to low value for the evaluation species) for the Mitigation Policy. The report cautions that the terrestrial habitat in the vicinity of the project site may contain several endangered animal species and a candidate plant specie and that formal consultation with USFWS will be required pursuant to Section 7 of the Endangered Species Act of 1963. The report states that significant impacts to the endangered species can be avoided in the project area, and no impacts are likely which cannot be mitigated satisfactorily.

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construction activities near and over the Hookelekele. No meetings have been held with the canefield operations to discuss the feasibility or potential problems associated with this alternative.

NO ACTION ALTERNATIVE

If the proposed project is not implemented, and the hydropower facilities are not constructed, the physical and biological environments would remain in their present states at the project site. This alternative fully conforms with the objectives of the Conservation Lands Plan, to protect watershed areas and native plant habitats. The electric utility would continue to generate its electricity using oil and bagasse as its primary fuels. Because the quantity of bagasse is essentially fixed, the utility will be forced to increase its consumption of oil as the electricity demand on Hawaii continually grows as it is forecast. This would not conform to the State Energy Plan and the Hawaii County General Plan, both of which have the objective of decreasing the amount of fuel oil consumed in Hawaii through other alternative energy sources.

If the project were not completed, employment provided for its construction would not be realized. Tax revenues and direct and indirect revenues for goods and services would also not be realized. The water resources of the Wailuku watershed would not be utilized to their maximum potential. The advantages of a non-polluting source of energy with relatively stable costs would not be realized.

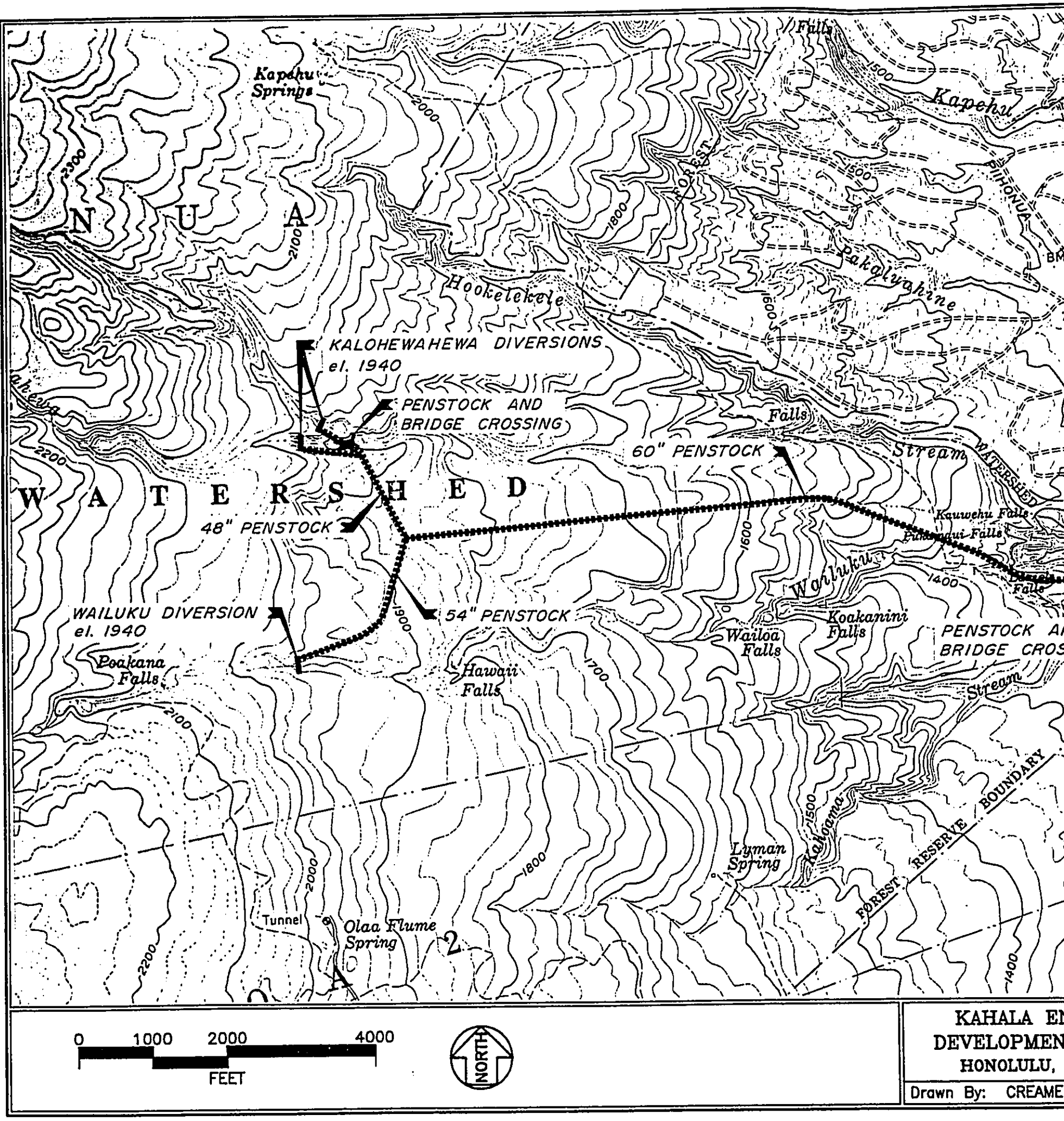
ENERGY RESOURCE ALTERNATIVES

Alternative energy sources include solar, wind turbines, ocean thermal, geothermal, and biomass projects. Conservation is also classified as an energy "source." Each of these potential energy sources has its own set of environmental impacts, some of which are generally regarded as more serious than run-of-river hydropower. Except for biomass energy in the form of bagasse, none of these energy sources has been able to make a widespread market penetration in Hawaii because of various technical and economic factors.

Energy Conservation

Nonstructural alternatives to hydropower fall under the broad category of energy conservation measures, which include reducing the level and/or time pattern of demand by time-of-day pricing; appliance efficiency standards; education programs; inter-regional power transfers; increased transmission efficiency; and technology which makes minimum use of traditional structural measures, such as solar energy.

Energy conservation can rightly be considered as an alternate energy source which is comparable with other energy sources in terms of payback, accessibility, reliability, ease of recovery, and environmental effects. Energy conservation is expected to make a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Pakalyahne
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FOREST
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BRIDGE CROSSING
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Kauwehu Falls
Pilipauui Falls
Waikiku
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WAILUKU DIVERSION
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Wailoa Falls
PENSTOCK A
BRIDGE CROS
Poakana Falls
Hawaii Falls
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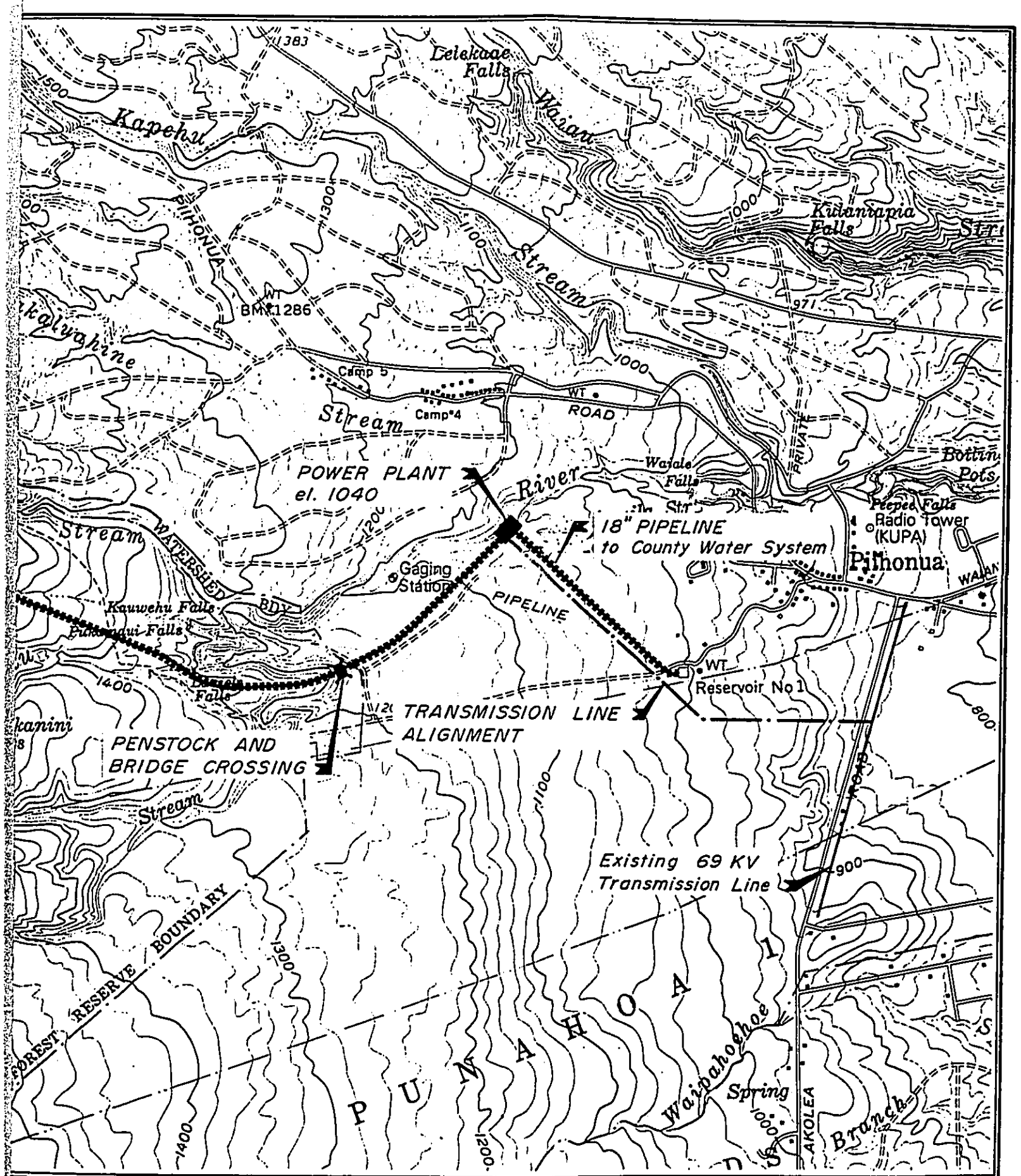
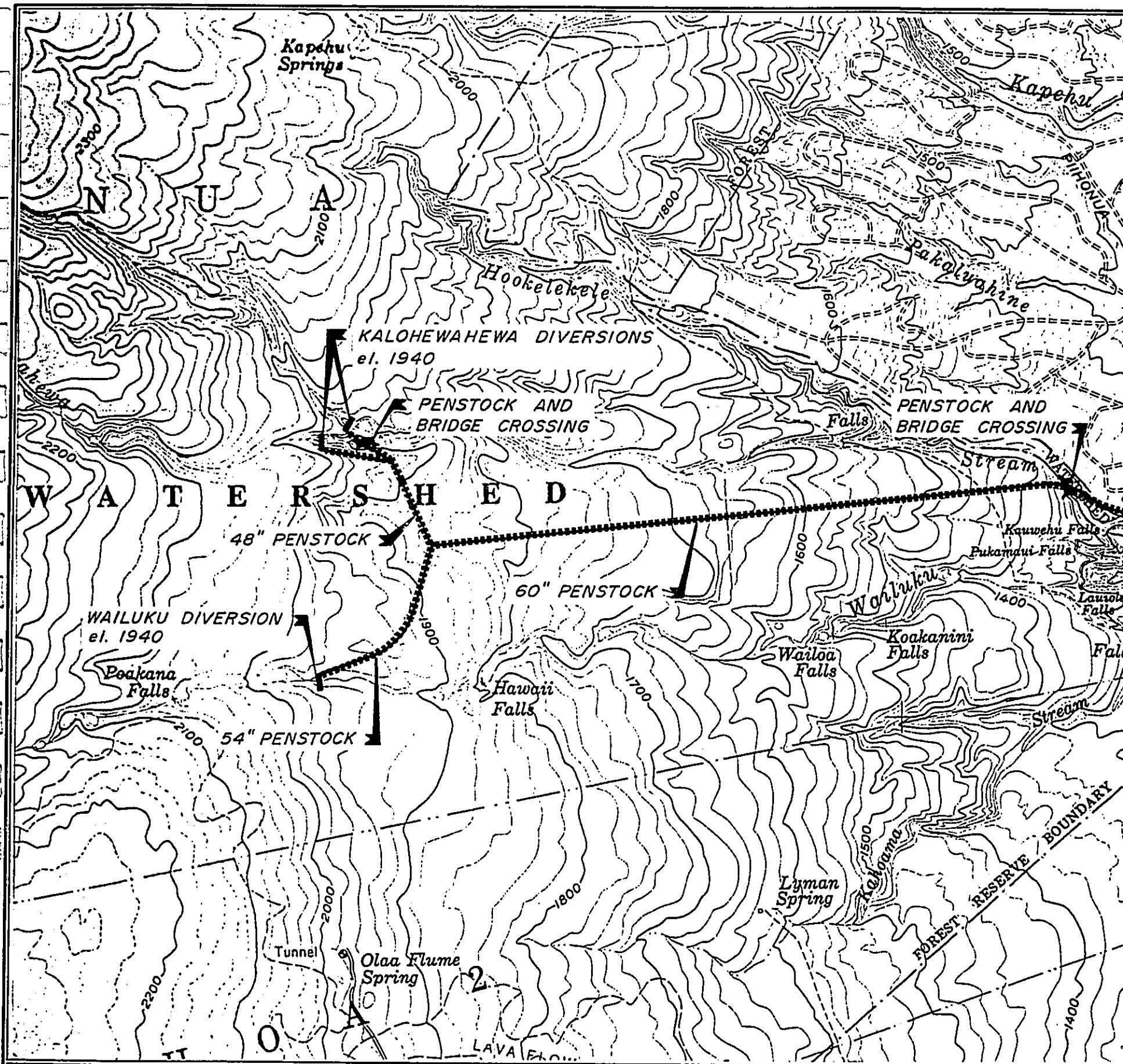


KAHALA ENERGY DEVELOPMENT CORP. HONOLULU, HAWAII	WAILUKU RIVER HYDROELECTRIC PROJECT
Drawn By: CREAMER & NOBLE INC.	PROPOSED PROJECT FACILITIES ALTERNATIVE A — EXHIBIT V-1



KAHALA E
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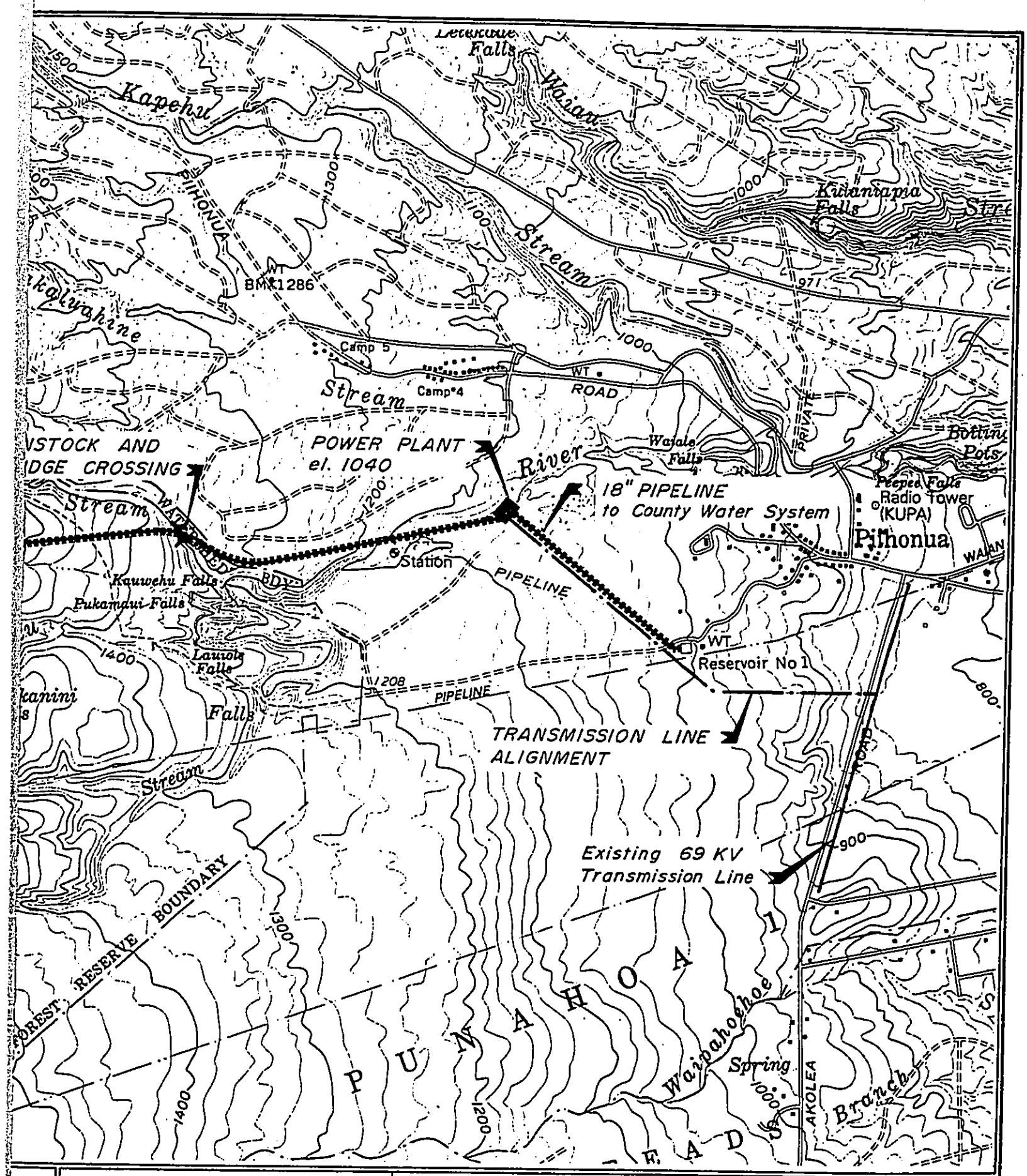

KAHALA ENERGY DEVELOPMENT CORP. HONOLULU, HAWAII	WAILUKU RIVER HYDROELECTRIC PROJECT
Drawn By: CREAMER & NOBLE INC.	PROPOSED PROJECT FACILITIES ALTERNATIVE B EXHIBIT V-2

significant contribution to increasing the state's and the Big Island's energy independence. Conservation will enable the island to consume petroleum fuels at a slower rate and serve as a partial moderator until effective alternative energy technologies are implemented. In the near-term, energy conservation offers the most cost-effective, readily available and environmentally benign means of obtaining "additional" energy. However, peak load growth is expected to occur even with conservation measures adopted. Some form of oil-fired generation is expected to handle the increased peak load.

Conservation, therefore, is an effective means of reducing overall energy consumption but does little to reduce the peak load. Conservation as a potential solution to the island's energy dependence on oil is not a viable solution and is considered only as a partial alternative to a new hydropower plant.

Geothermal

Natural heat from the earth shows great long-range potential for Hawaii's energy future. Economic comparisons generally show that geothermal energy is competitive with conventional energy sources.

Practically all potential developable geothermal energy in the State of Hawaii is located on the island of Hawaii. Although the amount of recoverable geothermal energy is still unknown, a test well (HGP-A) was drilled 6,450 feet into the eastern rift zone of Kilauea volcano on Hawaii in 1976 to explore geothermal potential. Construction of a 2.8 MW geothermal power plant to utilize the steam from HGP-A, which is funded by the Department of Energy, began in January of 1980. HELCO agreed to purchase 2.6 MW of energy for the first two years the generator operated. The first production of electricity from geothermal energy began in March 1982. Commercial exploration of Kilauea East Rift Zone of Puna District is currently underway through three geothermal mining leases granted by the State of Hawaii.

Environmental concerns in regard to geothermal energy production have focused on the emission of gases, the disposal of large volumes of hydrothermal fluids, aesthetic visual impacts, and the possible effect of volcanic activity on a power plant built in an active rift zone. Preliminary studies have concluded that the impact of HGP-A does not appear to be harmful, although monitoring and analysis is still on-going. A comprehensive environmental assessment of large-scale development of geothermal energy is in the process of being prepared.

Biomass

Biomass, which comprises any organic material, is an extremely important energy resource to the state. The major biomass resources in Hawaii are sugarcane, pineapple plants, and trees. In Hawaii County, biomass combustion comprised over 40 percent of the system's capability. The commercialization of biomass in Hawaii is faced mainly with economic rather than technological constraints. Many biomass resources, such as

molasses, pineapple, and wood, are already valuable for other uses, and it would require a drastic shift in market values or government incentives to redirect existing biomass resources entirely into an energy program.

Wind

Hawaii has some of the best wind regimes in the world due to its geographic relief and the northeasterly tradewinds which prevail 70 percent of the time. North Kohala (Kahua Ranch), South Kohala, and Waimea on the Big Island have been identified as sites with good energy potential. The most recent estimate of wind energy potential in Hawaii indicates that the development of each island's wind resources theoretically could exceed the total amount of electricity sold in 1980.

Wind energy constitutes one of the most benign energy technologies and, therefore, is a highly desirable alternative to petroleum. The technology in large scale wind turbine design and manufacturing is progressing rapidly and wind is considered one of the most promising forms of alternative energy on the Big Island today.

Winds in Hawaii are particularly consistent, with the prevailing northeast trades blowing 70 percent of the year at an average of 10 to 15 mph over the surrounding ocean. The favorable conditions are further enhanced over land by mountain ranges. However, the utilities currently estimate that they can accept a wind penetration level of only 10 to 20 percent of their generating capacity because wind is relatively intermittent, unpredictable, and uncontrollable.

Ocean Thermal

Ocean thermal energy conversion (OTEC) is based upon the temperature differences between the sun-warmed surface waters and the deeper cold bottom ocean currents.

Hawaii has warm surface water and deep cold water at great depths nearshore the year round. The technology of OTEC uses this thermal energy differential to produce electricity. Should OTEC systems become a practical reality, Hawaii could become energy self-sufficient. A demonstration plant, mini-OTEC, produced 50 KW or electricity successfully. Commercial OTEC's would range in capacity from 200 MW to 400 MW at a potential low cost. Commercial scale components still need to be developed and economic feasibility must be demonstrated.

Direct Solar Energy

Direct solar energy is the energy that is obtained by collecting and/or focusing the sun's rays. The primary application in Hawaii is for residential water heating. There are over 500 such installations on the Big Island today. This energy source will continue to be used in the future, however, because of the expense for the installations and

because it is mainly used for water heating, it will not produce significant energy savings in the near future.

Nuclear Energy

Nuclear power as a replacement for fossil fuels in electric generation is not considered a viable alternate energy technology for Hawaii within the next 20 years. Economic and environmental feasibility are the major disadvantages.

Coal

The environmental concerns surrounding nuclear power also apply generally to the utilization of coal. In addition, switching to coal would entail high equipment facility and operational costs and would require the construction of the necessary infrastructure for coal handling, such as port facilities and storage. Combustion of coal can also increase the emissions of particulate matter and noxious gases. However, the state considers coal as a potential oil replacement in the long-term future and it is currently being used as a supplemental fuel at bagasse-fueled power plants.

CHAPTER VI

RELATIONSHIP TO PLANS, POLICIES AND CONTROLS

This section discusses the project's consistency with state and county land use and energy plans, policies and controls. A list of required permits throughout the life of the project is also included.

STATE PLANS AND POLICIES

Hawaii State Plan

Development of hydroelectric power resources implements the Hawaii State Plan's objectives, policies and priority guidelines for energy use and development, and is consistent with other objectives, policies and priority guidelines contained in the Hawaii State Plan Revised adopted by the Hawaii State Legislature in May, 1986 (HRS 226).

The two energy objectives of the state are increased energy self-sufficiency and dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people. To achieve these objectives, the following policies have been adopted:

- Support research and development as well as promote the use of renewable energy sources
- Ensure a sufficient supply of energy to enable power systems to support the demands of growth
- Promote prudent use of power and fuel supplies through education, conservation, and energy-efficient practices
- Ensure that the development or expansion of power systems and sources adequately consider environmental, public health and safety concerns, and resource limitations (HRS 226-18)

The priority guidelines for energy use and development include encouraging "the development, demonstration, and commercialization of renewable energy resources." (HRS 226-103 (f))

Development of hydroelectric power resources also implements the objective and a policy in the Plan that relates to achieving economic growth through the development and expansion of potential growth activities that serve to increase and diversify Hawaii's economic base.. One policy that is directly relevant is:

- Facilitate investment and employment in economic activities that have the potential for growth such as .... energy .... (HRS-110)

State Functional Plans

Twelve "functional plans" have been prepared by state agencies in accordance with Chapter 226, HRS and adopted by the State Legislature. The purpose of the plans is to further define and implement the State Plan's comprehensive goals, objectives, policies and priority guidelines.

The State Energy Functional Plan developed by the Department of Planning and Economic Development (DPED) identifies alternate energy resource development as one of five areas of concern. The alternate energy resource development objective is to:

> Accelerate the transition to an indigenous renewable energy economy by facilitating private sector activities to explore supply options and achieve local commercialization and application of appropriate alternate energy technologies.

The State Energy Functional Plan states:

> Hawaii's near-total dependence on imported petroleum, spiraling oil prices, the net outflow of dollars for oil payments, and the political unrest of major oil-producing nations threaten local economic stability and the ability to serve energy needs over time. Support and assistance for private sector activities to develop local energy resources will reduce dependence on the world oil market, improve the State's balance of payments, and thus promote economic development, and increase the number and diversity of employment opportunities.

The implementing action that directly relate to hydroelectric energy resource development is:

- Conduct feasibility studies and implement appropriate hydropower projects.

The State Water Resources Development Functional Plan developed by the Department of Land and Natural Resources recognizes water for industry and energy production as an important water use. This water resource development objective is to:

> Encourage and coordinate with other water programs the development of self-supplied industrial water and the production of water-based energy.

The State Water Resources Development Functional Plan states:

> The development of . . . self-supplied water should be coordinated with other water programs for better resource management. Energy production

will continue to receive strong statewide attention and the striving for energy self-sufficiency will result in the development of more domestic sources of energy. Hydroelectric power production can be increased by improving the efficiency of existing plants and by constructing new plants at suitable sites.

The implementing action for hydroelectric energy resource development is:

Continue to assess sites for commercial hydroelectric and geothermal power plants, and study feasibility of joint public and private financing and operation of such power development projects.

HAWAII COUNTY PLANS AND POLICIES

The Hawaii County General Plan, adopted in 1971, provides policy guidance for land development and other activities for the County of Hawaii. In February 1980, the Plan was amended to give special emphasis on energy self-sufficiency because of the heavy dependence on imported fuel (approximately 60%) and the escalating cost of electricity. The plan is presently in the process of being revised and updated. Policies and courses of action described below are from the 1987 Draft Plan.

The County General Plan contains several policies supporting the development of alternate energy resources. Development of hydroelectric power resources is consistent with these goals and policies. Energy goals for Hawaii County are to:

- Strive towards energy self-sufficiency for Hawaii County.
- Establish the Big Island as a demonstration community for the development and use of natural energy resources.

Policies relating directly to hydroelectric power development are:

- The County shall encourage the development of alternative energy resources
- The County shall encourage the expansion of energy research industry
- The County shall ensure a proper balance between the development of alternate energy resources and the preservation of environmental fitness
- The County shall strive to ensure a sufficient supply of energy to support present and future demands

APPLICABLE PERMITS AND APPROVALS

Permits and approvals required for the development of hydroelectric power at the proposed site are listed in Table VI-1.

TABLE VI-1

APPLICABLE REVIEWS, PERMITS, AND/OR APPROVALS

AGENCY AND PERMIT	LEGISLATION OR REGULATION	CONCERN
Federal Permits		
Department of the Army		
Permit to Discharge Dredged or Fill Material	Section 404, Clean Water Act 33 USC 1344; 33 CFR Parts 320 through 330	Protection of water quality
Federal Energy Regulatory Commission		
*License to Develop Power	Federal Power Act16 USC 791-828	Power plant operation
State Permits		
Board of Land & Natural Resources		
Conservation District Use Permit	Chapter 183, HRS DLNR Adminstrative Rules, Title 13, Chapter 2	Required for commercial use of land within a Conservation District
Land Lease	Chapter 171, HRS	Protect leasee's investment; provide State revenue

*Authority to issue permit in dispute

TABLE VI-1 (Continued)

AGENCY AND PERMIT	LEGISLATION OR REGULATION	CONCERN
Commission on Water Resources Management		
Stream Diversion Works Construction Permit	Chapter 174C, HRS DLNR Adminstrative Rules, Title 13, Subtitle 7, Chapter 13-168	Protect instream uses
Amendment to Interim Instream Flow Standards	Chapter 174C, HRS DLNR Adminstrative Rules, Title 13, Subtitle 7, Chapter 13-169	Protect instream uses
Stream Channel Alteration Permit	Chapter 174C, HRS DLNR Adminstrative Rules, Title 13, Subtitle 7, Chapter 13-169	Protect instream uses
Office of Environmental Quality Control		
Environmental Impact Statement	Chapter 343, HRS DOH Adminstrative Rules, Title 11, Chapter 200	Environmental protection
Office of State Planning		
Coastal Zone Management Consistency	Coastal Zone Management Act of 1972 15 CFR 930 Chapter 205A, HRS	Consistency with State Coastal Management Program, in conjunction with U.S. Army 404 Permit

TABLE VI-1 (Continued)

AGENCY AND PERMIT	LEGISLATION OR REGULATION	CONCERN
State Permits (Cont'd)		
Department of Health		
Water Quality Certification	Section 401, Clean Water Act Chapter 342, HRS; DOH Administrative Rules, Title 11, Chapter 55	Protection of water quality, in conjunction with U.S. Army 404 Permit
Air Pollution Control Permit: Authority to Construct or Modify a Facility; Permit to Operate	Clean Air Act (42 USC 1857h-7 et seq.) Chapter 342, HRS; DOH Adminstrative Rules, Title 11, Chapters 59 and 60	Air quality, public health
Hawaii County Permits		
Grading, Grubbing, and Stockpiling Permit	Hawaii County Code, 1983, Chapter 10, Articles 2 and 3	Environmental impacts of earth moving activities
Building Permit	Hawaii County Code, 1983, Chapter 5 and Chapter 14, Article 9	Health and safety

CHAPTER VII

AGENCIES, ORGANIZATIONS AND INDIVIDUALS CONSULTED IN THE PREPARATION OF THE DRAFT AND FINAL ENVIRONMENTAL IMPACT STATEMENTS

A. COMMENTS AND RESPONSES

The following agencies, organizations, and individuals received copies of the Environmental Assessment (EA) and NOP and/or the Draft Environmental Impact Statement (DEIS). Those identified with an asterisk (*) responded to either the EA or the DEIS or both. Respondents with substantial comments are identified by double asterisks (**) and their comments are reproduced along with responses to the comments in this section. There were five letters containing substantial comments on the Draft EIS. These were from the Department of Land and Natural Resources, the Office of State Planning, the Office of Hawaiian Affairs, the Environmental Center, and the Sierra Club Legal Defense Fund.

FEDERAL

**Army Corps of Engineers

Department of Agriculture

*Soil and Conservation Service

Department of the Interior

**Fish and Wildlife Service

Geological Survey

Environmental Protection Agency

STATE

* Department of Agriculture

**Department of Health

**Department of Health, Hilo District Health Office, DOH

**Department of Land and Natural Resources

**Commission on Water Resource Management

Department of Business and Economic Development

Energy Division

* Department of Defense

* Department of Accounting and General Services
* Department of Transportation
**Office of Hawaiian Affairs
**Office of Environmental Quality Control
**Office of State Planning
Coastal Zone Management Program
University of Hawaii
**Environmental Center
Water Resources Research Center
State Legislature
Senators and Representatives, East Hawaii Districts
*Representative Wayne Metcalf
House Committee on Planning, Energy and Environmental Protection
Senate Committee on Agriculture, Energy and Ocean Resources

COUNTY OF HAWAII
Office of the Mayor
County Council
**Department of Planning
**Department of Research and Developmen
Department of Water

ORGANIZATIONS AND INDIVIDUALS
American Lung Association of Hawaii, Hawaii Council
Conservation Council of Hawaii, Hawaii Island Chapter
Hawaii Audubon Society
Hawaii Island Chamber of Commerce
Hawaii's Thousand Friends
Hawaiian Electric Light Company

Hunters' Association

The Nature Conservancy

* Sierra Club, Hawaii Chapter, Moku Loa Group

**Sierra Club Legal Defense Fund

Sportsmen of Hawaii

*Wai 'Ola

*Waimana Enterprises

*Elaine Wender

*Carol Wilcox

The Wildlife Society, Hawaii Chapter

B. PREPARERS OF DEIS

A list of the persons involved in the preparation of this draft supplemental environmental impact statement, the firms with which they are associated, and their areas of expertise and qualifications is presented in Table VII-1.

TABLE VII-1

LIST OF EIS PREPARERS

NAME	FIRM	TITLE	EXPERTISE
K. Reed Noble	Creamer & Noble Engineers	Project Engineer	water resources engineering
Terry J. Hickman	Creamer & Noble Engineers	Environmental Coordinator	biology
Jacqueline A. Parnell, AICP	KRP Information Services	Environmental Planner	technical writing
Dr. Thom Hardy	Utah State University	Research Assistant Professor	hydraulic modeling instream flow analysis

COMMENT LETTERS AND RESPONSES

Environmental Assessment

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

REPLY TO ATTENTION OF:

September 28, 1988

Planning Branch

Ms. Jacqueline Parnell
KRP Information Services
P.O. Box 27506
Honolulu, Hawaii 96827

Dear Ms. Parnell:

Thank you for the opportunity to review the Environmental Assessment and Notice of Preparation of Environmental Impact Statement (EA/EISPN) for the proposed Wailuku River Hydroelectric Project, South Hilo District, Island of Hawaii. The following comments are offered:

a. Wailuku River is a headwaters stream; thus any fill placed in the stream would require a Department of the Army permit. Because the EA/EISPN describes numerous structures to be constructed in and around the stream, a DA permit will be necessary. The applicant should contact Operations Branch at 438-9258 to set up a preapplication meeting to discuss permit requirements.

b. According to the Flood Insurance Study for the City and County of Honolulu, the project parcel is located in Zone D (areas in which flood hazards are undetermined).

Sincerely,

Clarence S. Fujii
Acting Chief
Engineering Division

Copy Furnished:

Office of Conservation and Environmental Affairs
ATTN: Don Horiuchi
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

KRP Information Services
320 Ward Avenue, Suite 106, Honolulu, Hawaii 96814
Mailing Address: PO Box 27506, Honolulu, HI 96827
Phone: 808 545-3633

April 3, 1989

Chief Engineering Division
US Army Corps of Engineers
Fort Shafter HI 96858-5440

Subject: Environmental Assessment and Notice of Preparation of Environmental Impact Statement for the Wailuku River Hydroelectric Project, South Hilo District, Hawaii.

This letter supplements the response that we made on November 18, 1988 to your letter of September 20, 1988 which provided comments on the subject document. We will be filing a draft environmental impact statement with the State Office of Environmental Quality Control on April 5, 1989.

Our client has decided to apply for the necessary Department of the Army permit after the State Department of Land and Natural Resources has acted on the Conservation District use application and the State Water Commission has responded to the petition to amend the interim stream flow standards. At that time we will set up a preapplication meeting with the staff of Operations Branch to discuss permit requirements.

Sincerely,

Jacqueline A. Parnell, AICP
General Partner

cc: Kahala Energy Development Corporation
Don Horiuchi, DLNR

UNITED STATES
DEPARTMENT OF
AGRICULTURE

SOIL
CONSERVATION
SERVICE

P. O. BOX 50004
HONOLULU, HAWAII
96850

September 22, 1988

KRP Information Services
Attention: Jacqueline Parnell
P.O. Box 27506
Honolulu, HI 96827

Dear Ms. Parnell:

Subject: Environmental Assessment and Notice of Preparation of Environmental Impact Statement for the Wailuku River Hydroelectric Project, South Hilo District, Hawaii

We have no comments to offer at this time; however, we would appreciate the opportunity to review the draft EIS.

Sincerely,

Herbert J. Lyford acting

RICHARD N. DUNCAN
State Conservationist

cc:
Office of Conservation and Environmental Affairs, Department of Land and Natural Resources, Attention: Don Horiuchi, P.O. Box 621, Honolulu, HI 96809

United States Department of the Interior
FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

ES
Room 6307

SEP 22 1988

KRP Information Services
Attn: Jacqueline Parnell
P.O. Box 27506
Honolulu, Hawaii 96827

Re: Environmental Assessment and Notice of Preparation for an Environmental Impact Statement, Wailuku River Hydroelectric Power Project, Hawaii

Dear Ms. Parnell:

We have reviewed the referenced document and offer the following comments for your consideration.

General Comments

The proposed hydropower development is similar to the project designed for the Wailuku River by the U.S. Army Engineer District, Honolulu (Corps) in 1984. The U.S. Fish and Wildlife Service (Service) has been involved in the planning and design of this hydroelectric power project since 1984. We prepared a draft Coordination Act report for the Corps' Wailuku-Honolii Hydropower study on June 4, 1984. On August 15, 1986, we reviewed a State Conservation District Use Application (CDUA) by the Garratt-Callahan Company for a hydropower project similar to the Corps' proposal. Since then, we have met with Bingham Engineering to identify unresolved issues, and to recommend additional studies and mitigation measures.

Specific Comments

a. Page II-4. Maintenance Flows. As stated in our 1984 Coordination Act Report, the Service recommended that specific instream flows to support aquatic resources be developed prior to the construction of the power facility. My staff is available to assist in the proposed studies to determine a biologically appropriate instream flow for the Wailuku, Kalohewahewa, and Hookelekele streams. We recommend that representatives from the Department of Land and Natural Resources and the Commission on Water Resources Management be involved in the scoping of these studies.

b. Page II-7. Access Roads. We recommend that bridges be used for stream crossings instead of concrete fords. We also recommend that an ornithologist examine the alignment of the proposed access road to determine if nests of the endangered Hawaiian Hawk (Buteo solitarius), threatened Newell's Townsend's Shearwater (Puffinus auricularis newelli), and roosts for the endangered Hawaiian Bat (Lasiurus cinereus semotus) are present.

c. Page III-8. Aquatic Fauna. The endemic o'opu alamo'o (Lentipes concolor) is a Category 1 candidate endangered species (50 FR 181:37958-37967). The results of the July 1986 aquatic surveys by Kelly Archer should be included in the draft Environmental Impact Statement (EIS).

d. Page III-12. Birds. The Hawaiian Hawk is a listed endangered species that is protected by the Service. We incorrectly stated that this species was threatened in our August 15, 1986 letter. As recommended in the ornithological reports prepared in 1986, we suggest that additional surveys to determine the presence of nesting sites for the Newell's Townsend's Shearwater be conducted. We recommend that fledglings and nesting sites be located by professional ornithologists during the nesting season using playback tapes of Newell's Townsend's Shearwater songs.

e. Page IV-1. Alteration of Landforms. Measures to control erosion during the construction period should also be discussed in the draft EIS. It may be appropriate to install temporary silt fences and erosion control fabric along steep cuts to minimize erosion before native vegetation can be replanted.

f. Page IV-2. Water Quality. The design of the cofferdam should be discussed in the draft EIS. We recommend that an earthen cofferdam not be constructed because of the potential for release of fine sediments into the stream. In addition, the excavation spoils should be protected from erosion.

g. Page IV-2. Flora and Fauna. We are pleased that the powerhouse will be relocated to avoid the concentrations of the Newell's 'ohi'a lehua (Hetrosideros collina polymorpha newellii). We suggest that measures to provide long-term protection of this rare plant be considered in the design of this project.

h. Page IV-5. Aquatic Fauna. The Service's mitigation goal is no net loss of habitat value for the native aquatic animals such as the 'opae kala'ole (Atyoida bisulcata) and the candidate endangered o'opu alamo'o. Our conservation flow recommendation will be consistent with this goal. We are pleased that the revised project does not include a diversion on Hookelekele Stream.

i. Page IV-6. Flora and Fauna. In addition to the Division of Forestry and Wildlife, we recommend that the Service and U.S. Department of Agriculture, Animal Damage Control Program (Tim Ohashi, District Supervisor) be consulted to develop a plan to control feral pigs in the watershed.

j. We suggest that the draft EIS include a description of the hydrology of the Wailuku, Kalohewahewa, and Hookelekele streams with and without the proposed project. Field studies are recommended to determine the extent of accretion flow between the stream intakes and powerhouse tailrace.

k. Drawings and a description of the diversion weir, screen, and fish passage structure should also be included in the draft EIS. We recommend that a notch be cut in the crest of the diversion weir to allow for the release of the conservation flow; and, the downstream face of the weir and notch should be grouted with cobbles and boulders, or placed across a natural rock sill, to mimic cascades and to allow the upstream migration of native diadromous species. We suggest that the intake structure include an automatic shut-off valve to immediately discontinue water withdrawal in the event of penstock failure.

l. We recommend that the draft EIS include a discussion of the timing and magnitude of flushing flows to remove accumulated sediments from the streambed. Specific release schedules should be determined through consultation with the Service and the Department of Land and Natural Resources.

m. We ask that the draft EIS discuss the streamflow monitoring program that would evaluate compliance with the conservation flow recommendation. For your information, we have enclosed a brief article that analyzed the discrepancy between agreed-to and actual streamflows for various water development projects in the western United States (Enclosure 1).

Summary Comments

The current proposal reflects the history of coordination with the Service. To reduce impacts to important fish and wildlife resources, the proposed project avoids diverting Hookelekele Stream to maintain flows for 'opae and o'opu alamo'o, relocates the powerhouse and penstock to avoid the main concentrations of Newell's 'ohi'a lehua, and proposes to develop a watershed protection plan to control feral pigs. The major remaining unresolved issue is the determination of a biologically appropriate conservation flow.

Re: Wailuku Hydropower Project, Hawaii

We appreciate the opportunity to comment, and look forward to participating in studies to determine appropriate instream flows.

Sincerely,

William R. Kramer
for Ernest Kosaka
Field Supervisor
Office of Environmental Services

Enclosure

cc: Commission on Water Resources Management
Planning Department, Hawaii County
DLNR
ADC

Research
Information bulletin
U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
NO. 88-50
DATE July 1988

Streamflow Records Indicate Frequent Failures In Meeting Minimum Flow Standards

Of 61 stream locations evaluated in three western States, 54 (89%) exhibited flows below those established in streamflow agreements on at least some occasions; 28 locations (46%) had flows 25% of the established agreement or less. Several locations showed chronic deviations. Actual flows were lower than agreed-to flows for 20% or more of the time at 17 (28%) of the 61 locations.

Streamflow Records Were Analyzed

Evaluations of acceptance, implementation, and effectiveness of recommendations are important parts of the mitigation process. One area of concern is the extent to which streamflows below water development projects are maintained at levels established or negotiated as part of mitigation. To address this concern, we examined water development projects in Colorado, Montana, and Wyoming. All known projects with streamflow agreements and data on streamflow below the development were assessed to determine the frequency of discrepancies between agreed-to and actual flows. We chose to use the term "discrepancy" instead of violation in our analysis because many agreements do not carry legally binding responsibilities for compliance.

A total of 73 water development projects were identified, involving 119 locations with minimum streamflow agreements. Of the 119 locations, only 61 (51%) had streamflow data. There were no apparent patterns of discrepancies related to the agency responsible for the development or the formality of the agreement. Regional precipitation, extent of water development, and primary uses of water appeared to be factors related to variations in discrepancies among the three States. Projects in Colorado had the highest frequency of discrepancies, but Colorado also had the overall lowest precipitation, highest extent of water development, and greatest demand by municipal and industrial users.

Additional Monitoring Is Needed

Lack of streamflow data for many streams and lack of routine monitoring probably decrease the effectiveness of streamflow agreements. Without flow data and systematic analyses, it is impossible to evaluate the implementation of instream flow agreements, identify factors contributing to lack of implementation, or assess biological effectiveness. Institutional responsibilities for monitoring and enforcement need to be clearly delineated at the time mitigation recommendations are established. The detailed biological assessment techniques and strenuous negotiations employed in reaching streamflow agreements may not lead to the desired results in many cases due to failure to maintain agreed-to flows.

For further information contact:

Wayne A. Hubert or Stanley Anderson
Wyoming Cooperative Fish and Wildlife
Research Unit
University of Wyoming
Box 3166, University Station
Laramie, WY 82071
(307) 766-5415 or FTS 328-0111

James E. Roelle
National Ecology Research Center
Creekside One Building
2627 Redwing Road
Fort Collins, CO 80526-2899
(303) 226-9435 or FTS 323-5435

Enclosure 1

Table 1. Frequency with which different magnitudes of flow discrepancies occur. For a particular discrepancy criterion, entries represent the number of stream locations in each frequency class.

Discrepancy criterion	Frequency class[a]						Total locations
	0%	<1%	1-20%	21-40%	41-60%	61-80%	
Flows below the minimum	7	10	27	11	4	2	61
Flows 90% of the minimum or less	11	11	29	7	3	0	61
Flows 75% of the minimum or less	16	13	25	6	1	0	61
Flows 50% of the minimum or less	23	15	21	2	0	0	61
Flows 25% of the minimum or less	33	20	8	0	0	0	61

[a]Percentage of days in the period of hydrologic record when measured streamflows were below the stated discrepancy criterion.

SEP 1988
RECEIVED

This bulletin is an interim report for information only. The data are considered provisional, pending completion of the research and analysis and interpretation of final results. Use of trade names does not imply U.S. Government endorsement of commercial products.

KRP Information Services
320 Ward Avenue, Suite 106, Honolulu, Hawaii 96814
Mailing Address: PO Box 27506, Honolulu HI 96827
Phone: 808 545-3633

April 3, 1989

Office of Environmental Services
US Fish & Wildlife Service
P O Box 50167
Honolulu HI 96850

Subject: Environmental Assessment and Notice of Preparation of Environmental Impact Statement for the Wailuku River Hydroelectric Project, South Hilo District, Hawaii.

This letter supplements the response that we made on November 18, 1988 to your letter of September 22, 1988 which provided comments on the subject document. We will be filing a draft environmental impact statement with the State Office of Environmental Quality Control on April 5, 1989 which will address your concerns. Brief responses to your specific comments are as follows:

a. Maintenance Flows

Your assistance in helping us to develop maintenance flows is appreciated. We believe that you will find the research, methodology and results of the IFIM study a useful contribution to your research on Hawaiian streams.

b. Access Roads

Bridges will be used for stream crossings. A biologist will be consulted during the design phase of the project and immediately prior to construction to ensure that disturbance to any possible native species in the area is either avoided or minimized.

c. Aquatic Fauna

Potential impacts on the o'opu alamo'o (*Lentipes concolor*) are discussed at length in the draft EIS. Results of all of Kelly Archer's aquatic surveys (two in 1986 and one in 1989) are summarized and discussed in the draft EIS.

d. Birds

A survey is planned to be conducted during the shearwater nesting season (April and May) which will cover the non-surveyed area between 1500' and 2000' elevation.

e. Alteration of Landforms and f. Water Quality

Various measures to control erosion during construction are discussed in the draft EIS. No significant long-term adverse change in water quality of the Wailuku River system is expected as a result of the proposed project.

g. Flora and Fauna

A qualified botanist will be included on the project design team when plans are finalized to ensure that all of the site is surveyed, and particularly to ensure that the populations of Newell's 'ohi'a lehua are not disturbed.

A management plan will be developed in cooperation with the Division of Forestry and Wildlife to improve plant and bird habitats as well as water quality within the project area through control of feral pigs and such other measures as may be deemed appropriate.

h. Aquatic Fauna

The project has been relocated to an elevation of 1940 feet which will avoid impacts on the habitat of the o'opu alamo'o and minimize impacts on the 'opae kala'ole. The habitat of these two species and the potential effects of the proposed project are discussed at length in the draft EIS.

i. Flora and Fauna

Your suggestion to involve DOA's Animal Damage Control Program and your office in the development of a management plan for control of feral animals is welcomed and will be pursued at the appropriate time.

j. Hydrology

The draft EIS addresses the hydrology of the Wailuku River and its tributaries in both the chapter on the environmental setting and the one on potential impacts and mitigation measures.

k. Diversion Structures, and l. Flushing flows

Drawings and a description of the diversion weir and appurtenant structures are included in the draft EIS. Based on recommendations from the FWS and Archer, diversion structures will be located on the Kalohewahewa Stream near the 2,000 ft elevation area. This will prevent entrainment of *Lentipes* (since no fish have been observed in this area). The other diversion structure will be located near the 2,000 ft elevation on the Wailuku River. Since no fish have been observed in this area, entrainment will not be a problem. Since the population of 'opae is so rare at both diversion locations, it is not necessary to screen for this species.

The intake weirs will have a self-regulating notch on the crest to allow downstream passage of continuous flows during peak power development. The intake structures will allow passage of all flows in surplus of power generation needs. Stream flushing that occurs presently during high-rainfall periods will continue. Design features in the diversion structure to allow for migration of aquatic species do not seem necessary. No fish occur in the area and the atyid shrimp is very rare. Also, migration of the atyid shrimp over the diversion structure should present no problems compared to the numerous waterfalls the species had to surmount just to reach the 2,000 ft elevation area.

Operation of the project should not affect the life history requirements of the diadromous species. Migration of the *Lentipes* fry up the Wailuku River on into the Hookelekele Stream should not be affected by operation of the project. The water will be diverted back to the Wailuku River a short distance (approximately 0.3 miles) downstream from its confluence with Hookelekele Stream. The project will not affect the high flows (freshets, etc.) in the Wailuku River or Hookelekele Stream which may be required to transport the larvae downstream to the ocean.

m. Streamflow monitoring

The water surface elevation will be maintained by use of sensors which will regulate water flows through the turbine needle valves. Telephone capability is required to facilitate this function.

We appreciate the constructive comments and support that have been provided by your office. We hope that you will concur that the redesigned project is acceptable.

Sincerely,

Jacqueline A. Parnell, AICP
General Partner

cc: Kahala Energy Development Corporation
Don Horiuchi, DLNR

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

September 28, 1988

In reply, please refer to:
EPHSO

Ms. Jacqueline A. Parnell
KRP Information Services
P. O. Box 27506
Honolulu, Hawaii 96827

Dear Ms. Parnell:

Subject: Environmental Assessment (EA) and Notice of Preparation of Environmental Impact Statement (EISPN) for the Wailuku River Hydroelectric Project, South Hilo, Hawaii

Thank you for allowing us to review and comment on the subject EA and EISPN. We have completed a review of the subject documents for the Wailuku River Hydroelectric Project and have the following concerns with respect to preparation of the EIS.

The EIS should address:

1. The expected rise in temperature and related impacts upon receiving water quality due to:

   a. the retention of flow upstream of the two diversion structures; and

   b. the movement of flow through turbines and penstock.

2. The expected rise in turbidity in the receiving waters due to the construction or operation of facilities used to generate hydroelectric power.

3. The expected degree of nitrogen supersaturation and the effects of nitrogen supersaturation both on the penstock construction materials and the receiving water quality (e.g., Could nitrogen supersaturation result in pitting inside the penstock? What effect would pitting have on water quality? What effect(s) would nitrogen gas have on aquatic life, in the receiving waters, etc.?).

Sincerely yours,

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

cc: Off. of Conservation & Env. Affairs, DLNR

KRP Information Services
320 Ward Avenue, Suite 106, Honolulu, Hawaii 96814
Mailing Address: P.O. Box 27506, Honolulu, HI 96827
Phone: 808 545-3633

April 3, 1989

Bruce S. Anderson, PhD
Deputy Director for Environmental Health
Department of Health
P O Box 3378
Honolulu HI 96813

Subject: Environmental Assessment and Notice of Preparation of Environmental Impact Statement for the Wailuku River Hydroelectric Project, South Hilo District, Hawaii.

This letter supplements the response that we made on November 18, 1988 to your letter of September 28, 1988 which provided comments on the subject document. We will be filing a draft environmental impact statement with the State Office of Environmental Quality Control on April 5, 1989 which will address your concerns. Brief responses to your specific comments are as follows:

1. Water Quality

No significant long-term adverse change in water quality of the Wailuku River system is expected as a result of the proposed project. The reach of the streams between the diversion structures and the powerhouse will experience reduced flow by the amount diverted for power production. There may be temporary periods when the proposed project will affect water quality during extended dry periods or during the time of the year when rainfall is low. This could result in limited increases in water temperature and pH and decreases in dissolved oxygen from the diversion points down to the confluences of the Wailuku River and Kalohewahewa Stream with Hookelekele Stream.

2. Turbidity

Construction of the proposed project will likely result in short-term effects on water quality in the form of periodic increases in turbidity and sediment load downstream of the disturbance.

Construction of the diversion structures will take place in the streams within a dewatered area between cofferdams. Construction and removal of these cofferdams will add some fine sediments downstream of the action for a few days. The diversion

structures will be located in an area where no *Lentipes concolor* occur and where the atyid shrimp is rarely observed. Should overtopping occur during construction of the diversion structures, turbidity may increase for the duration of the high flow; however, it is not expected to be significant compared to the high turbidity which occurs naturally during high flows.

3. Nitrogen

The intake weirs will have a self-regulating notch on the crest to allow downstream passage of continuous flows during peak power development. The intake structures will allow passage of all flows in surplus of power generation needs. It will not be necessary to design the intake structures with vortex preventers to minimize the risk of excessive dissolved gas pressure, since no fish species are found in the area. The potential for gas bubble disease in fishes near the power plant tailwaters will be minimal, since the fish experience far greater discharges at the base of each waterfall with no apparent problems.

We appreciate your constructive comments and hope that we have been able to address your concerns in a satisfactory manner.

Sincerely,

Jacqueline A. Parnell, AICP
General Partner

cc: Kahala Energy Development Corporation
Don Horiuchi, DLNR

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
465 SOUTH KING STREET, ROOM 104
HONOLULU, HAWAII 96813

MARVIN T. MIURA, PH.D.
DIRECTOR

TELEPHONE NO.
548 6915

August 30, 1988

MEMORANDUM

TO: Jacqueline Parnell
KRP Information Services

FROM: Marvin T. Miura, Ph.D.
Director
Office of Environmental Quality Control

SUBJECT: Comments on the Wailuku River Hydroelectric Project Preparation Notice

We offer the following comments on your preparation notice for your consideration:

1. It seems that there exists a water diversion in both the Wailuku and Hookelekele streams. Kahala Energy Development Corporation's proposal to construct a hydroelectric plant will divert still more water from those streams. Our primary concern is that the remaining stream flow between the proposed hydroelectric plant's intake and powerhouse will be perennial and of sufficient quantity to support existing stream fauna. The Lentipes concolor, a category two candidate for inclusion on the Federal List of Endangered or Threatened Species, has been observed in this stream section. We would therefore appreciate an indepth discussion on minimum streamflows in your draft EIS.

2. The construction of the access roads and the installation of the penstocks will alter the natural terrain of the area. This may cause the diversion of surface water runoff, resulting in increased soil erosion. Your proposal to revegetate cleared and grubbed areas with native plant species is a good one, however, topsoil may be removed during the clearing process, making for difficult revegetation. Additionally, the earthwork for the penstocks may produce a channel for water runoff. These impacts should be mitigated.

Thank you for providing us with this opportunity to review your preparation notice. Should you have any questions regarding these comments, please contact Roy Sakamoto of my staff at 548-6915.

cc: Department of Land and Natural Resources
State Energy Office
Office of State Planning

KRP Information Services
320 Ward Avenue, Suite 106, Honolulu, Hawaii 96814
Mailing Address: PO Box 27506, Honolulu, HI 96827
Phone: 808 545-3633

April 3, 1989

Mr Marvin T. Miura Director
Office of Environmental Quality Control
465 South King Street, Suite 104
Honolulu, HI 96813

Subject: Environmental Assessment and Notice of Preparation of Environmental Impact Statement for the Wailuku River Hydroelectric Project, South Hilo District, Hawaii.

This letter supplements the response that we made on November 18, 1988 to your letter of August 30, 1988 which provided comments on the subject document. We will be filing a draft environmental impact statement on April 5, 1989 which will address your concerns. Brief responses to your specific comments are as follows:

1. The project has been relocated to an elevation of 1940 feet which will avoid impacts on the habitat of the o'opu alamo'o and minimize impacts on the 'opae kala'ole. The habitat of these two species and the potential effects of the proposed project are discussed at length in the draft EIS.

2. Various measures to control erosion during construction are discussed in the draft EIS. No significant long-term adverse change in water quality of the Wailuku River system is expected as a result of the proposed project.

We appreciate your constructive comments and hope that we have been able to address your concerns in a satisfactory manner.

Sincerely,

Jacqueline A. Parnell

Jacqueline A. Parnell, AICP
General Partner

cc: Kahala Energy Development Corporation
Don Horiuchi, DLNR

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
LIBERT K. LANDGRAF
MANABU TAGOMORI
RUSSELL N. FURUMOTO

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

OCT 7 1988

DOC. NO.: 4419E
FILE NO.: HA-2185

Ms. Jacqueline Parnell
KRP Information Service
P. O. Box 27506
Honolulu, HI 96827

Dear Ms. Parnell,

SUBJECT: Wailuku River Hydroelectric Project

Attached for your consideration and preparation of the DEIS are comments from our Divisions regarding this project.

Yours truly,

Don Horiuchi

Don Horiuchi

Attachment

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Water and Land Development
Honolulu, Hawaii

September 27, 1988

'88 SEP 27 AM 2:55
RECEIVED
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

MEMORANDUM

TO: Mr. Roger Evans

FROM: Manabu Tagomori

SUBJECT: Review for Chairperson's Signature: Wailuku River Hydroelectric Project, South Hilo District, Hawaii

We have reviewed the application and supporting documents and have no objections to the Chairperson signing as landowner on behalf of the Board of Land and Natural Resources.

Please note, however, that the applicant will be required to comply with all State Water Code permit requirements as well as interim instream flow standards for the Island of Hawaii. Copies of the appropriate permit applications and the interim standard are attached.

We would like to suggest that the CDUA and Water Code permits be processed concurrently in this instance in order to simplify and expedite the permitting process. We will contact the applicants to discuss the required Water Code permits and the procedure to be followed to amend the interim standard.

for MANABU TAGOMORI

SS:fc

Attachment

RECEIVED

'88 SEP 26 PM 1:19

DLNR
OCEA

'88 SEP 22 P2:39

September 20, 1988

MEMORANDUM:

TO: Calvin W.S. Lum, D.V.M., Administrator

FROM: Charles K. Wakida, District Forester
Ronald E. Bachman, District Wildlife Biologist

SUBJECT: Application for Proposed Use of State-Owned Conservation District Lands, Review for Chairperson's Signature, File No. HA-2185-Kahala Energy Development Corporation for Hydropower Use

Thank you for the opportunity to comment on the subject Environmental Assessment.

1. We have no objection to the proposed hydroelectric development provided the project can be accomplished without adverse affects such as streamflow contamination and erosion problems, and provided it is compatible with the County Department of Water Supply operations.

2. Access roads to be upgraded/constructed within the forest reserve, and all bridges and/or fords be built to accommodate logging trucks and equipment. A good road system in the area will be advantageous to DOFAW for the management of planted eucalyptus stands in the area, which will also benefit the Department of Water Supply. (On March 16, 1986, heavy winds severely damaged eucalyptus stands in the area. Salvage logging would have facilitated repairs of pipeline by the Department of Water Supply and reforestation by DOFAW).

3. Improved hunter access will help in reducing wild pigs. On page IV - 6, Flora and Fauna, an EIS will be prepared for pig control. In this document, it should be stated that all control efforts be public and not for just a select few. It is also suggested that the roadway from Saddle Road be made available for hunter use.

4. Page IV - 6: Conservation Flows. Through consultation, a determination will be made as to what adequate residual flow is necessary to support native aquatic species. This should be done prior to construction of diversion weirs and the power plant tailrace.

CHARLES K. WAKIDA

RONALD E. BACHMAN

Enclosures

CKW/REB:flr

ENDORSEMENT 9/23/88

I concur with Forestry Manager Wakida and Wildlife Biologist Bachman's comments.

CALVIN W. S. LUM, D.V.M.
Administrator

cc: Hawaii District

12/22/87

State of Hawaii
Department of Land and Natural Resources
DIVISION OF AQUATIC RESOURCES

DATE: September 26, 1988

MEMORANDUM
TO: Paul Kawamoto, Program Manager, Aquatic Resources & Environmental Protection
THRU: Eric Onizuka, Program Manager, Recreational Fishing
FROM: Robert T. Nishimoto, Aquatic Biologist, Hawaii
SUBJECT: Comments on X 1. Conservation District Use Application HA-2185
2.

Comment Requested by Roger Evans, Office of Conservation and Environmental Affairs Date of Request _____ Date Rec'd _____

RECEIVED '88 SEP 28 AM 7:50 DLNR OCEA

Summary of Proposed Project

Title: Wailuku River Hydroelectric Project

Project by: Kahala Energy Development Corp.

Location: Wailuku River, Hilo, Hawaii

Brief Description:

The Kahala Energy Development Corporation proposes to build a 10 MV hydroelectric plant along the Wailuku River, utilizing water from the Wailuku River and Kalohewahewa Stream. This proposal is somewhat different from the Garratt-Callahan Co.'s 1985 proposal to construct a 5 MW plant using water diverted from Wailuku River and Hookelekele Stream (latter considered desirable habitat for o'opu alamo'o), proposed 5 and 7 cfs (as compared to "to be determined" upon consultation with this Division, Water Commission and USFWS in the new proposal) conservation flows in the dewatered stretches of the River and Stream, respectively, and location of the diversions (elevation of 1,390 feet and 1,405 feet respectively, for the River and Stream compared to 1,545 feet for both in the current proposal) and powerhouse (1,114 feet vs. 1,040 feet elevation below an established USGS gauging station).

Comments:

The information on aquatic fauna indicates that stream surveys of the area were conducted to a maximum elevation of about 1,500 feet. It would be most desirable to extend the surveys to the headwaters or to a terminal waterfall of Wailuku River and Kalohewahewa Stream, and all of its upstream tributaries. This additional information would allow evaluation of the total ecosystem, not only in the affected dewatered reaches.

Comments on short-term and long-term impacts of the proposal on the aquatic fauna of the Wailuku River and tributaries are as follows:

Short-term: The short-term impact during the construction phase will destroy existing habitats, eliminate migratory pathways and increase the sediment load in the streams. Measures should be taken to lessen this impact, the most critical being dewatering of the stream. It is suggested that an uninterrupted stream flow be maintained during periods of construction (i.e., it is not clear whether or not the cofferdam will affect stream flow during construction of the decision structure). Total dewaterment of a stream for any period of time may cause irreparable damage to the habitat and consequently, the aquatic life. Recruitment of stream fauna may be a stochiastic process and there is no "guarantee" that the impacted habitat will be colonized by new recruits.

Long-term: A conservation flow (minimum stream flow) has to be maintained at all times. A management plan to ensure maintenance of a conservation flow and the incorporation of this plan into the operation of the hydroelectric plant needs to be outlined. A monitoring program for water quality and the aquatic life (especially providing for optimal habitat conditions for the native stream life) along the dewatered stretch of the stream is necessary. Should adverse effects be determined, appropriate mitigating measures such as increasing the conservation stream flow, should be a requirement.

Finally, we disagree with the statement on page III-8 of the Environmental Assessment indicates that the o'opu alamo'o (Lentipes concolor) is a candidate for inclusion on the "Federal List of Endangered or Threatened Species." Some scientists have suggested that the Lentipes is becoming threatened in areas of the State. However, it has been determined that the species occurs in only certain streams/rivers. As an example, the species is very abundant in Waikolu Stream on Molokai, where counts of 500 individuals per pool and estimated population in excess of 10,000 were made. Scientific data and evidence are not available to identify Lentipes as "threatened."

for ROBERT T. NISHIMOTO

KRP Information Services
320 Ward Avenue, Suite 106, Honolulu, Hawaii 96814
Mailing Address: P.O. Box 27506, Honolulu, HI 96827
Phone: 808
545-3533

April 3, 1988

Office of Conservation and Environmental Affairs
Department of Land and Natural Resources
Attention: Don Horiuchi
P O Box 621
Honolulu HI 96809

Subject: Environmental Assessment and Notice of Preparation of Environmental Impact Statement for the Wailuku River Hydroelectric Project, South Hilo District, Hawaii.

This letter supplements the response that we made on November 18, 1988 to your letter of October 7, 1988 which provided comments on the subject document. We will be filing a draft environmental impact statement with the State Office of Environmental Quality Control on April 5, 1989 which will address your concerns. Brief responses to the specific comments made by your agency are as follows:

Division of Water and Land Development

The applications for permits and a petition to amend the interim instream flow standards has been filed with the Water Commission to facilitate joint processing with the CDUA.

Division of Forestry and Wildlife

Adverse effects on water quality will be temporary. Water supply for the County will be maintained.

Existing access roads will be upgraded and new access roads and bridges will be built to accommodate logging trucks and equipment for use by the Division of Forestry and Wildlife in forest and watershed management, and the County Department of Water Supply for maintenance of its system.

Pig hunting will be encouraged. A management plan will be developed in cooperation with the Division of Forestry and Wildlife to improve plant and bird habitat, as well as water quality within the project area through control of feral pigs and such other measures as may be deemed appropriate.

Division of Aquatic Resources

The project has been relocated to an even higher elevation of 1940 feet. The upper areas of the affected streams have been surveyed by Kelly Archer. Relocation of the diversion weirs to this elevation will avoid impacts on the habitat of the o'opu alamo'o and minimize impacts on the 'opae kala'ole. The habitat of these two species and the potential effects of the proposed project are discussed at length in the draft EIS.

We appreciate your constructive comments and hope that we have been able to address your concerns in a satisfactory manner.

Sincerely,

Jacqueline A. Parnell, AICP
General Partner

cc: Kahala Energy Development Corporation

OFFICE OF STATE PLANNING
Office of the Governor
STATE CAPITOL, HONOLULU, HAWAII 96813 TELEPHONE: (808) 548-5893
JOHN WAIHEE, Governor

Ref. No. P-8710

September 9, 1988

Ms. Jacqueline Parnell
KRP Information Services
P.O. Box 27506
Honolulu, Hawaii 96827

Dear Ms. Parnell:

Subject: Wailuku River Hydroelectric Project Environmental Assessment and Notice of Preparation of Environmental Impact Statement

We have reviewed the subject document and offer the following comments.

We generally support energy development projects that would lessen Hawaii's dependence on imported fossil fuels. The proposed project's 10 megawatt hydropower plant and the estimated 26,000,000 Kwhr of electricity it will produce annually will help meet the Big Island's demand. However, there are important impacts at the proposed site that need to be considered. We understand that a 66-inch diameter penstock will be above ground and will cross over Wailuku River in the vicinity of an unnamed pool and will be constructed as part of the access bridge. The penstock will also cross Kahoama Stream. Therefore, the visual impact of these crossings should be addressed in the draft Environmental Impact Statement (EIS).

Relative to Hawaii's Coastal Zone Management (CZM) objectives and policies, we offer the following comments.

Historic Resources

A CZM policy is to maximize information retention through preservation of remains and artifacts or salvage operations. We are pleased that additional archaeological surveys are planned for the project area and support the consultation with the State Historic Preservation Office (SHPO) in the event that sites are found. We suggest that the EIS also include a section explaining that if sites are discovered during the construction phase, all work will be suspended and the SHPO will be consulted.

Coastal Ecosystems

A CZM objective is to protect valuable ecosystems from disruption and minimize adverse impacts on all coastal ecosystems. The project area contains portions of natural forest ecosystems and supports the rare species, Newell's 'ohi'a lehua. This species is a Category 1 candidate for inclusion on the

Federal List of Endangered or Threatened Species. We suggest that the draft EIS discuss further the possible impacts on these plants and consider methods for encouraging regrowth of native species in disturbed areas.

Native fauna have also been observed in the project area. The Pacific Golden Plover, the Wandering Tattler, the Black-crowned Night Heron, the Hawaiian Hawk, the White-tailed Tropicbird and the Hawaiian Hoary Bat are among the species observed. The Hawaiian Duck and Newell's Shearwater could also be expected to be found in this area. We suggest that the draft EIS consider mitigation measures to reduce impacts to these species during the construction phase.

An important aquatic ecosystem exists in the Wailuku River and Hookelekele and Kalohewahewa Streams. A Category 2 candidate for inclusion on the Federal List of Endangered or Threatened Species, the goby Lentipes concolor and the endemic shrimp Atyoides bisulcata have been observed in the area. As instream flows are important to the viability of the aquatic ecosystems, we are pleased that the plans include establishing minimum conservation flows in consultation with the Department of Land and Natural Resources, the Water Commission and the U.S. Fish and Wildlife Service. We would appreciate an indepth discussion on minimum stream flows in your draft EIS. Another consideration should be the impacts associated with entrapment of fish in the diversion intakes. The draft EIS should discuss the probable impacts of entrapment on the aquatic ecosystem and should explain mitigation measures which will be undertaken. The discussion should include information on the mesh size of intake screens and the velocity of water in the intake area.

The draft EIS should contain a thorough discussion on the possibility of increased turbidity and sedimentation in the river and streams and the subsequent effect that it could have on the aquatic ecosystem. Mitigation measures should be discussed. The problems and mitigation measures associated with the revegetation of areas which have lost top soil as a result of erosion due to project disturbance should also be discussed.

Since the project will require a Federal permit, a Federal consistency determination must be submitted to our CZM office for review and concurrence.

Thank you for the opportunity to comment on this preliminary environmental assessment.

Sincerely,

Harold S. Masumoto
Director

cc: Mr. Don Horiuchi,
Office of Conservation and
Environmental Affairs, DLNR

KRP Information Services
320 Ward Avenue, Suite 106, Honolulu, Hawaii 96814
Mailing Address: PO Box 27506, Honolulu, HI 96827
Phone: 808 545-3633

April 3, 1989

Mr Harold Masumoto, Director
Office of State Planning
State Capitol
Honolulu HI 96813

Subject: Environmental Assessment and Notice of Preparation of Environmental Impact Statement for the Wailuku River Hydroelectric Project, South Hilo District, Hawaii.

This letter supplements the response that we made on November 18, 1988 to your letter of September 9, 1988 which provided comments on the subject document. We will be filing a draft environmental impact statement with the State Office of Environmental Quality Control on April 5, 1989 which will address your concerns. Brief responses to your specific comments are as follows:

Visual Impacts

Structures to be built for the proposed project will not be readily visible except from certain close vantage points. Almost the entire penstock for the Wailuku River site will be in thick forest, only visible from a short distance away. The powerhouse and switching yard next to the open pasture land will only be visible from nearby locations. There are no scenic lookouts or similar vistas within the proposed project area. The general effect on the quiet wooded areas will be minimal, especially after the penstock becomes overgrown with understory vegetation.

Historic Resources

Additional archaeological surveys of the transmission line and access road corridors will be conducted when their locations are fixed, unless they follow existing roads. If any archaeological sites are found, the State Historic Preservation Office will be contacted to ensure that appropriate mitigation measures are taken.

Coastal Ecosystems

A qualified botanist will be included on the project design team when plans are finalized to ensure that all of the site is surveyed, and particularly to ensure that the populations of Newell's 'ohi'a lehua are not disturbed. A management plan will be developed in cooperation with the Division of Forestry and Wildlife to improve plant and bird habitats, as well as water quality, within the project area through control of feral pigs and such other measures as may be deemed appropriate.

The project has been relocated to an elevation of 1940 feet which will avoid impacts on the habitat of the o'opu alamo'o and minimize impacts on the 'opae kala'ole. The habitat of these two species and the potential effects of the proposed project on the habitat are discussed at length in the draft EIS. Various measures to control erosion during construction are also discussed in the DEIS. No significant long-term adverse change in water quality of the Wailuku River system is expected as a result of the proposed project.

Kahala Energy Development Company will apply for the necessary Department of the Army permit after the State Department of Land and Natural Resources has acted on the Conservation District use application and the State Water Commission has responded to the petition to amend the interim stream flow standards. At that time we will also prepare a CZM consistency document for review by your office.

We appreciate your constructive comments and hope that we have been able to address your concerns in a satisfactory manner.

Sincerely,

Jacqueline A. Parnell, AICP
General Partner

cc: Kahala Energy Development Corporation
Don Horiuchi, DLNR

PLANNING DEPARTMENT

25 AUPUNI STREET • HILO, HAWAII 96720
(808) 961-8288

COUNTY OF HAWAII

DANTE K. CARPENTER
Mayor

ALBERT LONO LYMAN
Director

TIM LUI-KWAN
Deputy Director

September 22, 1988

KRP Information Services
320 Ward Street, S. 106
Honolulu, HI 96814

Gentlemen:

Environmental Assessment and Notice of Preparation
Wailuku River Hydroelectric Project
Kahala Energy Development Corporation

Page I-1 of the report states that the Kahala Energy Development Corporation project would provide "a more reliable source of water for the county." Page IV-3 states "none of these (DWS intake) diversions will be disturbed by the proposed project, nor will the diversion for municipal water supply be reduced". The maps, figures 2 and 4 belie the statements because - the applicant's own water intakes are above the Department of Water Supply's intakes on the same streams; the applicant's own penstocks would lead directly to their powerhouse also bypassing the DWS intakes; the water would only return to the river below the powerhouse where there are no DWS intakes nor pipelines. The location of the KEDC's intakes and their water release point would definitely affect the supply of water to the city when those sources are needed unless KEDC activity is planning to cease whenever the County needs the water.

On the other environmental aspects of the proposal, we have no objections at this point, noting that the project's location is within the Conservation district and will thus require a subsequent CDUA from the Board of Land and Natural Resources.

We attach a copy of the Department of Water Supply's memo to us on this subject.

Sincerely,

ALBERT LONO LYMAN
Planning Director

DT:aeb/#1399

encl.

cc: Mayor
Research & Development
Department of Water Supply

COPY

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII

25 AUPUNI STREET • HILO HAWAII 96720

September 20, 1988

TO: Planning Department

FROM: H. William Sewake, Manager

SUBJECT: ENVIRONMENTAL ASSESSMENT AND NOTICE OF PREPARATION
OF ENVIRONMENTAL IMPACT STATEMENT
WAILUKU RIVER HYDROELECTRIC PROJECT
FILE CS 25-09

The project scope described on Page I-1 states that the project will provide a more reliable source of water for the County of Hawaii. The Department currently uses 6 million gallons per day from the Kahoama surface source with a projected use of maybe 10 million gallons per day from three (3) surface sources in the area. During the dry season, Kahoama plus all of the water in the Wailuku River system cannot provide enough water for the City of Hilo. A well source supplements the additional water needed. It should be stated that the priority of water distribution shall remain with the Department of Water Supply for a potable water supply. The proposed hydroelectric plant should use only the excess water from the Wailuku River System.

There seems to be a conflict of flow rates in Section IV. It states that the Department utilizes 4.25 MGD.

Should there be any questions, please do not hesitate to contact us.

H. William Sewake

H. William Sewake
Manager

CS

... Water brings progress...

COPY PLANNING DEPARTMENT
25 AUPUNI STREET

COUNTY OF HAWAII
HILO, HAWAII 96720

December 15, 1988

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

Dear Mr. Paty:

CDUA - 10/7/88 - 2186
Hydropower Plant Along Wailuku River
Kahala Energy Development Corp.
South Hilo, Hawaii

We commented directly to the applicant on September 22, 1988 on the Environmental Assessment and Notice of Preparation that, according to the maps which are figures 2 and 4 of the report, that the applicant's own water intakes would be above the County Department of Water Supply's intakes on the same stream. This could result in a diminished County water supply. And, because the applicant's own penstocks lead directly to their powerhouse, the water would bypass the Department of Water Supply intake. The water would, further, only return to the river below the Department of Water Supply's diversion. Yet, page IV-3 of the report stated that "none of these (Department of Water Supply intake) diversions will be disturbed by the proposed project, nor will the diversion for municipal water supply be reduced".

The applicant did answer, on October 21, 1988, that ". . .it was our intent to show that we will provide in two locations . . .water supplies to the Department of Water Supply . . .".

While their answering statement is reassuring, we would like to see it in the response part of the EIS or as an inclusion in the maps accompanying the text so that they are a part of the document.

In addition, the following section/pages were missing from the CDUA EA-EIS submittal: IV-2, V-2, the entire section VI. And, on a clerical note, everything beyond section V is bound upside down.

The project lies outside the County's Special Management Area, thus our SMA rules are not applicable in this case.

Sincerely,

DUANE KANUHA
Acting Planning Director

DT:cmd

cc: Land Agent
Board Member
Kahala Energy Development Corporation

KRP Information Services
320 Ward Avenue, Suite 106, Honolulu, Hawaii 96814
Mailing Address: PO Box 27506, Honolulu, HI 96827
Phone: 808 545-3633

April 3, 1989

Mr Duane Kanuha, Director
Department of Planning
County of Hawaii
25 Aupuni Street
Hilo HI 96720

Subject: Environmental Assessment and Notice of Preparation of Environmental Impact Statement for the Wailuku River Hydroelectric Project, South Hilo District, Hawaii.

This letter supplements the response that we made on November 18, 1988 to your letter of September 22, 1988 and your letter to the DLNR dated December 15, which provided comments on the subject document. We will be filing a draft environmental Impact statement with the State Office of Environmental Quality Control on April 5, 1989 which will address your concerns.

Your concern about the diversion of water from the Hawaii County Department of Water Supply system is understandable. The EA was not very clear on how the water would be replaced.

As the project is now designed, the primary intake at Kahoama will be unaffected. The planned diversions will affect the Pukamaui and Lauiole intakes. The project design includes the construction of a new 18-inch pipeline to convey water from the power plant tailrace to the County water system to ensure that the municipal water supply will not be reduced during periods of low water conditions. The amount provided will be equal or greater than it is at present.

We appreciate your constructive comments and hope that we have been able to address your concerns in a satisfactory manner.

Sincerely,

Jacqueline A. Parnell

Jacqueline A. Parnell, AICP
General Partner

cc: Hawaii County Department of Water Supply
Kahala Energy Development Corporation
Don Horiuchi, DLNR

Speaker
DANIEL J. KIHANO
Vice Speaker
ESHERO S. ALCON
Majority Leader
TOM OKAMURA
Majority Floor Leader
PETER K. APO

DISTRICT REPRESENTATIVES
1st — ANDREW LEVIN
2nd — HARVEY S. TAJIRI
3rd — WAYNE METCALF
4th — DWIGHT Y. TAKAMINE
5th — VIRGINIA ISBELL
6th — MIKE O'KIEFFE
7th — MARK J. ANDREWS
8th — HERBERT J. HONDA
9th — JOSEPH M. SOUKI
10th — BILL PFEIL
11th — DANIEL J. KIHANO
12th — SAMUEL S. H. LEE
13th — ROBERT BUNDA
14th — JOSEPH P. LEONG
15th — REB BELLINGER
16th — TERRANCE W. H. TOM
17th — MARSHALL K. IGE
18th — WHITNEY T. ANDERSON
19th — JOHN JUSTIN MEDEIROS
20th — CAM CAVASSO
21st — PATRICK A. RIBELLIA
22nd — HAL JONES
23rd — BARBARA MARUMOTO
24th — FRED HEMMINGS, JR.
25th — CALVIN K. Y. SAY
26th — LES IHARA, JR.
27th — BRIAN T. TANIGUCHI
28th — JAMES T. SHON
29th — DAVID M. HAGINO
30th — JOAN HAYES
31st — CAROL FUKUNAGA
32nd — MAZIE HIRONO
33rd — ROD TAM
34th — MIKE LIU
35th — KENNETH T. HIRAKI
36th — DWIGHT L. YOSHIMURA
37th — DENNIS A. ARAKAKI
38th — EMILIO S. ALCON
39th — ROMY M. CACHOLA
40th — KAREN K. HORITA
41st — TOM OKAMURA
42nd — CLARICE Y. HASHIMOTO
43rd — DAVID Y. IGE
44th — ROLAND M. KOTANI
45th — MITSUO "MITS" SHITO
46th — PAUL T. OSHIRO
47th — MIKE CROZIER
48th — HENRY HAALILIO PETERS
49th — PETER K. APO
50th — EZRA R. KANOHO
51st — BERTHA C. KAWAKAMI

(Minority Leader
(Minority Floor Leader

HOUSE OF REPRESENTATIVES
THE FOURTEENTH LEGISLATURE

STATE OF HAWAII
STATE CAPITOL
HONOLULU, HAWAII 96813

August 26, 1988

Jacqueline A. Parnell
KRP Information Services
P.O. Box 27506
Honolulu, Hawaii 96827

Dear Ms. Parnell:

I acknowledge receipt of and thank you for the EIS you sent regarding the Wailuku River Hydroelectric Project.

I have no comments regarding the project at this time. However, please be assured that I will forward any concerns that might arise at a later time.

With warm personal regards.

Sincerely,

WAYNE METCALF
Chairman
House Committee on Judiciary

SIERRA CLUB
LEGAL DEFENSE FUND, INC.

Source, Mt. McKinley Ansel Adams

212 Merchant Street, Suite 202 Honolulu, Hawaii 96813 (808) 599-2436
FAX (808) 521-6841

HAWAII OFFICE
Arnold L. Lum
Michael R. Sherwood
Staff Attorneys
Marjorie F. Y. Ziegler
Research Analyst
Other Offices

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San Francisco, CA 94115
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Suite 1600
Denver, CO 80202
(303) 863-9898

WASHINGTON, DC OFFICE
1516 P Street, N.W.
Suite 200
Washington, DC 20005
(202) 667-4500

ALASKA OFFICE
323 Fourth Street
Juneau, AK 99801
(907) 586-2751

NORTHWEST OFFICE
216 First Avenue, South
Suite 330
Seattle, WA 98104
(206) 343-7340

September 21, 1988

KRP Information Services
Attn: Jacqueline Parnell
P.O. Box 27506
Honolulu, Hawaii 96827

Re: Wailuku River Hydroelectric Project EIS

Dear Jackie:

The Sierra Club Legal Defense Fund would like to request, pursuant to Section 11-200-15(b) of the Hawaii Environmental Impact Statement Rules, that we be made a consulted party on the above-referenced EIS.

Thank you.

Very truly yours,

Arnold L. Lum

ALL:sw/krplet
cc: Steve Holmes
Sierra Club, Hawai'i Chapter

WAI 'OLA

P. O. Box 791, Hanalei, Kauai, Hawaii 96714
Telephone: Kauai - Mina Morita 826-9828,

September 22, 1988

KRP Information Services
Attention: Jacqueline Parnell
P.O. Box 27506
Honolulu, Hawaii 96827

Dear Ms. Parnell:

I would like to be consulted on the preparation of the environmental impact statement for the Wailuku River Hydroelectric Project, South Hilo District, Hawaii.

Thank you for your attention to this matter.

Sincerely,

Mina Morita

Mina Morita

"Ho'omalu Na Kai Eu'alu"

SR 93
Ha'iku, HI. 96708
August 30, 1988

KRP Information Services
Attention: Jacqueline Parnell
P.O. Box 27506
Honolulu, HI. 96827

Dear Ms. Parnell:

I wish to be a consulted party in the EIS process for the:

Wailuku River Hydroelectric Project
South Hilo District, Hawaii

Please send me copies of the Environmental Assessment and EIS Preparation Notice immediately via first class mail. Please send me also any other publications and information which become available concerning this proposal, including copies of any engineering reports, draft EIS and final EIS.

Thank you.

Sincerely,

Elaine S. Wender

Elaine S. Wender

Carol Wilcox
111 Royal Circle
Honolulu, HI 96816

August 26, 1988

KRP Information Services
PO Box 27506
Honolulu, HI 96827

Attn: Jacqueline Parnell

RE: Wailuku River Hydroelectric Project, South Hilo District, Hawaii.

Dear Ms. Parnell,

I wish to be consulted in the preparation of the EIS for the above cited CDUA. May I please have a copy of the CDUA, the project description, and the environmental assessment, if one has been prepared. What is KRP Information Services' relationship to the Wailuku River Hydroelectric Power Company, Inc? Which department within the DLNR is taking the lead on this review?

sincerely,

Carol Wilcox

Carol Wilcox

cc OEQC
Wai Ola

WAIMANA ENTEPRISES, INC.

September 21, 1988

KRP Information Services
P. O. Box 27506
Honolulu, Hawaii 96827

Attn: Jacqueline Parnell

Re: Wailuku River Hydroelectric Project
South Hilo District, Hawaii

Gentlemen:

This is to confirm a telephone call we placed to your office today concerning the above-referenced hydroelectric project. Waimana Enterprises would like to be placed on record as a consultant party to the Environmental Impact Statement for this project.

Sincerely yours,

Marya Brown

Marya Brown

737 Bishop Street Suite 2460 • Grosvenor Center • Honolulu, Hawaii 96813
(808) 599-4441 Facsimile (808) 599-4653

COMMENT LETTERS AND RESPONSES

Draft Environmental Impact Statement

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

REPLY TO
ATTENTION OF:
Planning Branch

May 10, 1989

Dr. Marvin Miura
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Dr. Miura:

Thank you for the opportunity to review the Draft Environmental Impact Statement (DEIS) for the proposed Wailuku River Hydroelectric Project, South Hilo, Hawaii. Our previous comments (letter dated September 20, 1988) have been incorporated into the DEIS, and the applicant's agent has informed Operations Branch that they will set up a Department of the Army permit preapplication meeting with Operations Branch after the state Department of Land and Natural Resources has acted on the project Conservation District Use Application (CDUA) and Stream Channel Alteration Permit (SCAP). We have no additional comments on the DEIS.

Sincerely,

Clarence Fujii
Acting Chief
Engineering Division

Copies Furnished:

Board of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, Hawaii 96809

Mr. J. Paul Carrington
Kahala Energy Development Corporation
820 Hililani Street, #701
Honolulu, Hawaii 96813

Ms. Jacqueline Parnell
KRP Information Services
320 Ward Street, #106
Honolulu, Hawaii 96814

United States Department of the Interior
FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

Mr. Manabu Tagomori, Deputy Director
Commission on Water Resources Management
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

19 APR 1989

Re: Wailuku River Hydroelectric Project, Hilo, Hawaii: Petition to Amend Interim Instream Flow Standard (PTAS-HA-5); Application for a Stream Channel Alteration Permit (SCAP-HA-47); Application of a Diversion Works Permit (DWP-HA-3). Petitioner: Kahala Energy Development Corporation.

Dear Mr. Tagomori:

The Fish and Wildlife Service (Service) is currently reviewing the Draft Environmental Impact Statement (DEIS) and associated technical information prepared for the referenced project. Our principal concern with the proposed action is the maintenance of adequate instream flow to protect aquatic fishery resources. We are pleased to note that the diversion works on Kalohewaheva Stream were located so as to reduce adverse impacts to Lentipes concolor ('o'opu alamo'o).

The voluntary application of the Instream Flow Incremental Methodology (IFIM) to determine biologically appropriate conservation flows is also appreciated. In order to resolve some discrepancies in the IFIM study, representatives of the Petitioner met with Service biologists and staff members of the Department of Land and Natural Resources on April 19th. At that meeting, the Petitioner's agent agreed to request an extension of their Conservation District Use Application (CDUA), and temporarily withdraw their applications for diversion works and stream channel alteration in order to review the development and results of their IFIM study with Federal and State resource agency staff.

The Service is planning joint-agency field trips and meetings with the Petitioner's agent, Creamer and Noble Engineers, and Dr. Tom Hardy (the author of the IFIM study for the Wailuku River) in early May. We will defer making any recommendations for instream conservation flows until our mutual review of the IFIM has been completed later this spring.

Thank you for providing us with an opportunity to comment on this proposal.

Sincerely,

Allan Marmelstein
Pacific Islands Administrator

cc: RD, FWS, Portland, OR (DRD/AFWE)
KRP, Inc., Honolulu

United States Department of the Interior
FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

ES
Room 6307

APR 27 1989

Mrs. Jaqueline Parnell
KRP Information Services
320 Ward Avenue, Suite 106
Honolulu, Hawaii 96814

Dear Ms. Parnell:

The Fish and Wildlife Service (Service) is currently reviewing the potential environmental consequences of the Wailuku River Hydropower Project proposed by Kahala Energy Development Corporation. As part of this review, we have scheduled a joint-agency meeting to consider the results of a study conducted by Creamer & Noble Engineers (St. George, Utah) to determine appropriate instream conservation flows for fishery resources.

We invite you or your designated representative(s) to attend the meeting scheduled for May 5, 1989 from 1:00 p.m. - 5:00 p.m. in Room 5302, Prince Jonah Kuhio Federal Building, 300 Ala Moana Blvd., Honolulu, Hawaii. A list of invitees and a tentative agenda are attached.

During the period May 5 - 11, site visits will be made to the Wailuku River and additional working meetings will be held for the purpose of validating the study results. You or your representative(s) are also welcome to participate in these additional activities.

Please contact Mr. Andrew Yuen of my staff (808-541-2749) for details regarding the proposed meeting and field trip. If you plan to attend, we ask that you contact us as soon as possible so that we can finalize arrangements. We look forward to hearing from you.

Sincerely,

Ernest Kosaka
Field Officer Supervisor
Environmental Services

Attachments

LIST OF INVITEES: WAILUKU RIVER INSTREAM FLOW STUDY REVIEW

State of Hawaii
- Mr. Manabu Tagomori, Water Resources Management Commission
- Mr. Henry Sakuda, Aquatic Resources (DLNR)
- Mr. Roger Evans, Planning Office (DLNR)
- Mr. Douglas Tom, Coastal Zone Management Program (DBED)
- Dr. Marvin Miura, Office of Environmental Quality Control
- Dr. Robert A. Kinzie, III, Department of Zoology (UH-Manoa)

County of Hawaii
- Mr. Duane Kanuha, Planning Office
- Mr. William Sewake, Department of Water Supply

United States Government
- Mr. Stanley Arakaki, U.S. Army Engineer District, Honolulu

Private Sector
- Dr. Thomas Hardy, University of Utah
- Mr. Terry Hickman, Creamer & Noble Engineers
- Mrs. Jaqueline Parnell, KRP, Inc.
- Mr. Arnold Lum, Sierra Club Legal Defense Fund

KRP Information Services
820 Mililani Avenue, Suite 100, Honolulu, Hawaii 96814
Mailing Address: PO Box 27506, Honolulu, HI 96827
1314 S. King St., Suite 951
Phone: 808 545-3633

August 15, 1989

Mr. Allan Marmelstein
Pacific Islands Administrator
U S Fish & Wildlife Service
P O Box 50167
Honolulu HI 96850

Subject: Draft Environmental Impact Statement for the Wailuku River Hydroelectric Project, South Hilo District, Hawaii.

Since your letter of April 19 was written to the Commission on Water Resources Management, additional stream studies at the Wailuku River project site have been undertaken. A supplemental report entitled "Wailuku River Instream Flow Impact Analysis" was prepared and sent on June 7, 1989, to all persons or agencies who provided comments on the Environmental Assessment for this project. The comment period for the Draft Environmental Impact Statement was extended through June 30 to allow for review. In that we have not received additional comments from you, we presume that we have addressed your concerns. A copy of the report will be appended to the Final Environmental Impact Statement.

We appreciate the assistance provided by your office to help resolve the issues connected with this project.

Sincerely,

Jacqueline A. Parnell, AICP
General Partner
for: Kahala Energy Development Corporation

cc: Manabu Tagomori, Commission on Water Resources Management
Don Horiuchi, DLNR
Kahala Energy Development Corporation

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES

GILBERT S. LANDGRAF
MANABU TAGOMORI
RUSSELL N. FUKUMOTO

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

JUN 27 1989

File No.: HA-2185
Doc. No.: 5949E

Ms. Jacqueline Parnell
KRP Information Services
P.O. Box 27506
Honolulu, Hawaii 96827

Dear Ms. Parnell,

Subject: Draft Environmental Impact Statement for the Wailuku Hydroelectric Power Project

The Draft Environmental Impact Statement for the Wailuku River Hydroelectric Power Project has been reviewed by the Department. We have the following concerns and comments on the project.

Historic Sites Section

In a previous review of this project, we agreed that the portions of the project surveyed (Barrera 1986) contained no significant historic sites. But, we noted, as did Barrera and as does this Draft EIS (pp. III-29), that the transmission line and access road corridors also should recieve archeological survey when their locations are fixed, unless they follow existing roads. This is to determine if significant historic sites are present in those areas or not, so plans can be made to redesign and preserve such sites or to otherwise properly mitigate them.

Until this survey is completed, we cannot determine if significant historic sites are in the project area and, if so, what the effects of the project will be on such sites. We would like to be notified of the schedule for the survey and of the survey findings, whether sites are found or not. (The Draft EIS states that our Historic Sites Section will be contacted only if sites are found.) If no sites are present, we still must check the survey for adequacy of coverage, and issue a "no effect" determination. Also, it must be clear that if significant historic sites are present, an acceptable mitigation plan must be worked out with the Historic Sites Section, and proper mitigation in some cases may be realignment of project elements to preserve the sites.

Division of Aquatic Resources

Inasmuch as the early May, 1989 survey could impact/change the proposed conservation flow, our specific comments in relation to aquatic resources concerns will depend on the results of survey.

Division of Water and Land Development

Areas of concern to the Division such as impact to instream uses have been thoroughly addressed. However, there are several areas requiring additional information or explanation, as follows:

Pg. II-4/II-5. Penstock and access road alignments require three bridges for stream crossings. Exhibits showing typical bridge design and text description should be included in the final EIS. Short and long-term impacts resulting from these structures should also be discussed.

Pg. IV-5. Terrestrial Fauna. Potential impact or benefit to Koloa (Hawaiian Duck) should be addressed.

Pg. IV-2. Water Quality. While construction on the Kalohewahewa Stream may not directly affect the Lentipes population on the Hookelekele Stream, the Hookelekele reach immediately upstream of the confluence of Hookelekele Stream and Wailuku River may be affected; i.e., sediment will move through this reach. What impact, to Lentipes, within this reach is likely?

The supplemental information on the instream flow impact analysis appears to fully address changes in aquatic habitat.

Thank you for submitting the Draft Environmental Impact Statement for our review.

Very truly yours,

William W. Paty

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
EIBERT E. LANDGRAF
MANABU TAGOMORI
RUSSELL N. FUKUMOTO

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

JUL 5 1989

File No.: HA-2185
Doc. No.: 6004E

Ms. Jacqueline Parnell
KRP Information Services
P.O. Box 27506
Honolulu, HI 96827

Dear Ms. Parnell:

Subject: Draft Environmental Impact Statement for the Wailuku Hydroelectric Power Project

As indicated in our previous letter on the subject, we have a few additional comments on the project. These following comments concern the potential impacts to aquatic resources.

The stream channel in much of the higher elevation areas of the affected reaches of both the Wailuku River and Kalohewahewa Stream are generally narrow and steep, with high velocity flows. The reduction in velocity should have a positive benefit on the only species, opae kalaole, which is known to inhabit the area, and may also enhance habitat for other native fauna.

Although no oopu species and a few atyids were observed at the elevation of the diversion weirs, this does not preclude the possibility that the occurence of these species at this altitude may be seasonal. Spot surveys of the freshwater assemblage may be insufficient to indicate the seasonality (if any) of these species. Therefore, it may be presumptive to assume that there is no need to preclude their entrance from the penstock. Also, there is no data to indicate the "...velocities in the channel will be such that the shrimp that are present can easily avoid entrance forces" during periods of increased streamflow when atyids are observed to be washed downstream.

Reference is made that the Awaous is a "species of special concern" and the Sicyopterus as "threatened" by the American Fisheries Society. It is pointed out that the American Fisheries Society, in 1987, has reprinted a revised listing which points out that Hawaii has no "protected or special concern fishes." This should also be clarified for the Lentipes which has been found in abundance on the Big Island.

The supplemental information suggests that a negative impact of the project will be the loss of available habitat to juvenile Lentipes on the Hookelekele Stream to which the Kalohewahewa Stream is a tributary. Mitigative measures such as increasing the conservation flow for this section of the project should be considered to conserve juvenile habitat. Although the Lentipes population in the Wailuku River is low relative to other Hawaiian streams such as the Honolii, there is no reason to accept the suggestion that a negative loss of any goby habitat associated with this project should be accepted.

Thank you for providing us with the supplementary information to the draft EIS.

Very truly yours,

William W. Paty

KRP Information Services
300 Ward Avenue, Suite 106, Honolulu, Hawaii 96814 1314 S. King St., S. 951 Phone: 808 545-3633
Mailing Address: PO Box 27506, Honolulu, HI 96827

August 15, 1989

Mr. William W. Paty Jr, Chair
Board of Land and Natural Resources
Attention: Don Horiuchi
Office of Conservation and Environmental Affairs
P O Box 621
Honolulu, HI 96809

Subject: Draft Environmental Impact Statement for the Wailuku River Hydroelectric Project, South Hilo District, Hawaii

Dear Mr. Paty:

This letter responds to your letters of June 27 and July 5, 1989 which provided comments on the subject document. We will be filing a final environmental impact statement with your office and the State Office of Environmental Quality Control on August 16, 1989. Our responses to your specific comments and concerns expressed by your staff follow:

Historic Sites Section

We concur, as stated in the draft EIS, that an archaeological survey of any additional areas that would be affected by proposed construction except existing roads should be completed before construction is undertaken. We believe it is still too early to do this survey, given that the project is still in the conceptual stage and detailed engineering plans have not been developed. Rather than making a broad survey of any area that might be utilized, it seems more appropriate to focus the archaeological survey, and conduct it at the same time the botanical and biological surveys are accomplished. The three surveys should be undertaken concurrently at the detailed project design stage to ensure that the selected alignments for the access roads, penstocks and transmission lines have a minimal adverse impact on the project site and environs.

Staff of the Historic Sites Section will be consulted prior to conducting the surveys. If any archaeological sites are found, a mitigation plan acceptable to the Historic Sites Section will be prepared and followed.

Division of Water and Land Development

Penstock and Access Roads

Descriptions and drawing of the three proposed bridges will be included in the Final EIS. The short term impacts of bridge construction will be similar to that of road and other construction, principally clearing of vegetation and temporary increases in turbidity and sediments. No long term impacts are anticipated.

Terrestrial Fauna

As noted in the draft EIS (p. III-26), the Hawaiian Duck or Koloa (*Anas wyvilliana*), listed as endangered by the State of Hawaii and threatened by the U.S. Fish and Wildlife Service, could be expected to be found in the area because of its distribution and habitat requirements, although this species was not recorded during either of the two reconnaissance studies that were made. The most likely place that Koloa would be found is on the Hookelekele Stream which has the type of habitat preferred by this specie. There will be no construction on the Hookelekele.

Additional botanical and biological surveys will be made before any construction is undertaken. Staff of the Division of Forestry and Wildlife will be consulted after the surveys are completed and before final construction plans are drawn to ensure that important flora and fauna will not be adversely impacted.

Water Quality

The temporary increase in sedimentation from construction of diversions on the Kalohewahewa Stream will have a negligible impact on the *Lentipes* population in the Hookelekele Stream due to the distance from the proposed action and due to increased flows in the Hookelekele Stream. Should overtopping occur during construction of the diversion structures, turbidity may increase for the duration of the high flow. This is not expected to be significant compared to the high turbidity which occurs naturally during high flows.

Division of Forestry and Wildlife

A special survey of the project area to look for shearwater nests was requested by the Division of Forestry and Wildlife and scheduled to take place in May. The survey was canceled due to conflicts between time available by qualified ornithologists and the heavy rainfall in the project vicinity. (The Piihonua gauge 88-9, located at Camp 5 at the 1200' elevation, recorded 23.13 inches of rainfall in April, 41.48 inches in May, and 20.36 inches in June.) As noted above, botanical and biological surveys will be planned in consultation with DOFAW staff and undertaken at final engineering design stage of the project.

Division of Aquatic Resources

Atyids

Our assumptions are based on the work of Yee and Archer. Yee, et al (1986), collected aquatic samples over a several-year period and found no atyids above 3,520 feet. Archer (1989) noted that the habitat at the 2,100 feet elevation area was not considered optimum atyid habitat. It consisted of bedrock substrate which is not associated with high populations of atyids. We still conclude that few atyids occur in the area. However, a condition could be put into the permit to survey the area for atyids and install screening if it is warranted.

'O'opu alamo'o

We have changed the wording describing the status of *Lentipes* in the Final EIS to comply with your request.

Because no juvenile *Lentipes* have been found in the Wailuku River, no information on habitat requirements for juvenile *Lentipes* has been collected from this river. The adult *Lentipes* curves for velocity and substrate were adjusted based upon consultation with FWS (other agencies invited to participate in this process unfortunately were unable to do so). The juvenile curves were not adjusted due to lack of information and need. It was felt that if the juvenile curves were changed, they would closely resemble the adult curves. This would reduce (if not eliminate) negative impacts to the juvenile *Lentipes*. The low impact values are within the margin of error recognized by IFIM.

To ensure that any negative impacts on aquatic species are kept to a minimum, final determination of conservation flows for the project will be made at the project design stage, in consultation with your office and FWS.

We appreciate your constructive comments and hope that we have been able to address your concerns in a a satisfactory manner.

Sincerely,

Jacqueline A. Parnell, AICP
General Partner

cc: Kahala Energy Development Corporation

Enclosures

OFFICE OF STATE PLANNING
Office of the Governor
STATE CAPITOL, HONOLULU, HAWAII 96813 TELEPHONE (808) 548-3093

Ref. No. P-9661

June 21, 1989

Ms. Jacqueline A. Parnell, AICP
KRP Information Services
P.O. Box 27506
Honolulu, Hawaii 96827

Dear Ms. Parnell:

Subject: Draft Environmental Impact Statement (DEIS), Wailuku River Hydroelectric Project, Upper Piihonua, Hawaii

We have reviewed the subject Draft Environmental Impact Statement (DEIS) relative to the Coastal Zone Management (CZM) Program objectives and policies of Chapter 205A, HRS, and have the following comments.

Coastal Ecosystems

It is a CZM objective to protect valuable coastal ecosystems from disruption and minimize adverse impacts on all coastal ecosystems. In this regard, we are concerned that the project may have adverse impacts upon endangered fauna and flora.

According to the Nature Conservancy of Hawaii's Coastal Map and Element Occurrence Records, the Wailuku River may be a possible habitat for the endangered Koloa and the endangered endemic plant Ischaemum Byrone. There may be also rare, threatened and/or endangered endemic plants in the project vicinity. We acknowledge the comprehensive research that was done on the endemic Goby and Atyid shrimp and the proposed mitigation measure relative to the endemic Goby. It demonstrates sensitivity and attention to environmental concerns. However, the DEIS does not adequately address impacts on other native species of fauna and flora.

In addition, we believe that the impacts need to be evaluated for the entire Wailuku River System and not be limited to only the immediate project area. This approach would add a more comprehensive and well-rounded assessment of environmental impacts and their related effects on the entire river system.

Please note that the project will require a CZM Federal Consistency certification in conjunction with the United States Army Corps of Engineers Permit. The project's compliance with the objectives and policies of the Hawaii CZM program will be evaluated at that time.

Thank you for this opportunity to comment on the DEIS. Please feel free to contact our CZM office at 548-8465 if you have any questions.

Sincerely,

Harold S. Masumoto
Director

cc: Department of Land and Natural Resources,
Office of Conservation & Environmental Affairs

KRP Information Services
[illegible] Honolulu, Hawaii 96814 1314 S. King St., S. 951 Phone: 808 545-3633
Mailing Address: PO Box 27506, Honolulu, HI 96827

August 15, 1989

Mr Harold Masumoto Director
Office of State Planning
State Capitol
Honolulu Hawaii 96813

Subject: Draft Environmental Impact Statement for the Wailuku River Hydroelectric Project, South Hilo District, Hawaii

Your constructive comments on the proposed project have been received and are appreciated. Our response is as follows:

Koloa

As noted in the draft EIS (p. III-26), the Hawaiian Duck or Koloa (*Anas wyvilliana*), listed as endangered by the State of Hawaii and threatened by the U.S. Fish and Wildlife Service, could be expected to be found in the area because of its distribution and habitat requirements, although this species was not recorded during either of the two reconnaissance studies that were made.

Ischaemum Byrone

Ischaemum Byrone is a grass found in coastal areas, including the area in the vicinity of the mouth of the Wailuku River, and a candidate endangered species. According to staff of the U.S. Fish and Wildlife Service, the highest elevation at which it has been found is 175 meters. The project location ranges from 1000 feet for the powerhouse to 1940 feet for the diversion structures, well above the habitat of this plant.

Additional studies

We believe that we have adequately addressed impacts on native species of fauna and flora to the extent possible at this stage of project development. As we stated in the draft EIS, additional botanical and biological surveys should be completed before construction is undertaken. These surveys should be done at the detailed project design stage to ensure that the selected alignments for the access roads, penstocks and transmission lines have a minimal adverse impact on the project site and environs. Staff of the DLNR's Division of Forestry and Wildlife will be consulted after the surveys are completed and before final construction plans are drawn to ensure that important flora and fauna will not be adversely impacted.

Entire Wailuku River system

We do not understand your comment that the impacts should be evaluated for "the entire Wailuku River System." The project will have no effect at all on the portions of the river system above the diversion sites, and we believe we have addressed all of the potential downstream effects. Water will be returned to the Wailuku River below the powerhouse. As you note in your letter, effects on aquatic fauna in the system have been described comprehensively. There will be no effect on flows below the project, and effects on water quality have been described.

Kahala Energy Development Corporation will apply for the necessary Department of the Army permit after the State Department of Land and Natural Resources has acted on the Conservation District Use Application, and the State Water Commission has responded to the petition to amend the interim stream flow standards. At that time we will also prepare a CZM consistency document for review by your office.

Sincerely,

Jacqueline A. Parnell

Jacqueline A. Parnell, AICP
General Partner
for: Kahala Energy Development Corporation

cc: Don Horiuchi, DLNR
Kahala Energy Development Corporation

STATE OF HAWAII
OFFICE OF HAWAIIAN AFFAIRS
1600 KAPIOLANI BLVD., SUITE 1500
HONOLULU, HAWAII 96814
(808) 545-0068
(808) 545-2642

June 26, 1989

C-L89-0068

Dr. Marvin Miura, Director
Office of Environmental Quality Control
465 S. King St. #104
Honolulu, Hawaii 96813

SUBJECT: Draft EIS: Wailuku River Hydroelectric Power Project, Hilo, Hawai'i

Dear Dr. Miura:

Thank you for sending our office a copy of the draft EIS, and for the opportunity to comment. The EIS indicates that one archaeological survey was conducted, and that more fieldwork will be conducted in the future. We request that copies of all archaeological reports resulting from this project be sent to our office for review and comment.

Sincerely,

Richard K. Paglinawan

Richard K. Paglinawan
Administrator

RKP:EN:klr

cc: BLNR
Kahala Energy Development Corp.
KRP Information Services

KRP Information Services
320 Ward Avenue, Suite 106, Honolulu, Hawaii 96814 1314 S. King St., S. 951
Mailing Address: PO Box 27506, Honolulu, HI 96827
Phone: 808 545-3633

August 15,1989

Mr Richard K. Paglinawan, Administrator
Office of Hawaiian Affairs
1600 Kapiolani Blvd., Suite 1500
Honolulu HI 96814

Subject: Draft Environmental Impact Statement for the Wailuku River Hydroelectric Project, South Hilo District, Hawaii

Thank you for taking the time to review and comment on the draft EIS for the Wailuku River Hydroelectric Project. I am enclosing a copy of the archaeological study that was done for the project area by William Barrera, Jr. of Chiniago, Inc. in December 1985 for the previous owners of the project.

Since the presently proposed project will be constructed at a higher elevation than originally proposed, it appears unlikely that any sites will be found. As we indicated in the draft EIS, additional surveys of the access road, penstock and transmission line corridors will be conducted prior to any construction. We will be pleased to send you a copy of the archaeological survey report when it is completed.

Sincerely,

Jacqueline A. Parnell

Jacqueline A. Parnell, AICP
General Partner
for Kahala Energy Development Corporation

cc: Don Horiuchi, DLNR
Kahala Energy Development Corporation

Enclosure

University of Hawaii at Manoa

Environmental Center
Crawford 317 • 2550 Campus Road
Honolulu, Hawaii 96822
Telephone (808) 948-7361

May 23, 1989
RE:0533

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

Dear Mr. Paty:

Draft Environmental Impact Statement
Wailuku River Hydroelectric Power Project
South Hilo, Hawaii

The above referenced document proposes construction of a 10 megawatt hydropower plant including appurtenant structures on the Wailuku River. The project will consist of two diversion structures on the Kalohewahewa Stream and one on the Wailuku, a powerhouse, penstocks, access roads, and a transmission line.

This review was conducted with the assistance of Joseph Halbig, Geology-UH Hilo; John Chan, Biology-UH Hilo; Yu-Si Fok, Water Resources Research Center; Bion Griffin, Anthropology; and C. Anna Ulaszewski, Environmental Center.

General Comments

Our reviewers were pleased with the the relocation of the diversion structure from elevation 1,545 feet to the presently proposed elevation 1,940 feet. This location, as stated in the Draft EIS, will have both environmental as well economic benefits.

Natural Hazards (page III-28)

Volcanic

We are very concerned about the fact that the project site is located in a "high risk volcanic area". Although the most recent flow in March 1984 came no closer than about 5 miles from the Wailuku River, it served to accentuate a significant potential hazard. The fact that lava flows tend to follow stream courses increases the hazard potential.

Social and Economic Characteristics (page III-28)

Archaeology

The proposed actions concerning historic/archaeological sites are completely inadequate and inappropriate. The Draft EIS must include the results of the completed intensive archaeological survey of any areas to be affected including transmission line and access road locations. A mitigation plan, including procedures approved by the State Historic Preservation Office must be in hand and included in the Draft EIS for review.

This document pointedly does not include a report of the reconnaissance survey, which was conducted by W. Barrera. Without documentation, we are unable to determine the adequacy of the methodology and the justification for statements made in this document.

Thank you for the opportunity to comment on this document. We hope our comments will be helpful in preparing the Final Environmental Impact Statement.

Yours truly,

John Harrison
Environmental Coordinator

cc: OEQC
J. Paul Carrington,
Kahala Energy Development Corp.
KRP Information Services
L. Stephen Lau
Yu-Si Fok
John Chan
Joseph Halbig
Bion Griffin
C. Anna Ulaszewski

KRP Information Services
[illegible] Honolulu, Hawaii 96814 1314 S. King St., S. 951 Phone. 808 545-3633
Mailing Address. PO Box 27506, Honolulu, HI 96827

August 15, 1989

Mr. John Harrison, Environmental Coordinator
Environmental Center
Crawford 317, 2550 Campus Road
Honolulu HI 96822

Subject: Draft Environmental Impact Statement for the Wailuku River Hydroelectric Project, South Hilo District, Hawaii.

Your constructive comments on the proposed project have been received and are appreciated. Our response is as follows:

Natural Hazards

Although the project site is located within a "high risk volcanic area," risks to personnel from volcanic activity are low due to the excellent Civil Defense warning system in effect on Hawaii, allowing ample time to evacuate. The risk to personnel from an earthquake and/or subsidence would be the same anywhere in the area whether or not the project were built. Risks to downstream residents because of earthquake damage to the facility is minimal because of the project design, i.e., water is not impounded behind earthen dams.

Archaeology

A copy of the report prepared by William Barrera, Jr. on his archaeological reconnaissance of the project area is attached and will be appended to the final EIS. The findings and conclusions are the same as those presented in the draft EIS, that there is "no evidence of significant archaeological or historical remains." Additional information in the report not included in the draft EIS relates to historic uses of the lands in the vicinity of the project site. These uses were generally of a temporary measure, not involving the construction of permanent structures.

We concur, as stated in the draft EIS, that an archaeological survey of any additional areas that would be affected by proposed construction should be completed before construction is undertaken. However, we do not agree on the timing of this survey, given that the project is still in the conceptual stage and detailed engineering plans have not been developed. Rather than making a broad survey of any area that might be utilized, it seems more appropriate to focus the archaeological survey, and conduct it at the same time the botanical and biological surveys are accomplished. The three surveys should be undertaken concurrently at the detailed project design stage to ensure that the selected alignments for the access roads, penstocks and transmission lines have a minimal adverse impact on the project site and environs.

Staff of the appropriate divisions and offices of the Department of Land and Natural Resources will be consulted prior to conducting the surveys. If any archaeological sites are found, a mitigation plan acceptable to the State Historic Preservation Office will be prepared and followed.

Sincerely,

Jacqueline A. Parnell

Jacqueline A. Parnell, AICP
General Partner
for: Kahala Energy Development Corporation

cc: Don Horiuchi, DLNR
Kahala Energy Development Corporation

Enclosure

SIERRA CLUB
LEGAL DEFENSE FUND, INC.

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April 17, 1989

William W. Paty, Jr.
Chairperson
Board of Land and Natural Resources
1151 Punchbowl Street
Honolulu, HI 96813

Kahala Energy Development Corporation
820 Mililani Street
Suite 701
Honolulu, HI 96813

Re: Sierra Club Comments on the Wailuku River Hydroelectric Project DEIS, Kahala Energy Development Corporation CDUA No. HA-10/7/88-2185 and Petition to Waive Instream Flow Standards

To the Applicant and Members of the Board:

On behalf of the Sierra Club, the Sierra Club Legal Defense Fund, Inc. hereby submits comments on the Wailuku River hydroelectric project Draft Environmental Impact Statement (DEIS) and the above-referenced applications for permits to construct diversion works on two branches of the Kalohewahewa River, a diversion works on the Wailuku River, a penstock and power plant on the banks of the Wailuku River, and to divert water from the Kalohewahewa and Wailuku Rivers. The Sierra Club also reserves its right to submit separate comments.

First, the Sierra Club would like to note that the DEIS appears to be fairly thorough in addressing the environmental impacts associated with the project. We also note that Kahala Energy Development Corporation (Applicant) has revised the project to relocate the diversion works upstream in areas that apparently do not provide good habitat for, and do not contain significant populations of, native instream fauna. And we concur with the Applicant's proposal to preserve the Newell's

ohia lehua stands which occur along the streams within the project site, further urging, however, that the Board of Land and Natural Resources incorporate as a condition revoking Applicant's CDUA permit, the destruction of any Newell's ohia trees.

On the other hand, the Sierra Club has substantial concerns about the consultant's IFIM study and recommended instream conservation flows of 5 cfs for the Wailuku River and 3 cfs for the Kalohewahewa River. As an initial point, we would like to note that there is no biological consultant's report appended to the DEIS. This makes it difficult for us to evaluate the procedures that were followed, the data that were collected, and how the data were analyzed. It is also unclear whether the suitability index curves which were appended to the DEIS in Appendix B were developed from biological census data taken in Kalohewahewa and Wailuku Streams, or whether these curves were extrapolated from information contained in other Lentipes studies. One of the constraints on the use of IFIM in high gradient Hawaiian streams is the apparent inability to transfer fish utilization curves from one stream to another. See, e.g., Kinzie, Ford, Yuen and Chow, October 1986; Habitat Modelling of Hawaiian Streams, Technical Report No. 171, Water Resources Research Center, University of Hawaii (preliminary draft copy), p. 63. Accordingly, it is critical to determine just how these curves were developed.

We also understand that one of the protocols to be observed by consultants in the application of IFIM is agency cosultation. It is our further understanding that Thom Hardy's suitability curves, upon which the 5 and 3 cfs conservation flow recommendations are apparently based, were developed without consulting with the U.S. Fish and Wildlife Service, or other agencies or institutions with expertise in the application of IFIM in Hawaii. Accordingly, we request that Applicant consult with the USFWS and University of Hawaii Water Resources Research Center regarding the proposed conservation flows.

The Sierra Club believes that, given the above omissions from the DEIS, it would be prudent for the Applicant to have its IFIM consultant consult with the USFWS and other agencies with expertise on the use of IFIM in Hawaii, prepare a revised report, and incorporate the consultant's revised IFIM report for Wailuku and Kalohewahewa Streams into the DEIS. In the interim, the Sierra Club requests that the Board of Land and Natural Resources and

Commission on Water Resource Management to hold in abeyance further processing of the Applicant's permits.[1]

We do not intend these comments to be critical of the use of biologically-based conservation flow studies, such as IFIM, in Hawaii. If the constraints on application of IFIM are followed, and the protocols which have been established complied with, we believe that such studies can be used to establish recommended conservation flows for Hawaiian streams. The alternative to IFIM, i.e., the collection of baseline data and the application of "best professional judgment" to evaluate of the impact of dewatering, does not, in our opinion, provide a rational basis for predicting the impact of stream-related projects on the instream biota. However, because IFIM incorporates notions of predictive modelling, special care must be taken to insure that all appropriate procedures are complied with, and a conservative approach (i.e., one which errs in favor of no net habitat loss) applied in interpreting the data.

Thank you for this opportunity to comment on the Wailuku River hydroelectric project DEIS and on the BLNR and Water Resources Commission permit applications.

Very truly yours,

Arnold L. Lum

ALL:sw/wailuku.let

cc: Deborah Ward

bcc: John Ford

[1] It is our understanding that the processing of the CDUA may exceed the 270-day limit (based on the CDUA application number, we assume that the CDUA is now being processed within the 90-day automatic extension period), and accordingly request that the BLNR dismiss, without prejudice, the CDUA to allow Applicant sufficient time to prepare a revised DEIS.

KRP Information Services
3200 Waialae Avenue, Suite 1006, Honolulu, Hawaii 96816 1314 S. King St., S. 951
Mailing Address: P.O. Box 27506, Honolulu, HI 96827
Phone: 808 545-3633

August 15, 1989

Mr Arnold L. Lum
Sierra Club Legal Defense Fund
212 Merchant Street, Suite 202
Honolulu HI 96813

Subject: Draft Environmental Impact Statement for the Wailuku River Hydroelectric Project, South Hilo District, Hawaii.

As you are aware, additional stream studies have been undertaken since your letter of April 17, 1989 was written. A supplemental report entitled "Wailuku River Instream Flow Impact Analysis" was prepared and sent to all persons or agencies who provided comments on the Environmental Assessment for this project, and the comment period was extended an additional 30 days to allow for review. In that we have not received additional comments, we presume that we have addressed your concerns. A copy of the report will be appended to the Final Environmental Impact Statement.

We appreciate your constructive comments and the assistance you have provided in resolving issues connected with this project.

Sincerely,

Jacqueline A. Parnell, AICP
General Partner
for: Kahala Energy Development Corporation

cc: Don Horiuchi, DLNR
Kahala Energy Development Corporation

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APPENDIX A

Plant Checklist

SPECIES CHECKLIST

Plant names in the list are in accordance with H. St.John's 1973 "List and Summary of the Flowering Plants in the Hawaiian Islands" and C.H. Lamoureux's unpublished 1984 checklist of Hawaiian Ferns and Fern Allies.

Families are listed alphabetically within each of three groups: Pteridophyta (ferns and fern allies); and Monocotyledonae, Dicotyledonae (two major groups of flowering plants). Genera and species are arranged alphabetically. Wherever possible, common names are included; those underlined are Hawaiian names and those not underlined, English.

A relative abundance rating was determined for each species recorded according to the following standard qualitative scale:

A	ABUNDANT, generally the major or dominant species in a given area
C	COMMON, generally distributed throughout a given area in large numbers
UC	UNCOMMON, observed uncommonly but more than 10 times in a given area
O	OCCASIONAL, observed here and there, often widely scattered, not forming a major component of the vegetation
R	RARE, observed 2 to 10 times in a given area
S	SINGLE, found only or principally in one or more restricted areas

The biogeographic status of each species is indicated as follows:

E	ENDEMIC to the Hawaiian Is., i.e. occurring nowhere else in the world
I	INDIGENOUS, native to the Hawaiian Is., but also occurring naturally elsewhere
X	EXOTIC or INTRODUCED, plants of accidental or deliberate introduction after the Western discovery of the islands
P	POLYNESIAN INTRODUCTION, includes those plants brought by Polynesian immigrants previous to Capt. Cook's visit in 1778

Other abbreviations in the table are as follows:

*EN	ENDANGERED, in considerable danger of disappearance

Under HABITAT, the following letters are used:

P	Pasture
E	Eucalyptus forest
O	'Ohi'a-koa native forest
R	Riparian or streamside habitat

CHECKLIST OF PLANTS FROM WAILUKU RIVER PROJECT SITE, ISLAND OF HAWAII

SCIENTIFIC NAME	COMMON NAME	STATUS	HABITAT P	HABITAT E	HABITAT O	HABITAT R
PTERIDOPHYTA: FERNS AND FERN ALLIES						
ADIANTACEAE						
Adiantum raddianum Presl.	'iwa, Southern maidenhair	X		UC	UC	UC
Pityrogramma calomelanos (L.) Link	silver fern	X		UC		R
ASPIDACEAE						
Dryopteris glabra (Brack.) Kze	kilau	E			R	
Dryopteris sandwicensis (Hook.& Arn.)C.Chr.		E			S	
ASPLENIACEAE						
Asplenium contiguum Kauif	spleenwort-with-crowded-sori	I			UC	
ATHYRIACEAE						
Deparia petersenii (= Athyriopsis japonica Thunb. Ching)		X		UC	UC	UC
Athyrium sandwichianum (Presl.)Diels	ho'i'o	E		C	C	UC

SCIENTIFIC NAME	COMMON NAME	STATUS	P	E	O	R
BLECHNACEAE						
Blechnum occidentale (L.)	occidental blechnum	X		UC	UC	UC
Sadleria cyatheoides Kaulf.	ama'uma'u	E			UC	O
DENNSTAEDIACEAE						
Microlepia strigosa (Thunb.)Presl.	palapalai	E		UC	O	UC
DICKSONIACEAE						
Cibotium chamissoi Kaulf	hapu'u i'i	E		UC	UC	UC
Cibotium glaucum (J.Sm.)Hook. & Arn.	hapu'u	E		UC	C	UC
C.hawaiensis Nakai & Ogura	hapu'u	E		UC	C	UC
ELAPHOGLOSSACEAE						
Elaphoglossum alatum Gaud.	ekaha	E		O	UC	O
E. crassifolium (Gaud.) Anders.& Crosby	ekaha,net-veined elaphoglossum	E		O	UC	O
GLEICHENIACEAE						
Dicranopteris linearis Burm.	uluhe, matted fern	E		A	A	A
Diplopterygium pinnatum (Kunze)Nakai (= Hicriopteris pinnata)	giant uluhe	E			O	UC

SCIENTIFIC NAME	COMMON NAME	STATUS	P	E	O	R
GRAMMITACEAE						
Adenophorus pinnatifidus Gaud		E		O	UC	
A.tamariscinus (Kaulf.) Hook.& Grev.	wahine noho mauna	E		O	C	
A. tripinnatifidus Gaud.	" " "	E		O	UC	
Grammitis hookeri (Brack.)Copel.	kolokolo	I		O	UC	
Grammitis tenella Kaulf.	mahina-lua	E		R		
HYMENOPHYLLACEAE						
Mecodium recurvum(Gaud.)Copel.	'ohi'a ku	E			C	
Sphaerocionium lanceolatum (Hook.& Arn.)	palai-hinahina	E			UC	
Vandenboschia davallioides (Gaud.)Copel.	pali-hihi	E			R	
LINDSAEACEAE						
Sphenomeris chinensis (L.)Maxon	pala'a	I		C	C	A
LYCOPODIACEAE						
Lycopodium phyllanthum Hook.& Arn.	large Hawaiian tree-lycopod	I			R	
Lycopodium serratum Thunb.		I			R	

SCIENTIFIC NAME	COMMON NAME	STATUS	P	E	O	R
NEPHROLEPIDACEAE						
Nephrolepis exaltata (L.) Schott	ni'ani'au, common sword fern	I		A	C	C
OPHIOGLOSSACEAE						
Ophioglossum pendulum (L.)	laukahi	I			R	
POLYPODIACEAE						
Phlebodium aureum (L.) J.Sm.	laua'e haole, hare's foot fern	I		UC	O	UC
Pleopeltis thunbergiana Kaulf.	'ekaha-'akolea	I			R	R
PSILOTACEAE						
Psilotum complanatum Sw.	moa, flat-stemmed psilotum	I			R	
P. nudum (L.) Beauv.	moa, upright psilotum	I		O	UC	O
SELAGINELLACEAE						
Selaginella arbuscula (Kaulf.) Spring	lepe-lepe-a-moa, Hawaiian selaginella	E		UC	C	C

SCIENTIFIC NAME	COMMON NAME	STATUS	P	E	O	R
THELYPTERIDACEAE						
Christella cyatheoides (Kaulf.)Holtt	kikawaio	E			UC	UC
C. dentata(Forsk.)Brownsey & Jermy	downy wood-fern	X		UC	UC	UC
Macrothelypteris torresiana (Gaud.)Ching	-	X			R	
VITTARIACEAE						
Vittaria elongata Sw.(sens.lat.)	-	I			R	R
GYMNOSPERMAE; CONIFERS						
CUPRESSACEAE						
Cupressus lusitanica Mill.	Mexican cypress	X		S		
MONOCOTYLEDONAE: FLOWERING PLANTS						
ARACEAE						
Anthurium andraeanum Lind.	anthurium	X		R,L		
Colocasia esculenta (L.)Schott	kalo, taro	X,P				O,L
Monstera deliciosa Liebm.	monstera	X		R,L		

SCIENTIFIC NAME	COMMON NAME	STATUS	P	E	O	R
COMMELINACEAE						
Commelina diffusa Burm.f.	honohono, day flower	X	UC	C	UC	C
CYPERACEAE						
Cyperus hypochlorus Hbd.	sedge	E	UC			UC
C.polystachyus Rottb.	sedge	I	UC			UC
Cyperus sp.(indet.)	sedge	?	R			
Fimbristylis dichotoma (=diphylla) (L.)Vahl	tall fringe rush	I				R
Rhynchospora lavarum Gaud.	pu'ukoa	E	R			
GRAMINAE						
Brachiaria mutica (Forsk.)Stapf.	California grass	X	UC			UC
Deschampsia australis Nees ex Steud	hairgrass	E				O
Digitaria adscendens (+ D. henryi)	Henry's crabgrass	X	A			UC
D. decumbens Stent	pangola grass	X	A			
Melinus minutiflora Beauv.	molasses grass	X		O	O	UC

SCIENTIFIC NAME	COMMON NAME	STATUS	P	E	O	R
Oplismenus hirtellus (L.) Beauv.	honohono-kukui, basketgrass	X		C	A	
Paspalum conjugatum Berg	Hilo grass	X	A	C	O	UC
P. dilatatum Poir	paspalum grass	X	O			
P. orbiculare Forst.	ricegrass	X	UC			
Setaria palmaefolia (Koen)Stapf	palmgrass	X		UC	C	C
Setaria glauca (L.)Beauv.	yellow foxtail	X	C			O
Sporobolus africanus (Poir.)Robyns & Tournay	African dropseed, rattail grass	X	UC			O
IRIDACEAE						
Tritonia crocosmiflora Nichols.	montbretia	X				O
LILIACEAE						
Cordyline terminalis (L.)Kunth	ki,ti	X,P		C	C	C
Smilax sandwicensis Kunth	hoi-kuahiwi	E				R
MUSACEAE						
Musa paradisiaca L.	mai'a, banana	X,P			O	
ORCHIDACEAE						
Arundina bambusaefolia (Roxa)Lindl	bamboo orchid	X		UC	UC	C

SCIENTIFIC NAME	COMMON NAME	STATUS	P	E	O	R
Phaius Tankervilliae (Banks ex L'Hér)Bl.	Chinese ground orchid	X			R	
Spathoglottis plicata Bl.	'okika, Malayan(Philippine)ground orchid	X			UC	UC
PALMAE						
Archontophoenix alexandrae (F.Muell.)H.Wendl. & Drude	Alexandra (King) palm	X		R		L
PANDANACEAE						
Freycineria arborea Gaud.	ie'ie	E			O	O
ZINGIBERACEAE						
Hedychium flavescens Carey	'awapuhi melemele,yellow ginger	X		O	O	UC
Zingiber zerumbet (L.) Roscoe in Sm.	'awapuhi kuahiwi,wild(shampoo)ginger	X,P		O	C	O
DICOTYLEDONAE: FLOWERING PLANTS						
APOCYNACEAE						
Alyxia olivaeformis Gaud.	maile	E			R	
AQUIFOLIACEAE						
Ilex anomala H.& A	kawa'u, Hawaiian holly	E		UC	O	

SCIENTIFIC NAME	COMMON NAME	STATUS	P	E	O	R
BEGONIACEAE						
Begonia hirtella	begonia	X				R
CARYOPHYLLACEAE						
Drymaria cordata (L.) Willd.ex R.&S	drymaria	X				R
CELASTRACEAE						
Perrottettia sandwicensis Gray	olomea	E				R
COMPOSITAE						
Ageratum conyzoides L.	ageratum	X	UC	UC	R	UC
Arctium Lappa L.	great burdock, gobo	X				O
Emilia javanica (Birm.f)C.B. Robins	red pualele, Flora's paintbrush	X	O			O
Erechtites hieracifolia (1.) Raf.	fireweed	X		UC	UC	C
Eupatorium riparium Regel.	spreading mist-flower, Hamakua pamakani	X		UC	UC	C
Gnaphalium purpureum L.	purple cudweed	X				O
Pluchea odorata (L.)Cass	shrubby fleabane	X	UC	UC		UC
Sonchus oleraceus L.	sow-thistle	X		UC	UC	UC
Tagetes minuta L.	marigold	X		R		

SCIENTIFIC NAME	COMMON NAME	STATUS	P	E	O	R
Vernonia cinerea (L.) Less.	little ironweed	X		O	O	O
Youngia japonica (L.) DC	Oriental hawksbeard	X		O	O	O
CONVULVULACEAE						
Ipomoea alba L.	koali-pehu, moonflower	I				UC
CUCURBITACEAE						
Sechium edule	chayote	X	S			
FLACOURTIACEAE						
Xylosma hawaiiense		E			R	
GESNERIACEAE						
Cyrtandra sp.		E		S		
GUTTIFERAE						
Hypericum mutilum L.	St. Johnswort	X	UC			UC
LAURACEAE						
Persea americana Mill.	avocado	X		S		

SCIENTIFIC NAME	COMMON NAME	STATUS	P	E	O	R
LEGUMINOSAE						
Acacia koa Gray	*koa*	E		R	UC	UC
Desmodium uncinatum (Jacq.) DC	spanish clover	X	O			
Medicago sp.		X	R			
LOBELIACEAE						
Clermontia parviflora Gaud. ex Gray	*'oha-wai*	E			R	
Clermontia sp. (?*drepanomorpha*)		E			R	
Laurentia longiflora (L.) Engl.	*pua-hoku*, star-of-Bethlehem	X	L			
LOGANIACEAE						
Buddleja asiatica Lour.	Asiatic butterflybush	X				O
LYTHRACEAE						
Cuphea carthagenensis (Jacq.)MacBride	tarweed	X	C	C	C	C
MALVACEAE						
Hibiscus rosa-sinensis L.	red (Chinese) hibiscus	X		S		

SCIENTIFIC NAME	COMMON NAME	STATUS	P	E	O	R
MELASTOMATACEAE						
Melastoma malabathricum L.	Malabar melastome	X	A	A	C	C
Melastoma sp.		X		S		
MYRTACEAE						
Eucalyptus globulus Labill.	Australian blue gum	X	S	UC		O
E. robusta Sm.	swamp mahogany	X		A	O	UC
Melaleuca leucadendra (Stickm) Linn.	paperbark	X		L	L	
Metrosideros collina polymorpha glabberima	'ohi'a lehua	E	O	O	A	C
M.collina polymorpha Newellii	'ohi'a lehua,variety Newellii	E,*EN	S			UC
M.collina polymorpha glabberima X Newellii	'ohiá lehua Newellii intermediates	E,*EN	O			UC
Psidium cattleianum Sabine	strawberry guava (yellow,red morphs)	X	C	A	C	C
P.guajava L.	common guava	X	UC	UC	UC	UC
NYCTAGINACEAE						
Pisonia umbellifera (J.R. & G. Forst)Seem	papala-kepau	E		UC	UC	O
OLEACEAE						
Fraxinus Uhdei (Wenzig)Lingelsh	tropical ash	X		UC		

SCIENTIFIC NAME	COMMON NAME	STATUS	P	E	O	R
OXALIDACEAE						
Oxalis corniculata L.	yellow wood-sorrel	X	UC	UC	UC	UC
PASSIFLORACEAE						
Passiflora edulis Sims	liliko'i, passionfruit	X			O	
P.ligularis Juss.	sweet granadilla	X			R,L	
PHYTOLACCACEAE						
Phytolacca octandra L.	southern pokeberry	X				UC
PIPERACEAE						
Peperomia leptostachya H.& A.	ala-ala-wai-nui	I		UC	UC	
P.tetraphylla(Forst f.) H.& A.	" "	I			O	
POLYGONACEAE						
Polygonum punctatum Ell.	smartweed	X				UC
Rumex acetosella L.	sheep sorrel	X				O
PLANTAGINACEAE						
Plantago major L.	laukahi, common plantain	X	UC	O	O	UC
ROSACEAE						
Rubus rosaefolius Sm.	thimbleberry	X		O	UC	O
RUBIACEAE						
Coprosma sp.(?ochracea)	pilo	E		R	O	
Gardenia sp.	gardenia	X		S		

SCIENTIFIC NAME	COMMON NAME	STATUS	P	E	O	R
Gouldia terminalis (A.&A.)Hbd	manono	E				S
Psychotria hawaiiensis (Gray)Fosb.	kopiko	E		O	UC	O
SAXIFRAGACEAE						
Broussaisia arguta Gaud.	kanawao	E				S
UMBELLIFERAE						
Centella asiatica L. Urban	Asiatic pennywort	X	UC	UC		O
URTICACEAE						
Pilea peploides (Gaud.) H.&A.		I				UC,L
Pipturus hawaiensis Levl.	mamaki	E			O	UC
Urera glabra (H.&A.)Wedd.	opuhe	E				R,L
VERBENACEAE						
Verbena litoralis HBK	weed verbena	X				O
Stachytarpheta jamaicensis(L.)Vahl.	Jamaica vervain	X	UC	UC	UC	UC

APPENDIX B

Instream Flow Analysis Curves

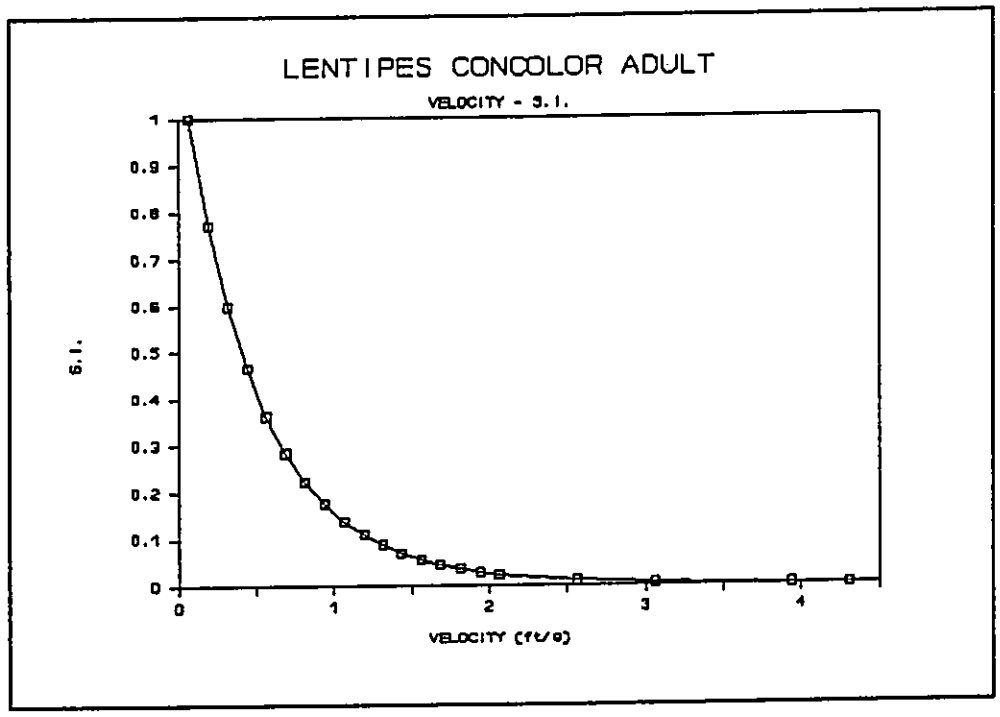

Figure 1. Suitability Index Curve for Lentipes Concolor adult for velocity.

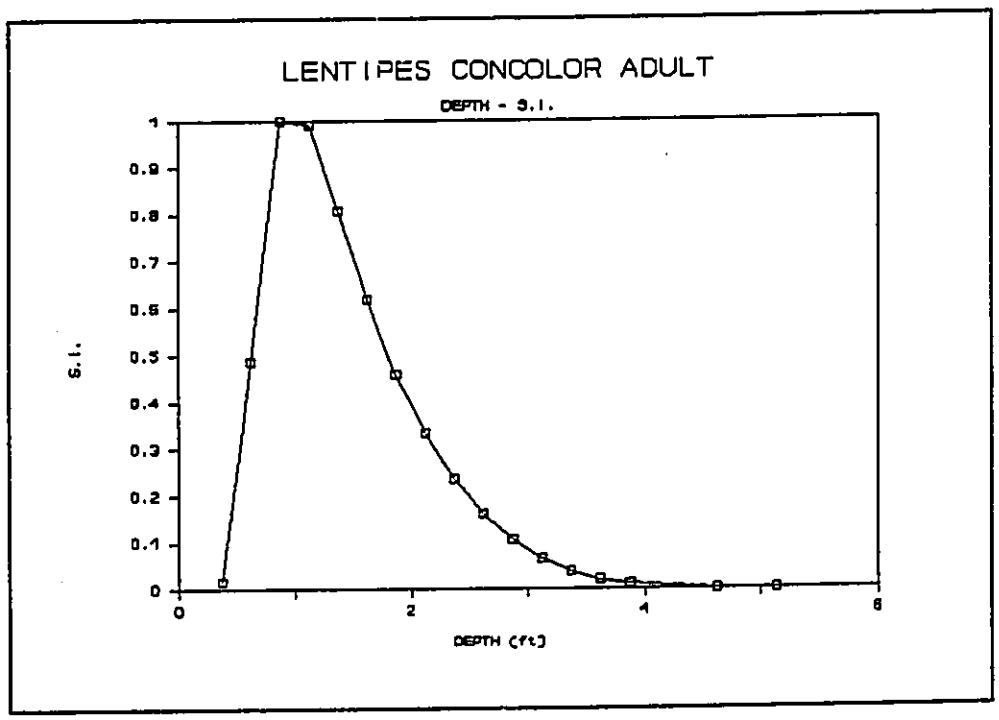

Figure 2. Suitability Index Curve for Lentipes Concolor adult for depth.

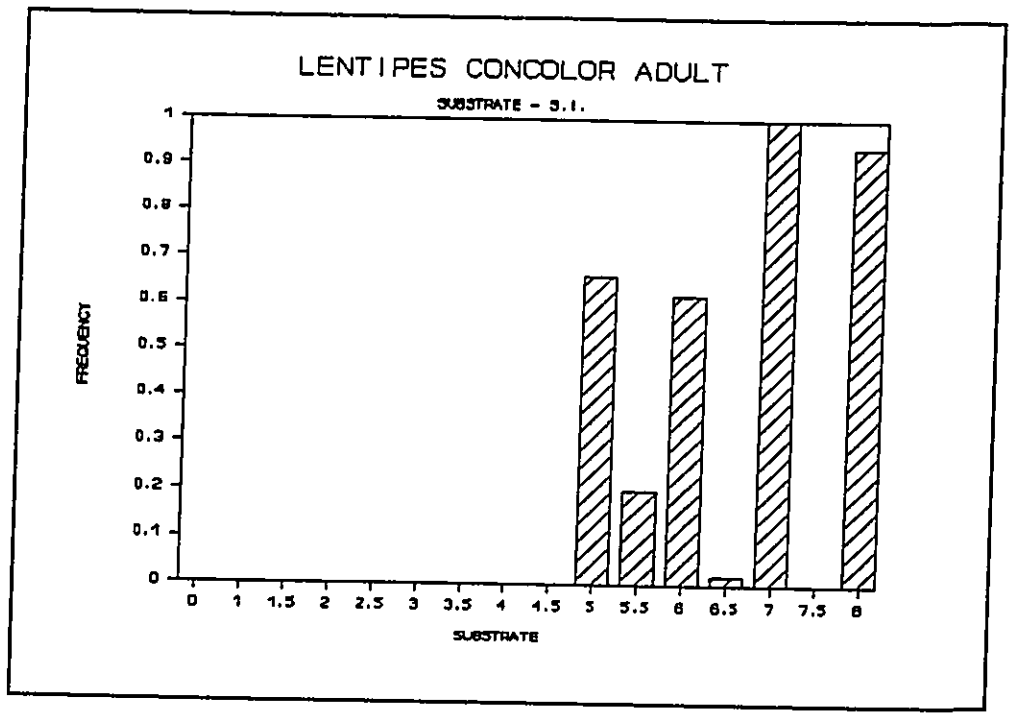

Figure 3. Suitability Index Curve for Lentipes Concolor adult for substrate.

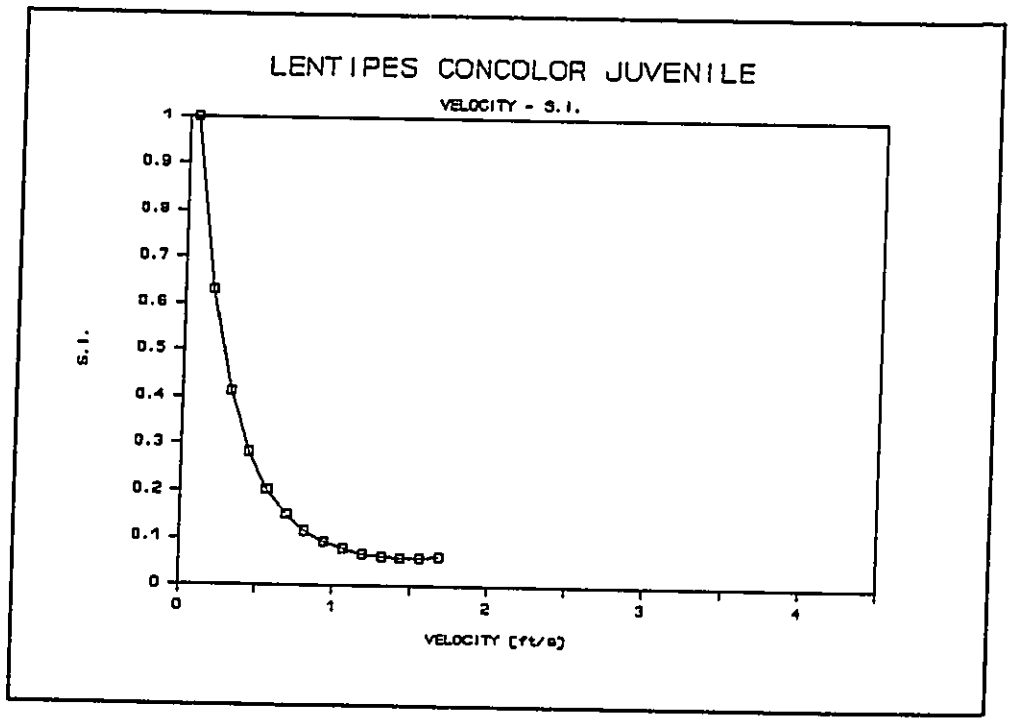

Figure 4. Suitability Index Curve for Lentipes Concolor juvenile for velocity.

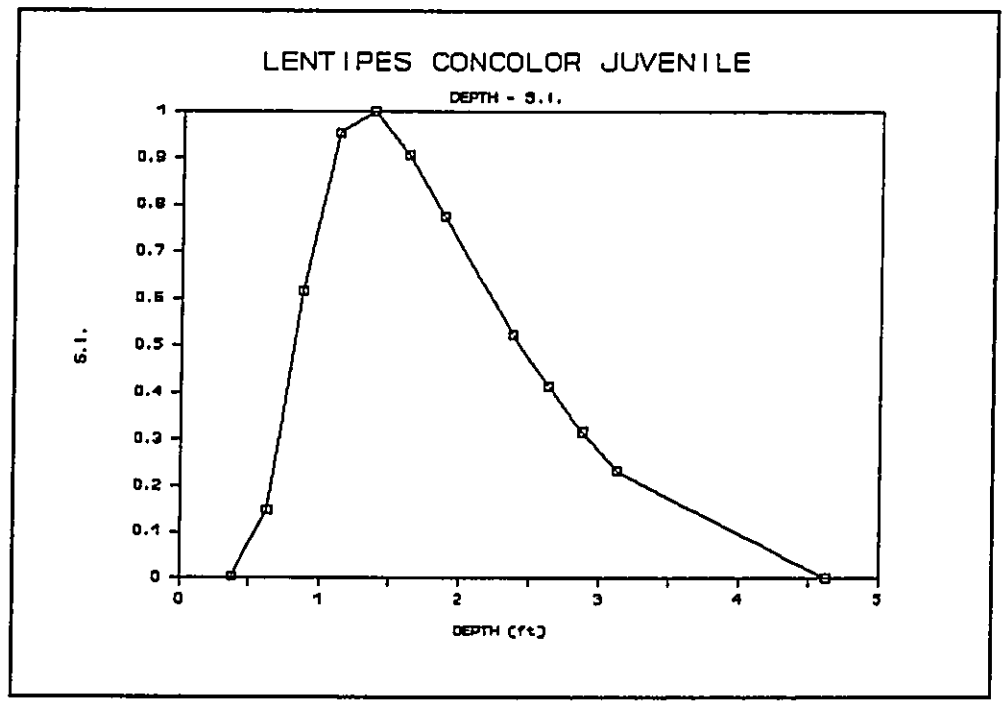

Figure 5. Suitability Index Curve for Lentipes Concolor juvenile for depth.

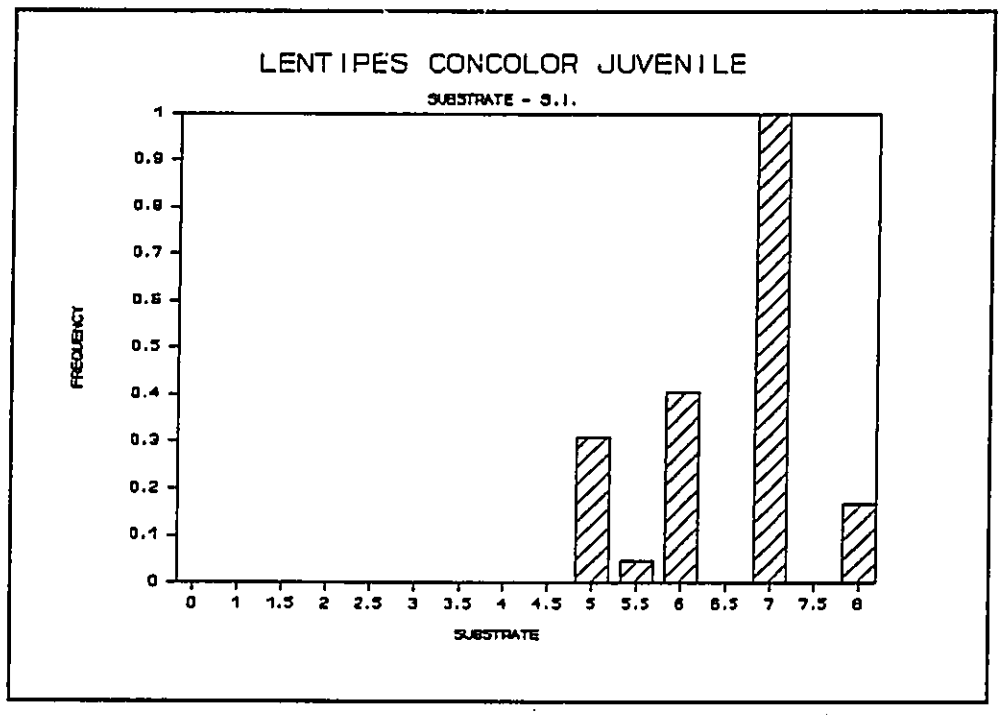

Figure 6. Suitability Index Curve for Lentipes Concolor juvenile for substrate.

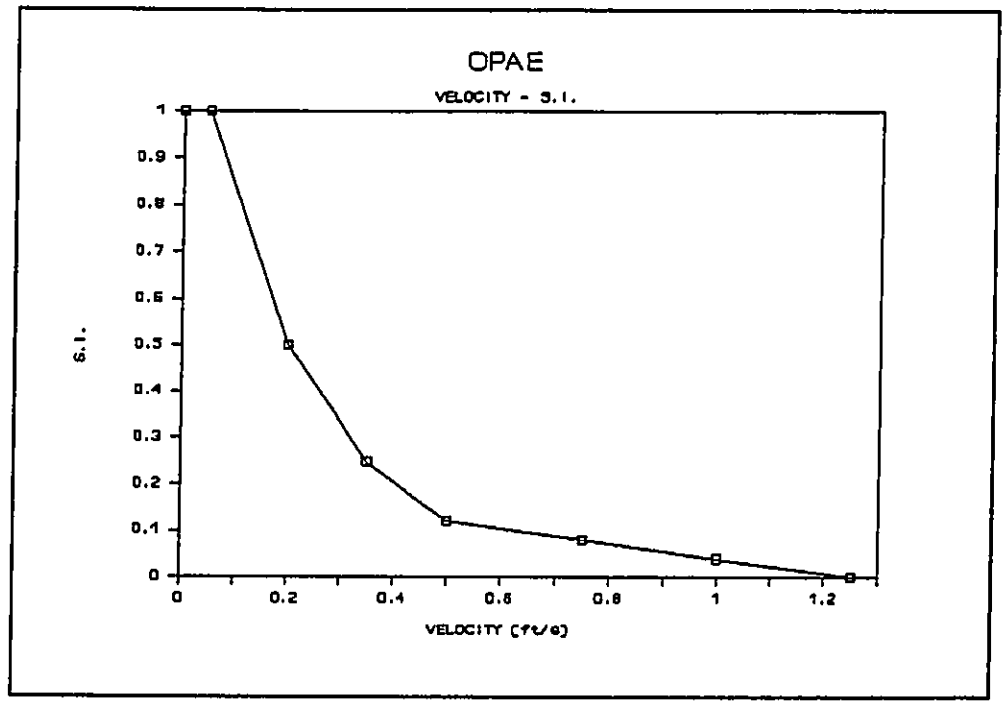

Figure 7. Suitability Index Curve for Opae adult for velocity.

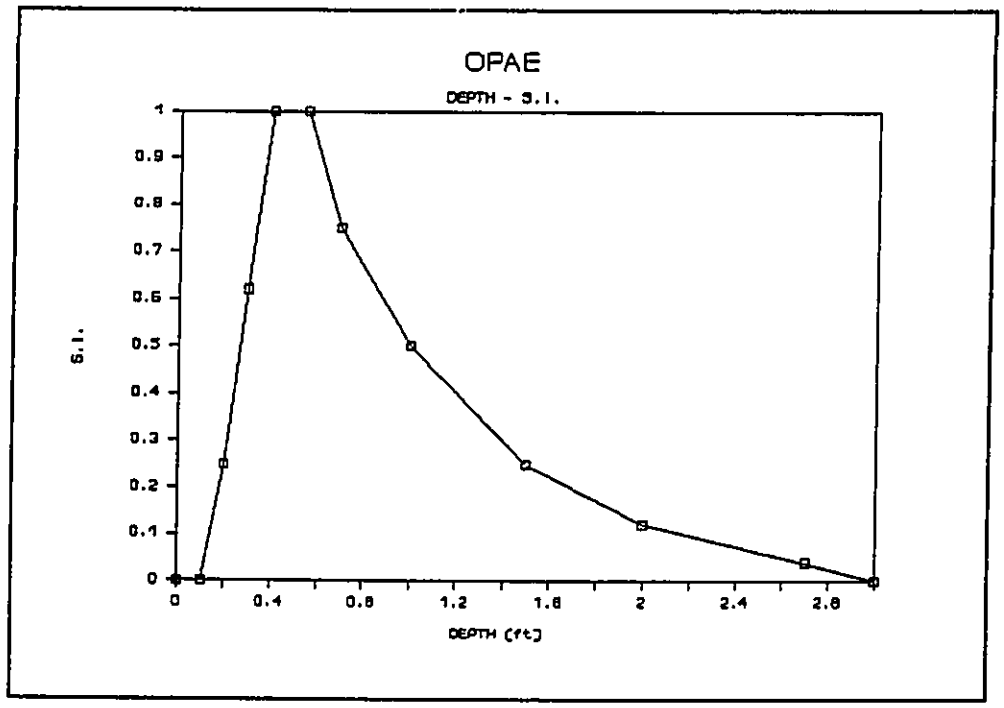

Figure 8. Suitability Index Curve for Opae adult for depth.

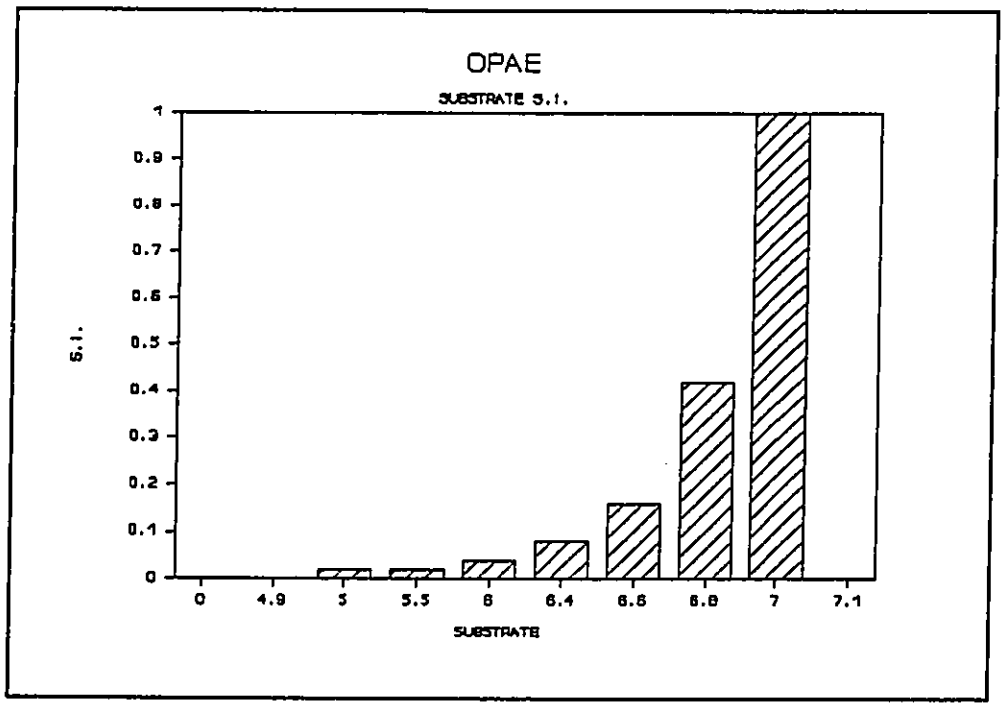

Figure 9. Suitability Index Curve for Opae adult for substrate.

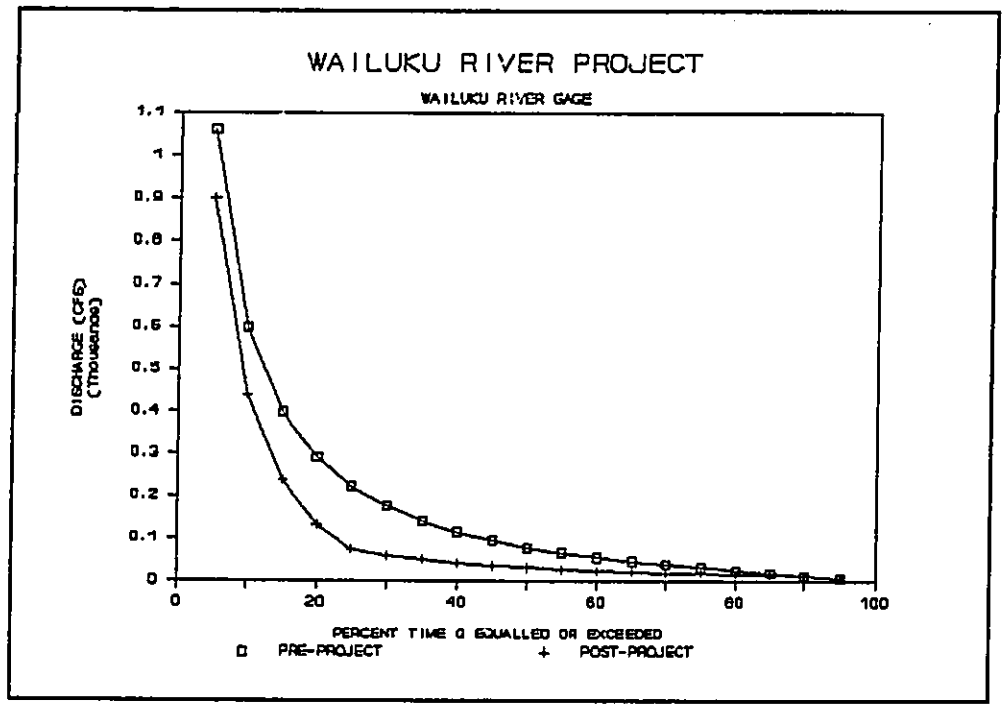

Figure 10. Pre and post project flow duration curves at the Wailuku River Gage.

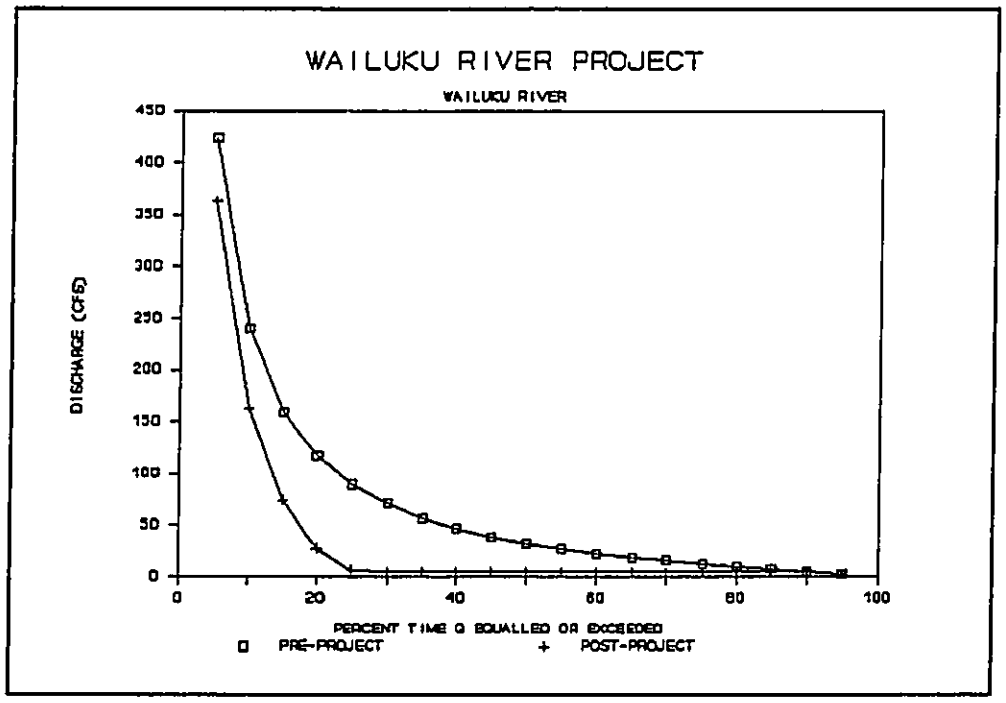

Figure 11. Pre and post project flow duration curves at the Wailuku River Station.

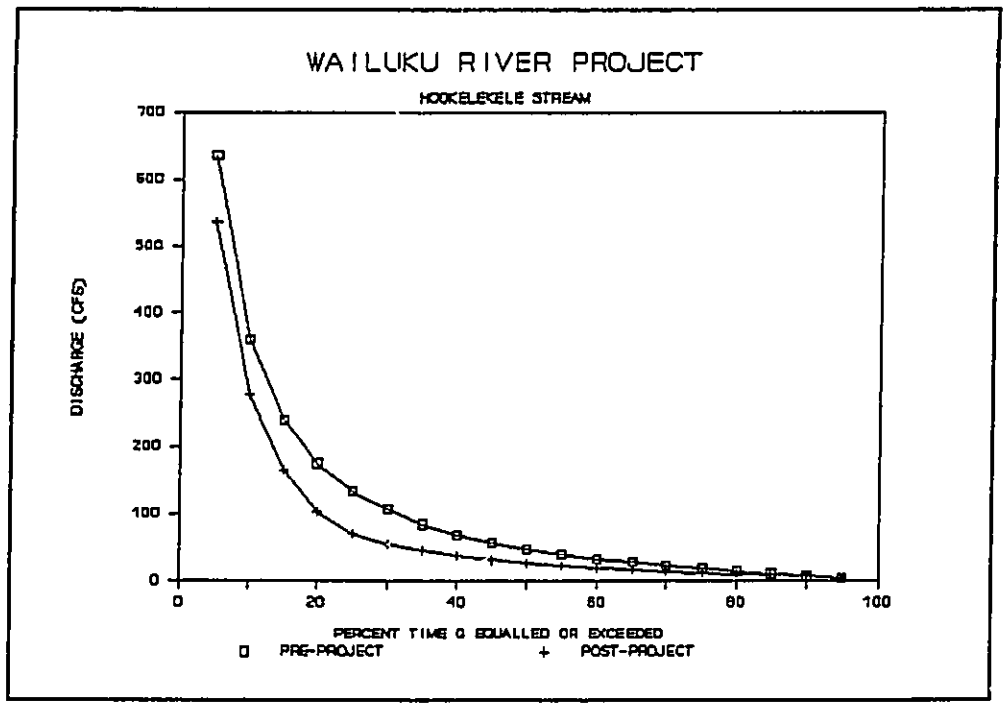

Figure 12. Pre and post project flow duration curves at the Hookelekele Stream Station.

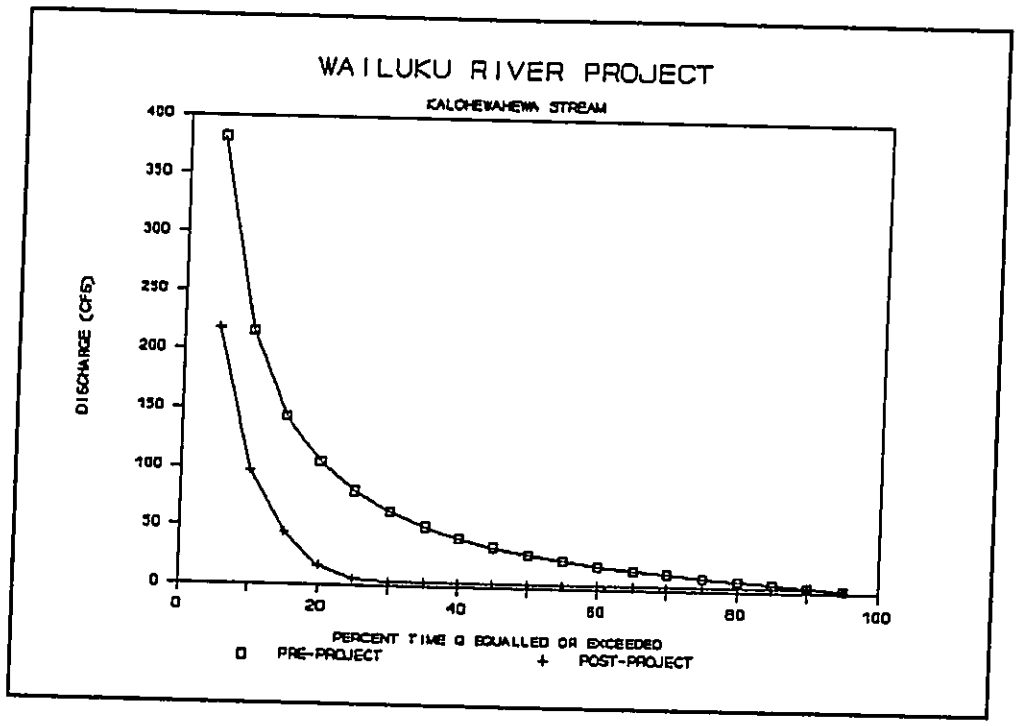

Figure 13. Pre and post project flow duration curves at the Kalohewahewa Stream Station.

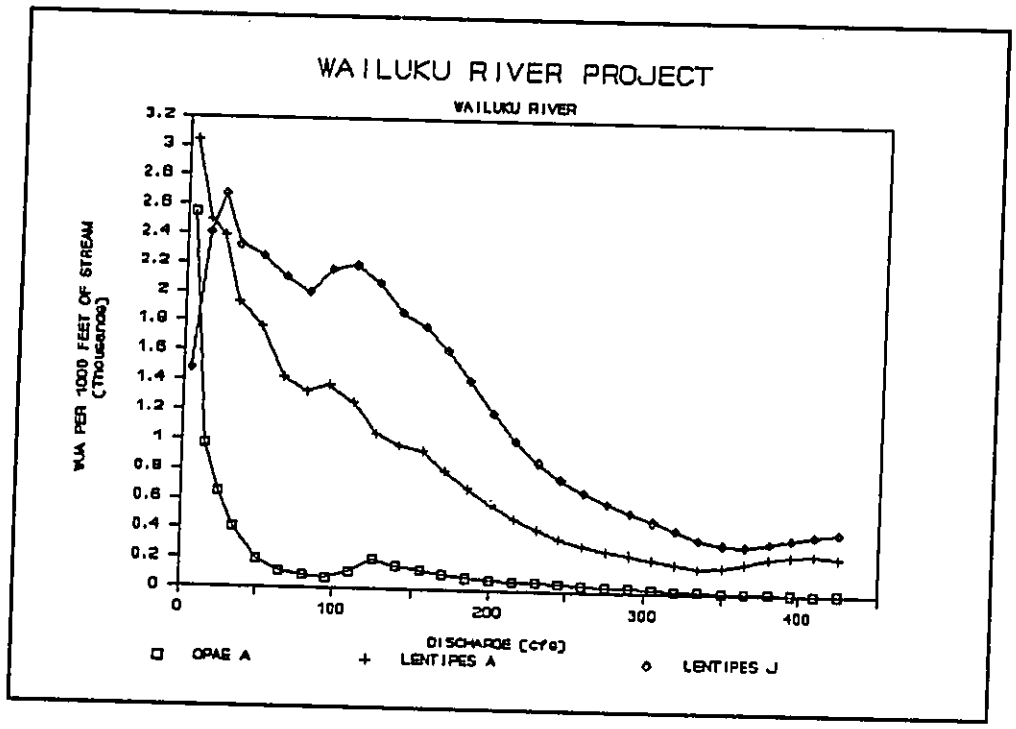

Figure 14. Relationship between WUA and discharge for Opae adult and Lentipes Concolor adult and juveniles at the Wailuku River Station.

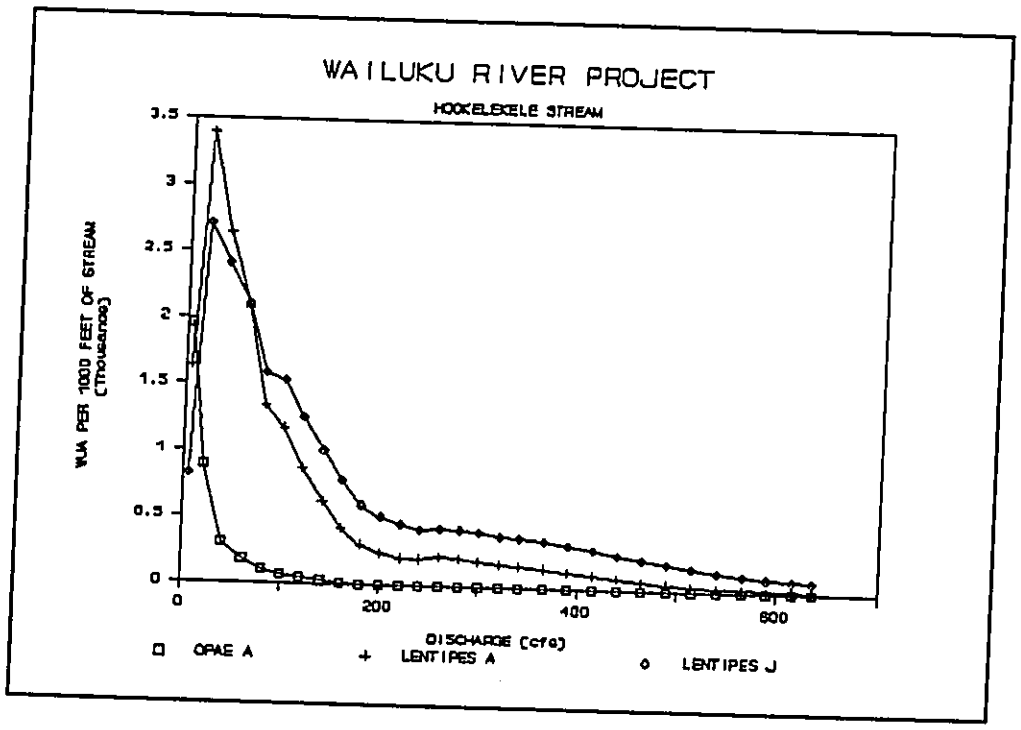

Figure 15. Relationship between WUA and discharge for Opae adult and Lentipes Concolor adult and juveniles at the Hookelekele Stream Station.

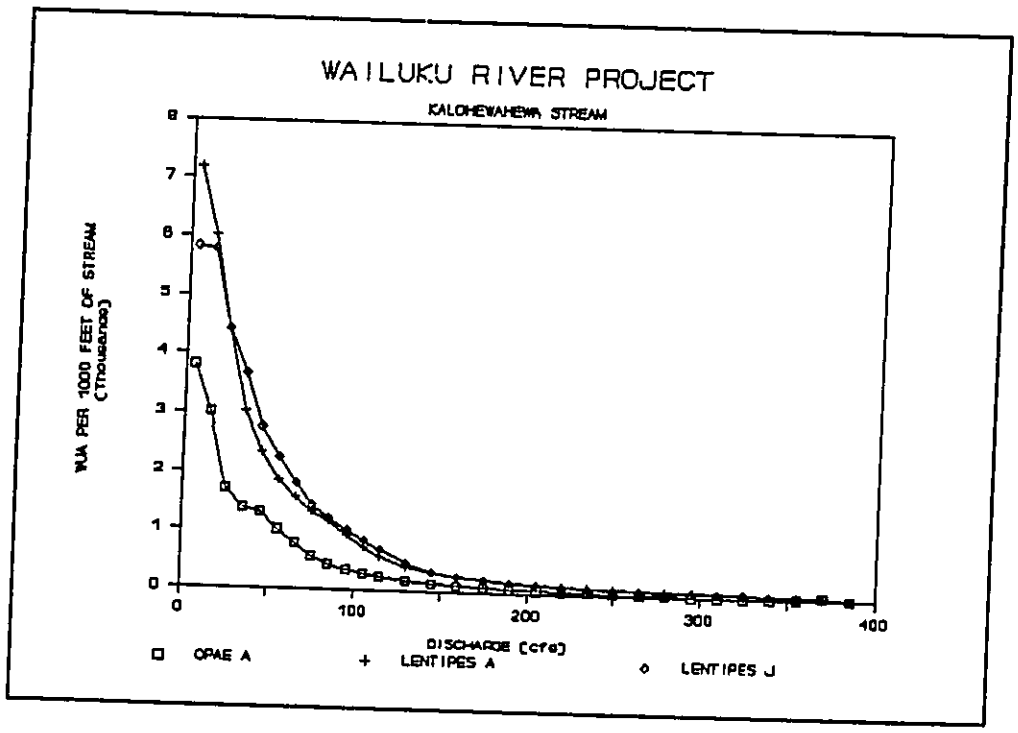

Figure 16. Relationship between WUA and discharge for Opae adult and Lentipes Concolor adult and juveniles at the Kalohewahewa Stream Station.

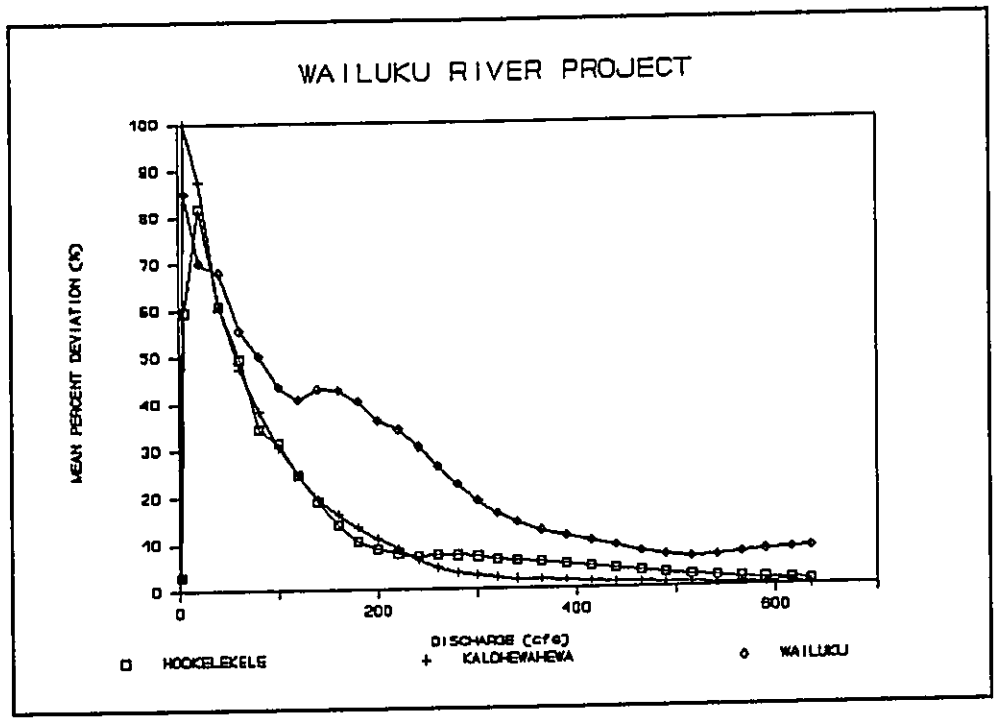

Figure 17. Relationship between Mean Percent Deviation (MPD) and discharge for the Wailuku River, Hookelekele and Kalohewahewa Stream Stations.

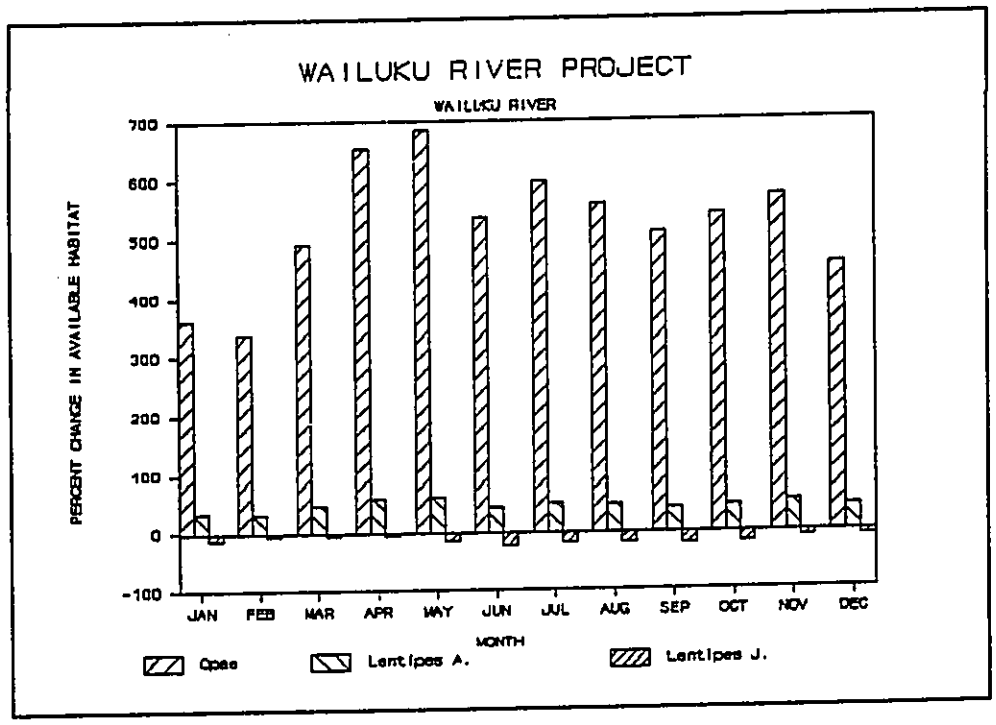

Figure 18. Average monthly percent change in available habitat based on daily flows at the Wailuku River Station for Opae, and Lentipes Concolor adults and juveniles.

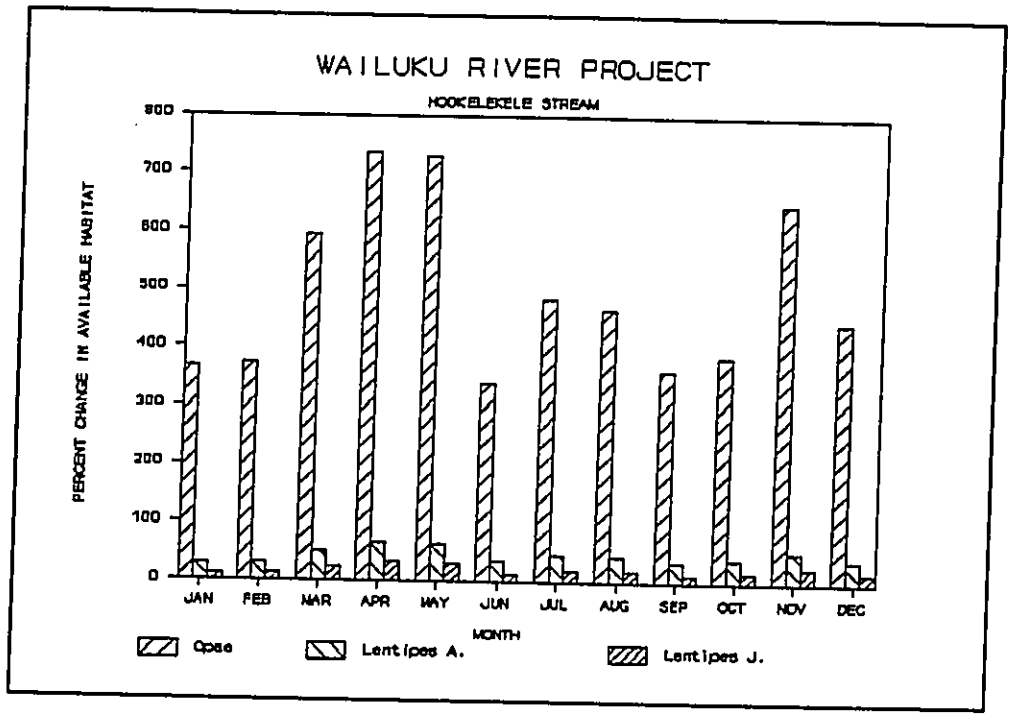

Figure 19. Average monthly percent change in available habitat based on daily flows at the Hookelekele Stream Station for Opae, and Lentipes Concolor adults and juveniles.

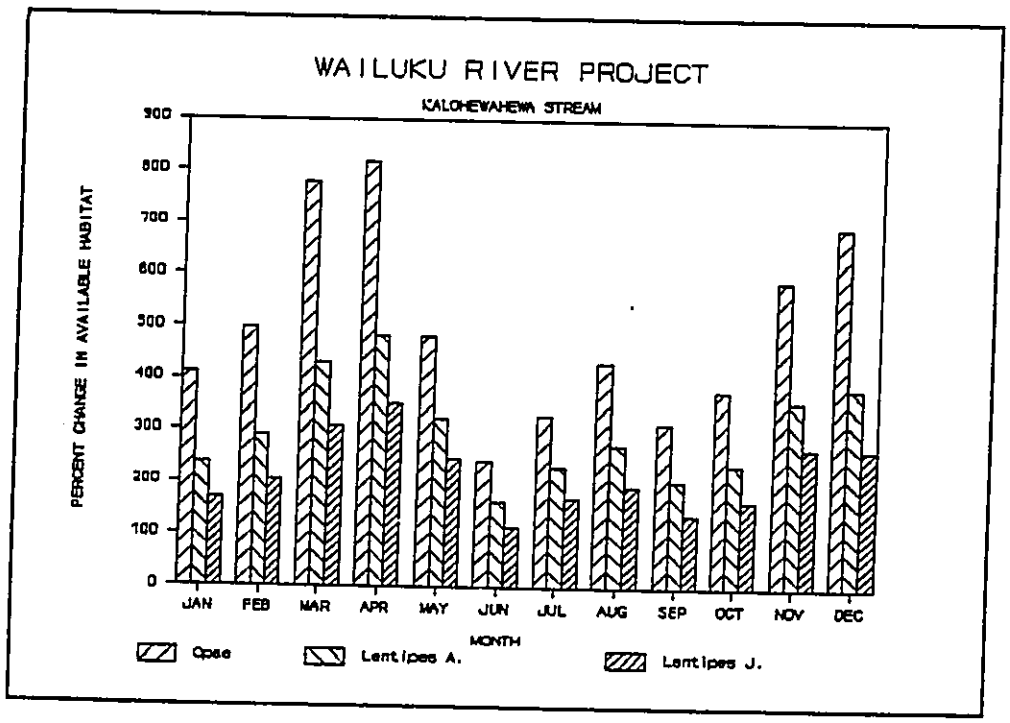

Figure 20. Average monthly percent change in available habitat based on daily flows at the Kalohewahewa Stream Station for Opae, and Lentipes Concolor adults and juveniles.

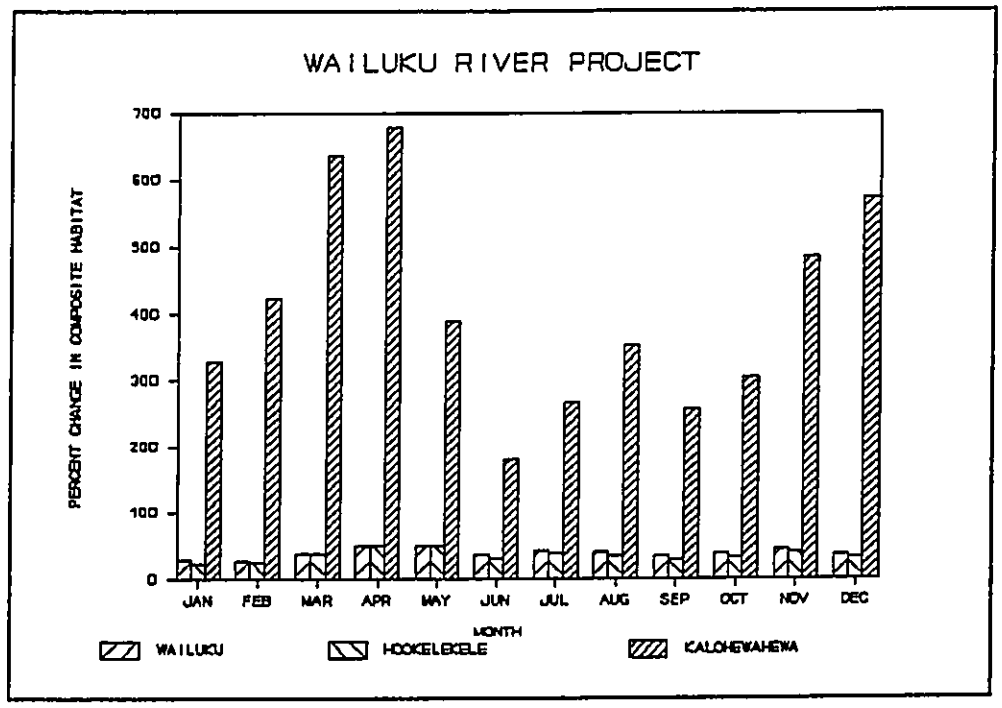

Figure 21. Average monthly percent change in MPD's at the Wailuku River Station Hookelekele and Kalohewahewa Stream Stations for Opae, and Lentipes Concolor adults and juveniles.

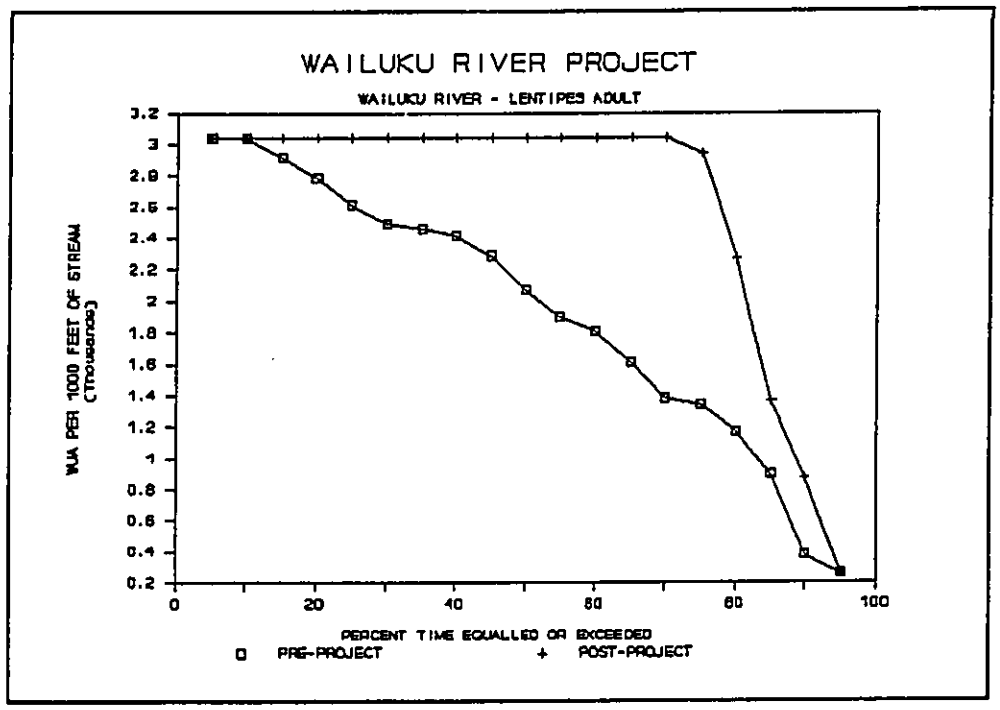

Figure 22. Pre and post project habitat duration curves at the Wailuku River Station for Lentipes Concolor adults.

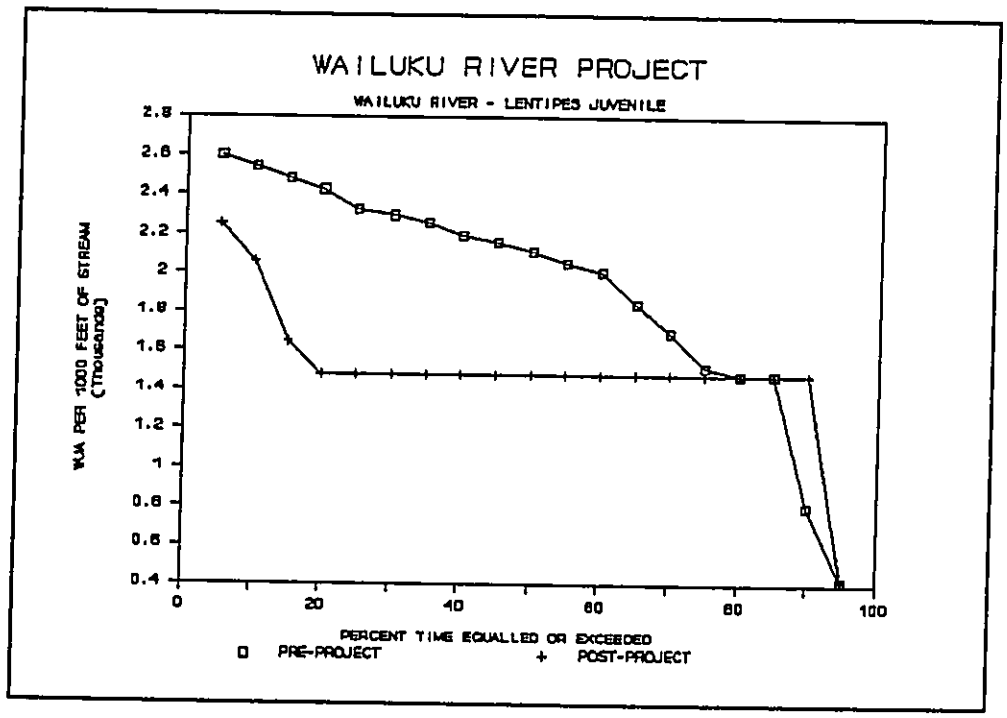

Figure 23. Pre and post project habitat duration curves at the Wailuku River Station for Lentipes Concolor juveniles.

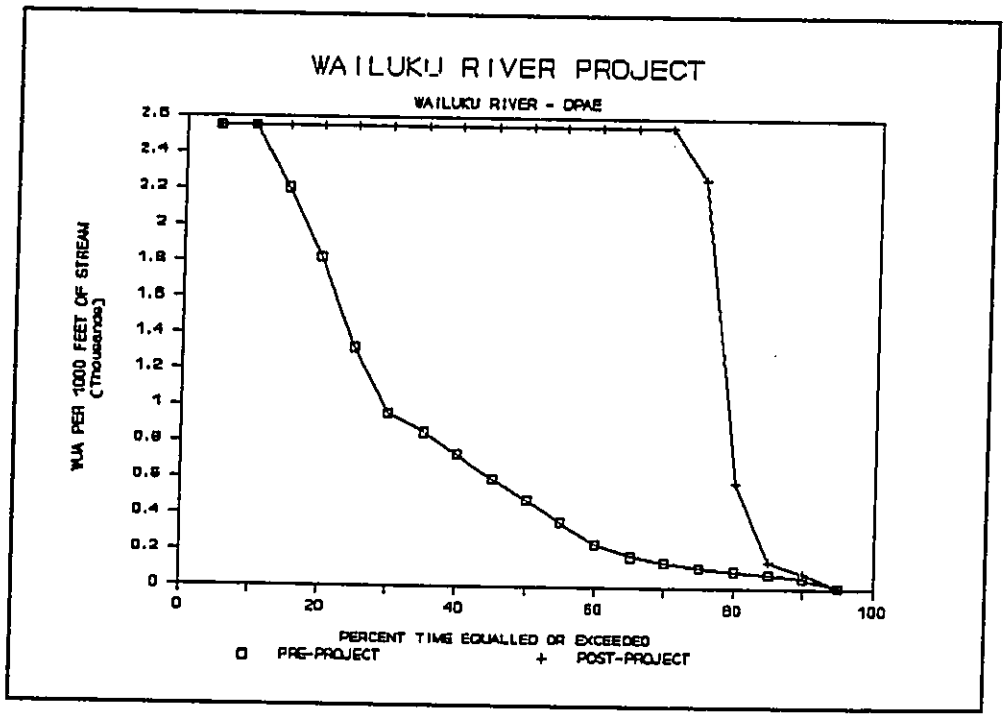

Figure 24. Pre and post project habitat duration curves at the Wailuku River Station for Opae adults.

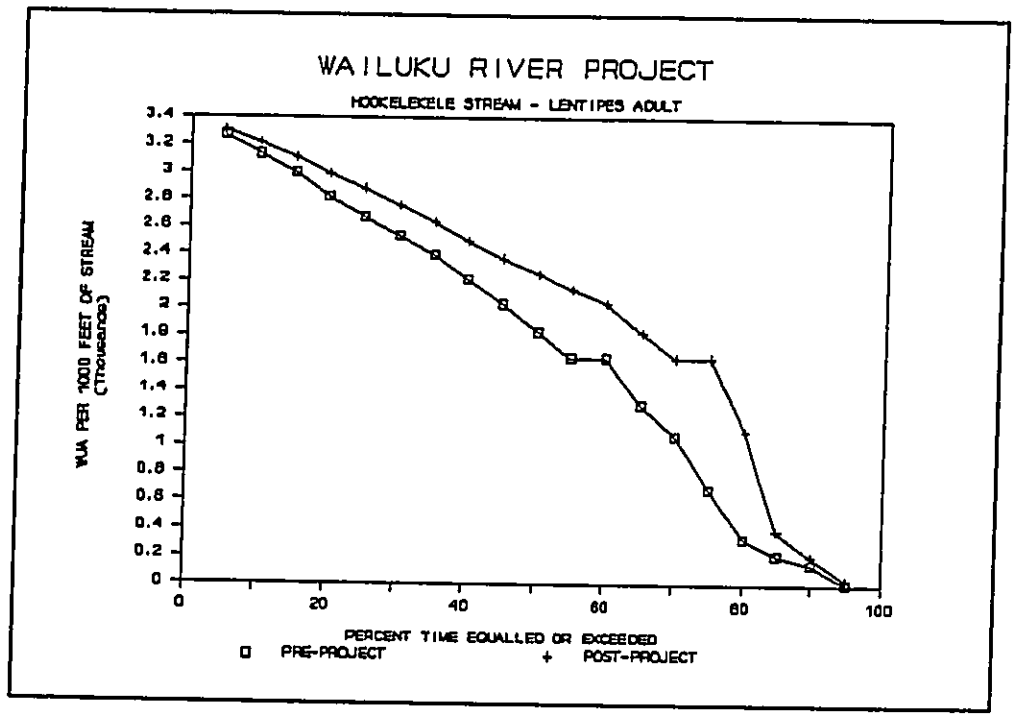

Figure 25. Pre and post project habitat duration curves at the Hookelekele Stream Station for Lentipes Concolor adults.

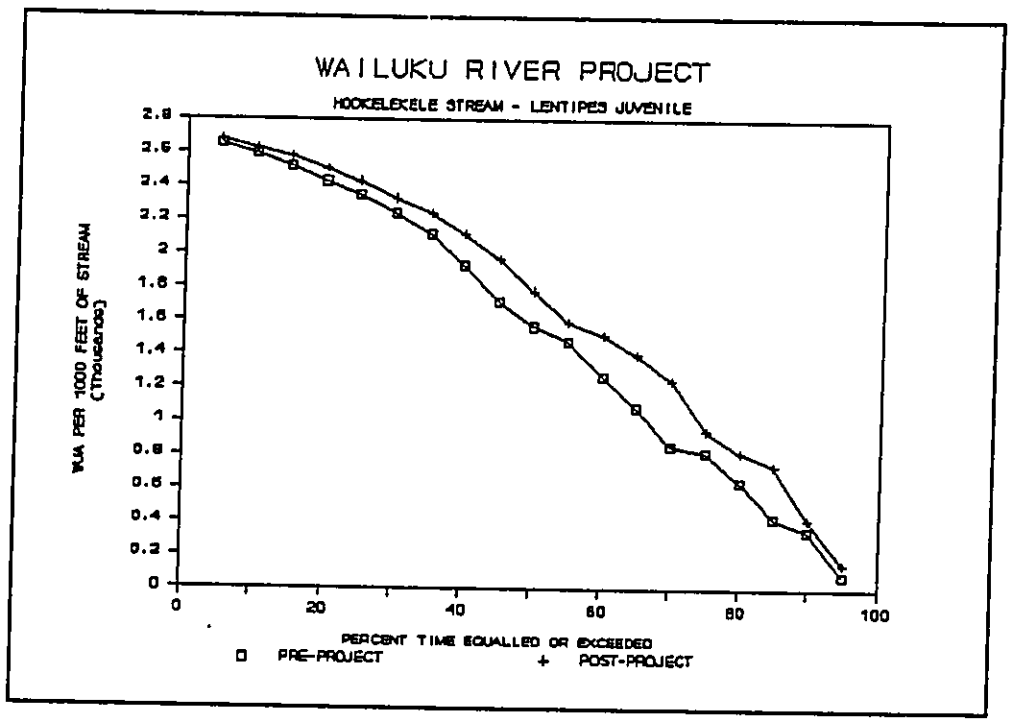

Figure 26. Pre and post project habitat duration curves at the Hookelekele Stream Station for Lentipes Concolor juveniles.

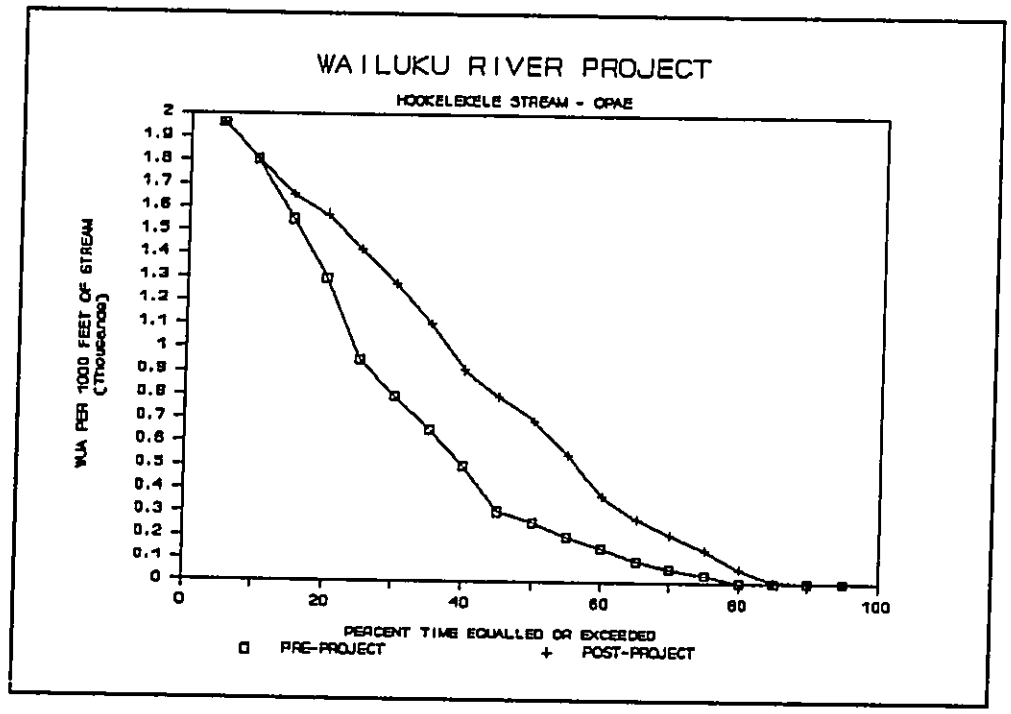

Figure 27. Pre and post project habitat duration curves at the Hookelekele Stream Station for Opae adults.

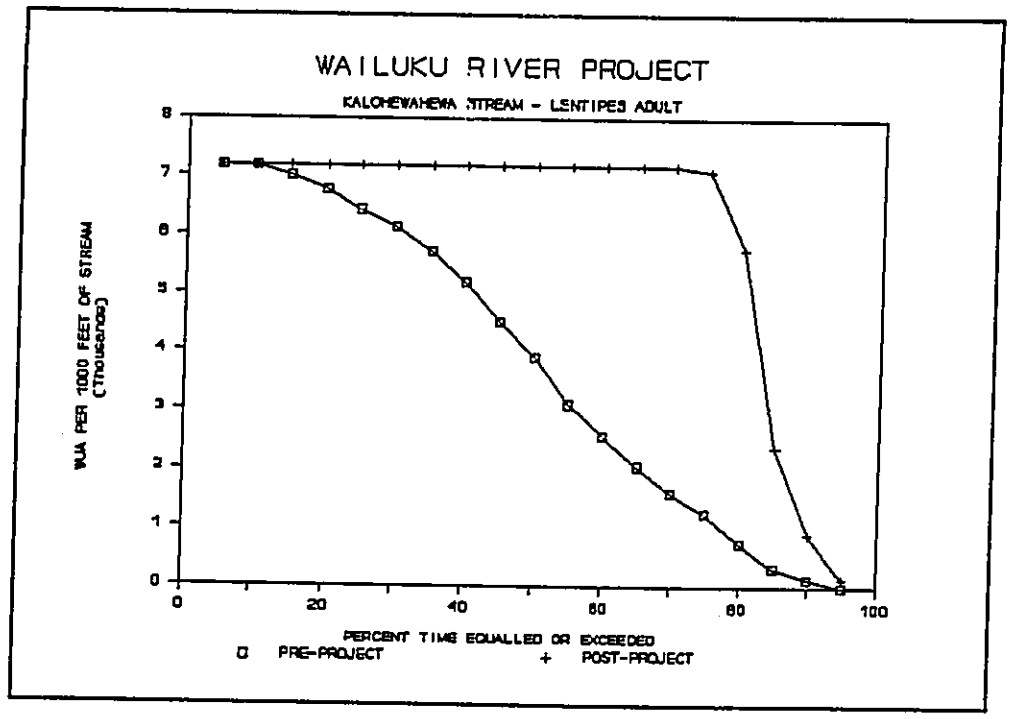

Figure 28. Pre and post project habitat duration curves at the Kalohewahewa Stream Station for Lentipes Concolor adults.

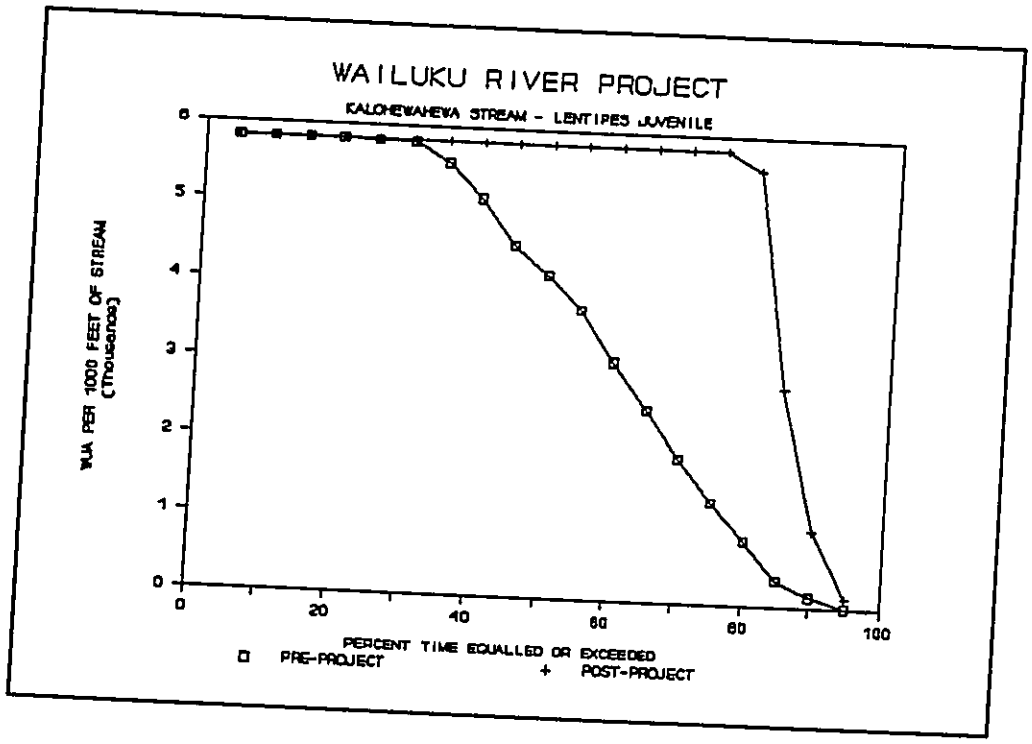

Figure 29. Pre and post project habitat duration curves at the Kalohewahewa Stream Station for *Lentipes Concolor* juveniles.

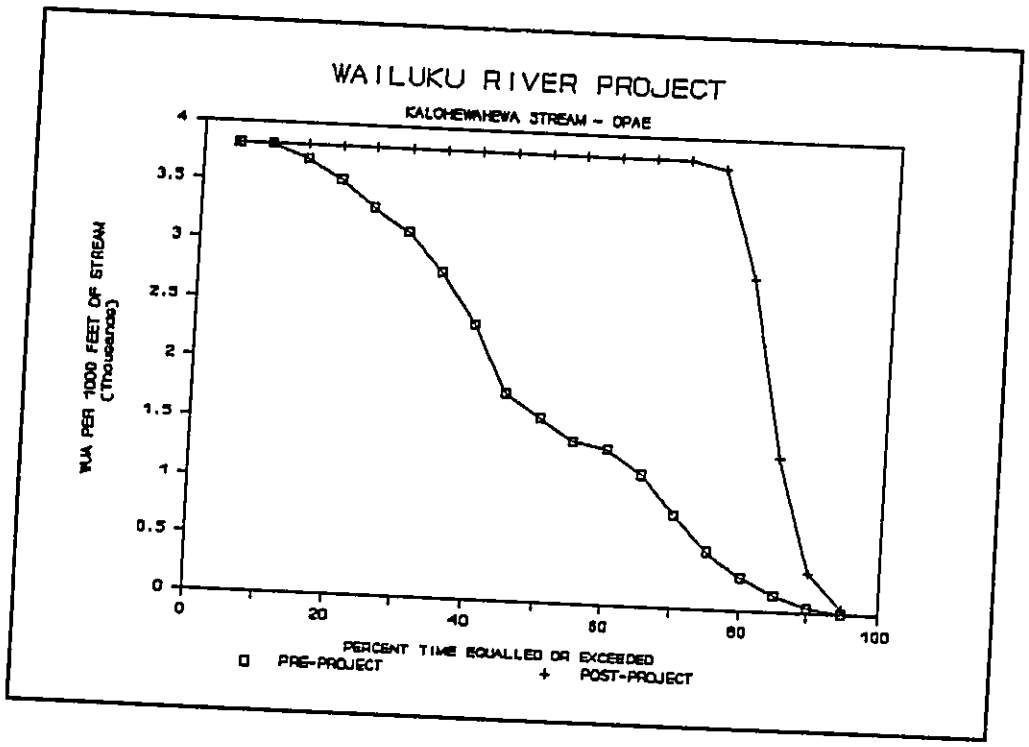

Figure 30. Pre and post project habitat duration curves at the Kalohewahewa Stream Station for Opae adults.

APPENDIX C

Supplemental Report on the Wailuku River: Instream Flow Impact Analysis

Supplemental Report on the Wailuku River Instream Flow Impact Analysis

by

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June 1, 1989

Introduction

The initial results of the instream flow impact analyses for the proposed Wailuku River hydroelectric project were presented in the draft EIS (1989). This report summarizes new results based on refinements in the suitability index curves for all species, additional hydraulic data collected from the Hookelekele Stream and a review of the analysis approach obtained through consultation with personnel of the United States Fish and Wildlife Service in Hawaii. Pertinent information on the methods and results of analyses contained in the draft EIS are repeated here for the sake of clarity and completeness.

Study Site Selection and Hydraulic Field Measurements

The Wailuku River drainage to be affected by the proposed hydroelectric project was divided into three sperate sections: 1) the Wailuku River above the confluence with the Kahoma and Hookelekele Streams up to the 2000 feet elevation; 2) the Hookelekele Stream below its confluence with the Kalohewahewa Stream; and 3) the Kalohewahewa Stream above its confluence with the Hookelekele Stream up to the 2000 feet elevation. Each of these river segments were surveyed from the air for potential access sites as well as for the types and distribution of available habitats. Based on these aerial reconnaissance surveys and ground visits, a total of six transects each were identified for the Hookelekele and Kalohewahewa Streams and twelve transects within the Wailuku River. Transect placement within micro-habitats was apportioned between pool, pocket pool/run and run habitats at each station were access was possible. Additional habitat mapping and review of transect placements were conducted on the Hookelekele Stream with the cooperation of the USFWS. The original number and placement of transects within specific available micro-habitats used in the draft EIS analyses were retained.

Each station on the Wailuku River and Kalohewahewa Stream were sampled at only one flow, wherein stage and discharge measurements were collected for each transect. Field collection techniques were followed according to Trihey and Wagner (1981). The Hookelekele Stream was sampled a second time during field reconnaissance with personnel from the USFWS. Best estimates of the discharge were 36 cfs for the Kalohewahewa Stream, 27 cfs for the Wailuku River and 33 cfs for the initial data set and 64 cfs for the second data set within the Hookelekele Stream. The second data set (64 cfs) at the Hookelekele Stream was utilized in subsequent analyses in this report as the magnitude of the discharge was closer to the average monthly discharges at this station. Given the small relative difference in magnitudes of the observed discharges and small differences in actual transect placement of a few feet, the use of both data sets for the development of stage-discharge relationships for the transects at this station was not attempted.

Hydraulic Simulation

After a review of the available data and analysis options for hydraulic modeling with personnel of the USFWS, the single stage-discharge measurements were utilized to calibrate the MANSQ hydraulic simulation model to generate the stage-discharge relationships for each transect. The simulated water surface elevations were then utilized within the IFG4 hydraulic simulation program in the production runs for the determination of individual cell velocities. As noted in the draft EIS, additional stage-discharge measurements might provide for a better assessment of this relationship at each transect, especially at higher discharges than those obtained in the field studies. However, a review of the preliminary results of the WUA versus discharge relationships suggested that maximum WUA values occurred at lower discharges within the "normal" 0.4 to 2.5 range of simulated flows based on the calibrated discharges used at each station. Collection and use of additional stage-discharge data may be more of an academic exercise rather than a quantifiable improvement in the simulations given the high gradient and narrowly incised structure of the stream channel and the shapes of the S.I. curves for velocities for Lentipes adults, juveniles and the atyid (see Figures 1 through 3). The channel characteristics at all stations (i.e. narrow channel widths with vertical walls) would be expected to convey bank full discharges at magnitudes on the order of few hundred cubic feet per second. Discharges greater than this would be anticipated to result in increasingly higher velocities with little or no provision for overbank flooding. Therefore, little or no increase in low velocity refugia would be available with increased discharges above bank full and this observation with the nature of the S.I. curves for velocities, would from first principals, suggest that available usable habitat would decrease rapidly for incremental changes in the magnitude of these higher discharges. Based on these observations, the range of simulated discharges were arbitrarily extended to higher flows in order to use the available daily discharge readings rather than the mean monthly averages.

Suitability Curve Development

At present, no known site specific suitability index (S.I.) curves have been developed for the Wailuku River or its tributaries for Lentipes or the atyid shrimp. To date only 25 individuals of Lentipes have been observed within the entire Wailuku River System, with the all but 4 of these observations occurring within the Hookelekele Stream. Kinzie and Ford (1988) note that S.I. curves developed from a particular system are not likely to be transferable to other streams in Hawaii. However, given the fact that no Lentipes have been observed from the main stem Wailuku River above Lauiole Falls or within the Kalohewahewa Stream, the development of site specific curves for these waters is not possible and additional field efforts in this regard are unlikely to yield sufficient data to develop these curves. For the known observations of Lentipes within the Hookelekele Stream, no site specific recordings of depth, velocity substrate and cover are available for use in the development of site specific S.I. curves. Therefore, a literature review, interviews with several species experts and data from Kinzie et al. (1984) were utilized to construct the initial S.I. curves for the adults and juveniles of Lentipes and adults of the atyid as reported in the draft EIS (see Figures 1 through 9 of Appendix B in the EIS).

After review of these curves by the USFWS several modifications were made. First, for all species, a simplified substrate coding scheme was developed based on the categories listed in Table 1. This table also indicates the relative suitability for the dominate substrate type for each species and life stage. Because substrates within the stream were categorized by both dominate and sub-dominate types where mixed substrates occurred, the suitability values for these mixed categories (i.e. cobble and gravel) were developed from the data listed in Table 1 by assuming that the combined suitability was equal to the arithmetic average of the component substrate types. For example, a mixed substrate in the stream composed of cobble and gravel (or gravel and cobble) for Lentipes adults would be (1.0+0.3)/2.0 = 0.65; cobble and mud (or mud and cobble) would be 0.50.

Table 1. Dominate substrate categories and relative suitability for Lentipes adults and juveniles and the atyid.

	Relative Suitability		
Substrate	Lentipes Adult	Lentipes Juvenile	Atyid
Organic material	0.00	0.00	0.00
Mud	0.00	0.00	0.00
Silt	0.00	0.00	0.00
Sand	0.00	0.00	0.00
Gravel	0.30	0.30	0.02
Cobble	1.00	1.00	0.04
Boulder	1.00	1.00	1.00
Bedrock	1.00	1.00	0.00

In addition to the modification of the substrate codes for each species, the velocity distribution for Lentipes adults was modified to reflect a slightly broader range of suitable velocities. The final set of S.I. curves utilized in subsequent analyses for each species and life stage are provided in Figures 1 through 3.

Pre-Project Hydrology

Daily flow records for the period of record from 1928 through 1988 on the main stem Wailuku River (station number 16704000) at the 1,090 feet elevation were used to establish mean monthly pre-project flow conditions within the study area. Partitioning of flows between the Wailuku River and the Hookelekele Stream were established as 40 percent and 60 percent of the gage readings based on the analysis presented in U.S. Army Corp. of Engineers (1984). Flows within the Kalohewahewa Stream were estimated as 60 percent of the Hookelekele Stream based on site reconnaissance of the channel morphology and from observations made by the USFWS (1984) and Archer (1989).

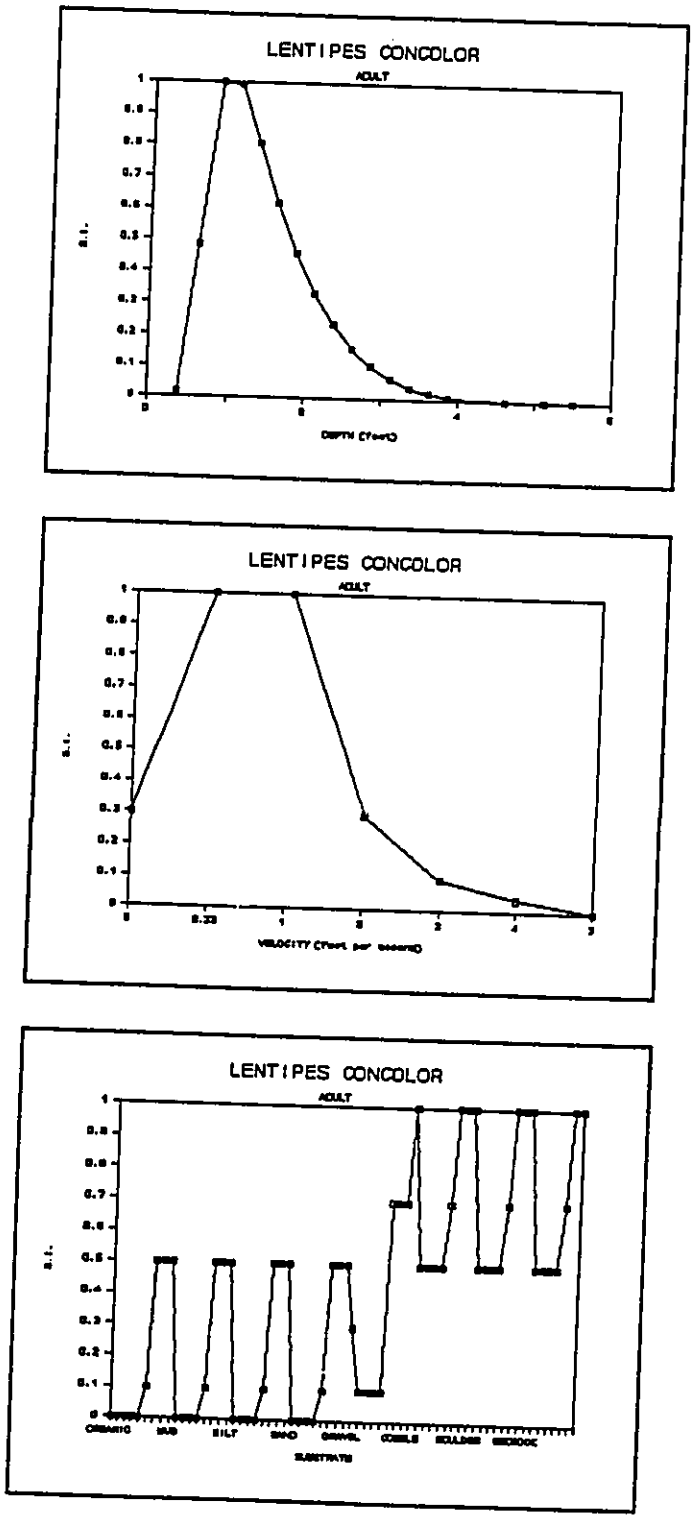


Figure 1. Suitability curves for depth, velocity and substrates for Lentipes concolor adults.

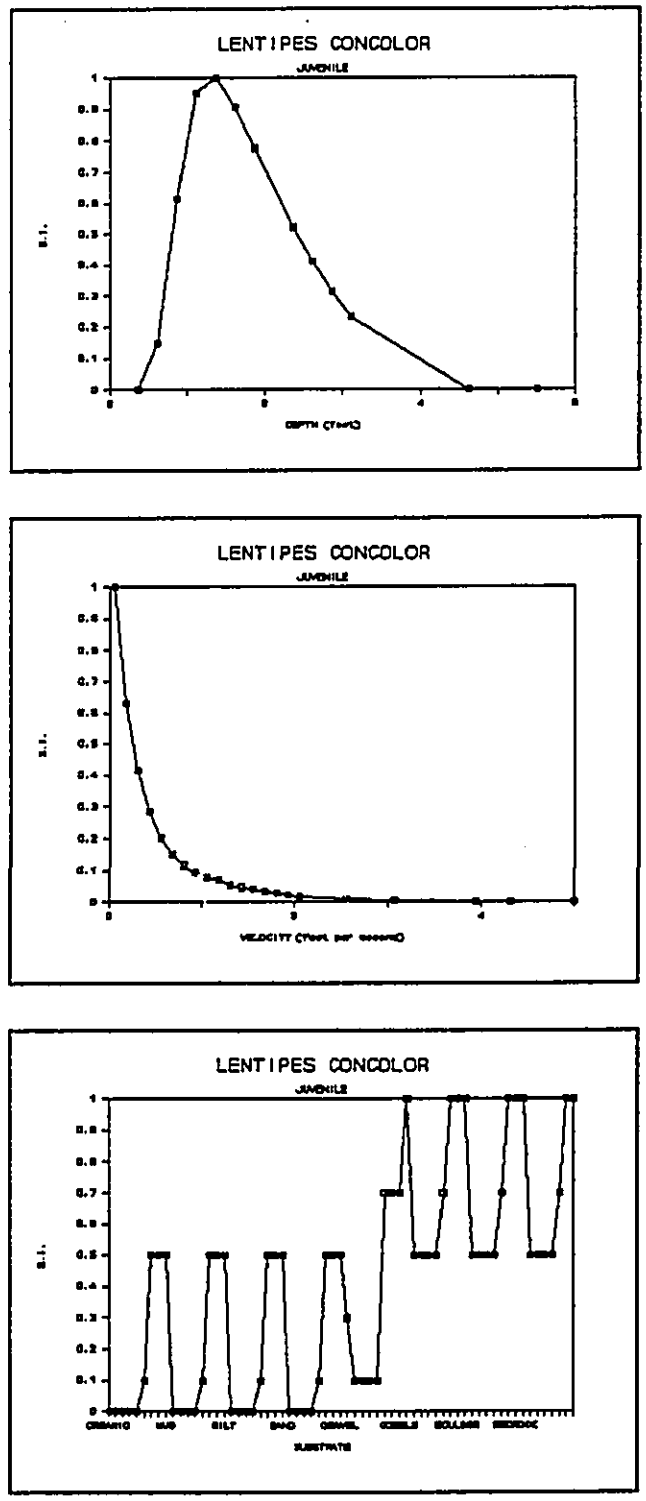


Figure 2. Suitability curves for depth, velocity and substrates for Lentipes concolor juveniles.

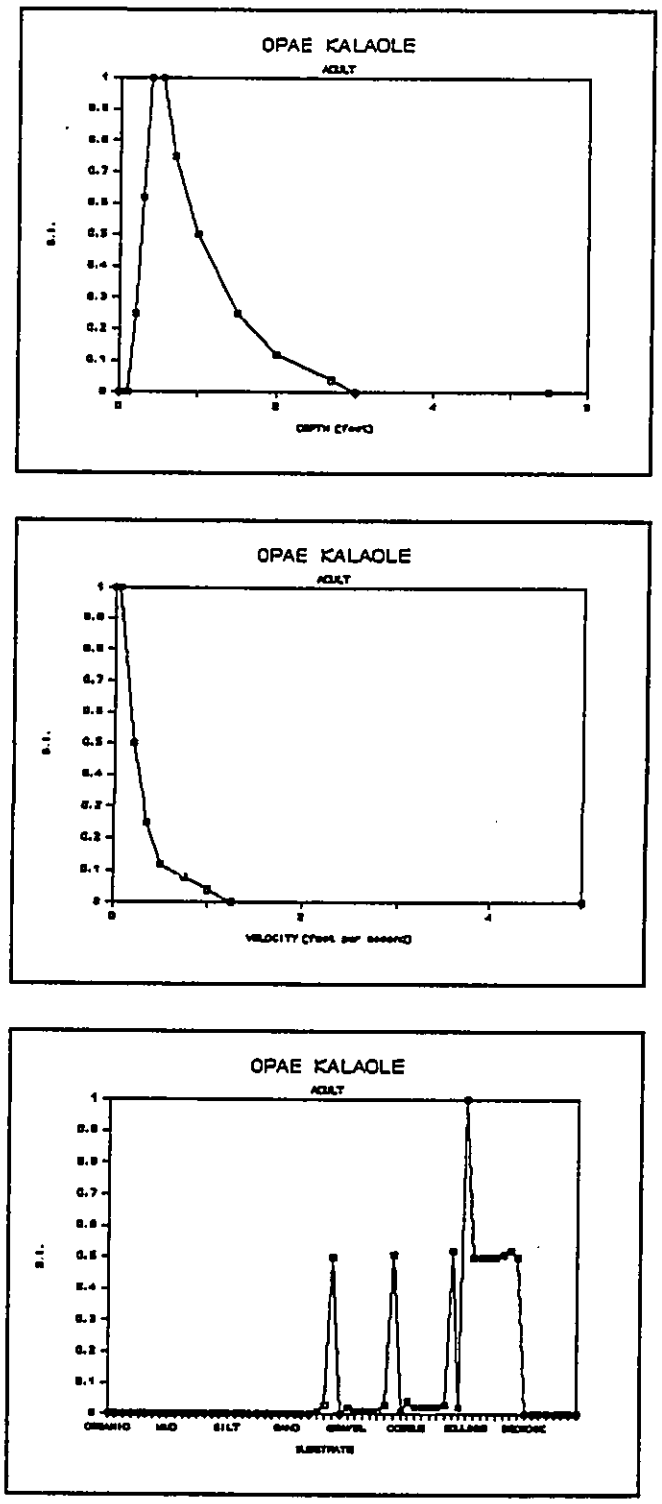


Figure 3. Suitability curves for depth, velocity and substrates for Opae kalaole adults (atyid).

Post-Project Hydrology

Mean monthly post project flows at each of the stations were derived by imposing the following plant operating regime on a daily basis for the period of record from 1928 to 1988. First, it was assumed that a combined flow of 70 percent of the pre-project Wailuku daily gage readings were available for power generation at the Wailuku River and Kalohewahewa Stream diversions. If the adjusted daily flow available for diversion was less than 13 cfs, then no water was diverted for power generation and post project flows equalled pre-project flows on that day at all stations.

If 70 percent of the Wailuku River daily gage flow fell between 13 cfs and 168 cfs then the flow below the diversion within the Wailuku River was set at 5 cfs, flow below the diversion within the Kalohewahewa Stream was set at 3 cfs and the combined flow of the Kalohewahewa and Hookelekele Streams equalled 30 percent of the Wailuku River gage for that day. This means that the difference between 8 cfs and 70 percent of the Wailuku River daily flow reading was diverted for power generation.

If 70 percent of Wailuku River daily gage reading exceeded 168 cfs, then 160 cfs was assumed to be diverted to the penstock and the remaining flow was apportioned as 62.50 percent within the Wailuku River below its diversion and 37.50 percent within the Kalohewahewa Stream below its diversion. Flow within the Hookelekele Stream was set such that the combined flow of the Kalohewahewa and Hookelekele Streams equalled 30 percent of the Wailuku River gage reading on that day. An illustrated example is presented in Table 2. The resulting summary of pre and post project mean monthly flows at each station based on the daily flows are presented in Table 3. The pre- and post project flow duration curves based on the mean daily flows for the Wailuku River gage, Wailuku River, Hookelekele and Kalohewahewa Streams are presented in Figure 4.

Table 2. Example of post project flow determinations based on daily flow readings at the Wailuku River gage and proposed operating criteria for the Wailuku and Kalohewahewa diversions.

Pre-Project Daily Gage	70 Percent of Gage	Amount Diverted	Wailuku River		Kalohewahewa		Hookelekele		Wailuku Gage	
			Pre	Post	Pre	Post	Pre	Post	Pre	Post
12.0	8.4	0.0	4.8	4.8	4.3	4.3	7.2	7.2	12.0	12.0
93.0	65.1	57.1	37.2	5.0	33.5	3.0	55.8	30.9	93.0	35.9
305.0	213.5	160.0	122.0	33.4	109.8	20.1	183.0	111.6	305.0	145.0

Table 3. Wailuku River Project mean monthly flows (cfs) for pre and post project conditions.

Month	Wailuku gage Pre	Wailuku gage Post	Wailuku Pre	Wailuku Post	Hookelekele Pre	Hookelekele Post	Kalohewahewa Pre	Kalohewahewa Post
JAN	283.0	228.1	113.2	89.4	169.8	138.7	101.9	53.9
FEB	310.8	254.0	124.3	100.4	186.5	153.6	111.9	60.5
MAR	412.6	329.6	165.0	128.6	247.5	201.0	148.5	77.3
APR	411.1	312.2	164.4	118.0	246.6	194.2	148.0	70.9
MAY	230.0	145.3	92.0	47.7	138.0	97.6	82.8	28.7
JUN	123.4	70.3	49.3	20.8	74.0	49.6	44.4	12.7
JUL	193.4	125.6	77.1	42.2	115.6	83.4	69.4	25.4
AUG	296.3	226.2	118.5	85.8	177.8	140.4	106.7	51.6
SEP	153.9	99.7	61.6	33.4	92.4	66.3	55.4	20.2
OCT	173.0	112.7	68.9	38.0	103.4	74.8	62.0	23.0
NOV	352.2	269.1	141.0	102.1	211.4	167.0	126.9	61.4
DEC	351.8	280.4	140.8	109.2	211.2	171.2	126.7	65.7

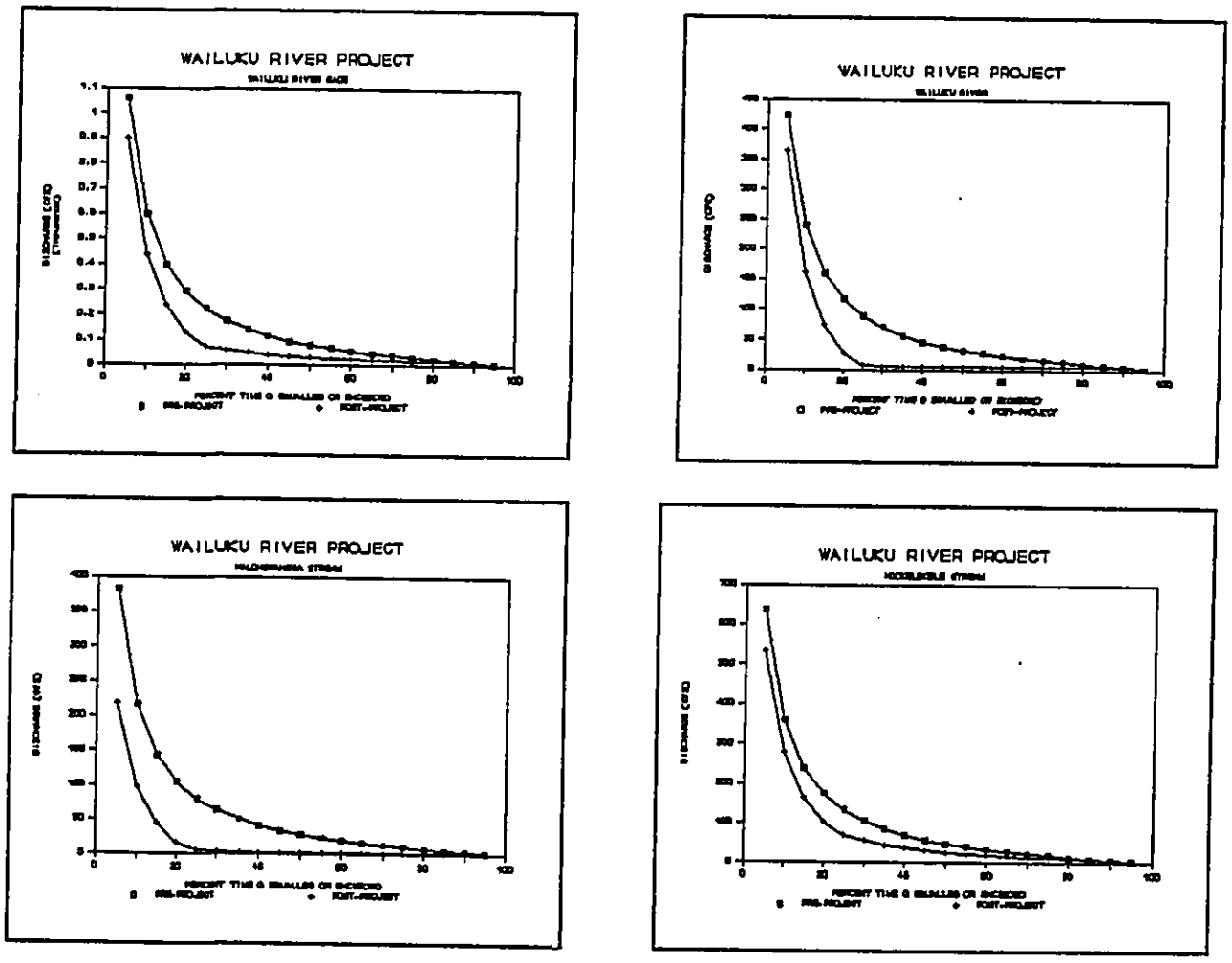


Figure 4. Pre and post project flow duration curves for the Wailuku River gage, Wailuku River, Kalohewahewa and Hookelekele Streams.

Habitat Simulation and Impact Analyses

Habitat availability was determined from integration of the hydraulic simulation and S.I. curve results with IFIM model HABTAT (Milhous et al. 1984). The functional relationships of WUA versus discharge for each species and life stage at each station are presented in Figure 5. In addition, an assessment of "community responses" were examined by development of single aggregated curves at each station computed as the mean percent deviation (MPD) from the normalized individual WUA functions (Geer 1986). The MPD curves, allow an assessment of impacts associated with optimized flows wherein all life stages for all species present within the river are simultaneously considered in the analyses. The MPD curves at each station are presented in Figure 6.

The available habitat (WUA) for each species and life stage as well as the MPD's based on daily pre- and post project flows over the period of record from 1928 to 1988 were calculated and utilized to compute the mean monthly percent change in available habitat. The results of the daily WUA values were also used as a basis for the development of habitat duration curves for pre- and post project conditions at each station. In the assessment of pre- and post project impacts, WUA for daily discharges greater than the maximum discharge simulated were set to the WUA occurring at the maximum discharge simulated. WUA values at discharges less than the minimum simulated were interpolated from the minimum to an assumed value of zero habitat at zero discharge. These are considered to represent reasonable assumptions given the properties of the individual WUA curves at the higher discharges and the high gradient, incised narrow canyon topography of the stream channels at each station. The results for the average monthly percent change in WUA and MPD's for each species and life stage at each station are given in Table 4 and Figure 7. The habitat duration curves for pre- and post project conditions at each station are shown in Figures 8 through 10.

Table 4. Mean monthly percent change in available habitat and MPD's based on daily flows for Lentipes adults and juveniles and Opae adults.

	Wailuku River				Kalohewahewa Stream				Hookelekele Stream			
Month	LA[1]	LJ[2]	OA[3]	MPD[4]	LA	LJ	OA	MPD	LA	LJ	OA	MPD
JAN	20	56	568	60	17	25	139	30	-1	-13	7	-5
FEB	20	51	519	53	23	36	143	34	2	-9	10	-2
MAR	29	74	775	75	38	57	208	54	7	-9	15	-0
APR	38	96	1026	97	46	67	285	68	11	-10	19	1
MAY	37	100	1077	103	31	40	254	55	8	-14	15	-2
JUN	24	77	850	85	2	7	122	23	-1	-18	8	-6
JUL	29	86	948	91	16	26	182	38	3	-16	11	-4
AUG	28	84	929	90	14	25	173	36	2	-17	11	-5
SEP	24	75	836	82	3	9	122	23	0	-17	8	-6
OCT	26	78	892	84	11	20	166	31	2	-15	10	-5
NOV	32	86	941	89	34	48	245	54	6	-13	14	-2
DEC	25	69	737	72	26	42	183	43	2	-13	11	-4

[1] LA = Lentipes adult percent change in WUA
[2] LJ = Lentipes juvenile percent change in WUA
[3] ON = Opae adult percent change in WUA
[4] MPD = Percent change in MPD

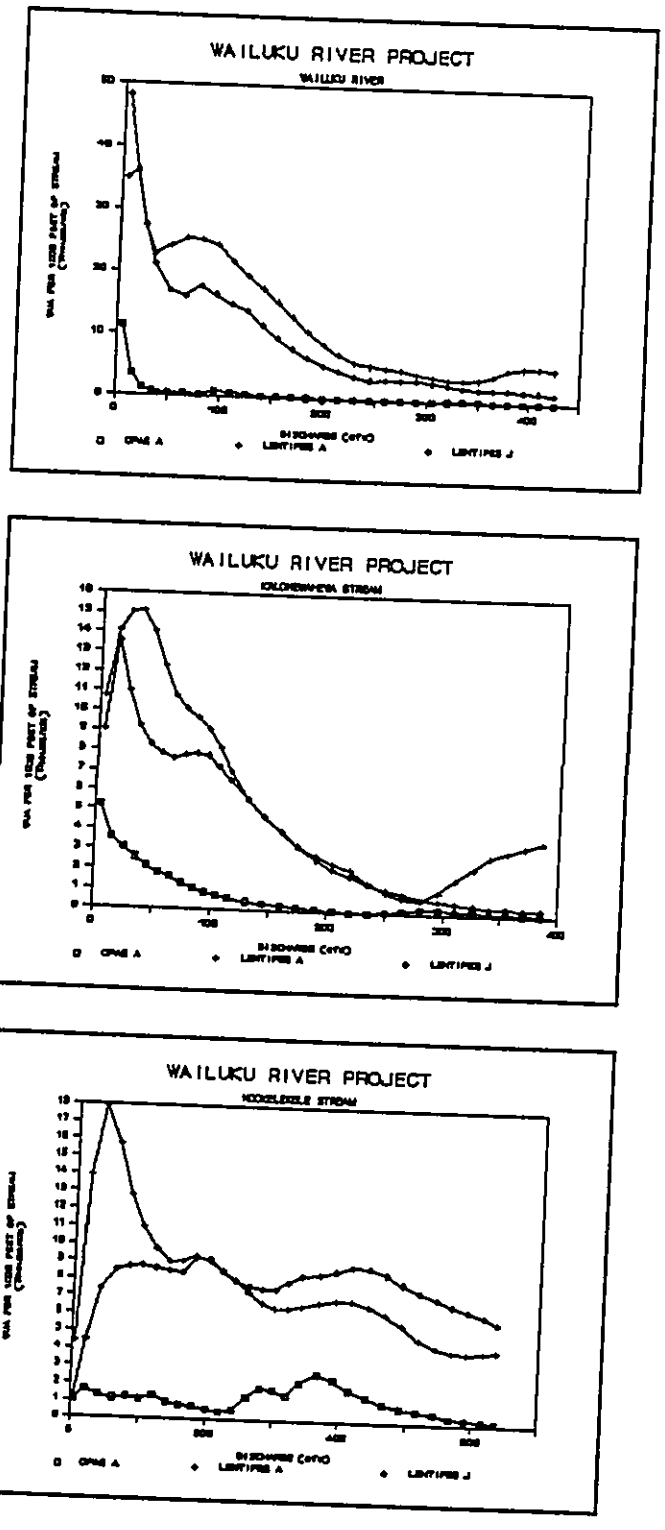


Figure 5. Relationships between WUA and discharge for Lentipes adult and juveniles and Opae adults for the Wailuku River and the Kalohewahewa and Hookelekele Streams.

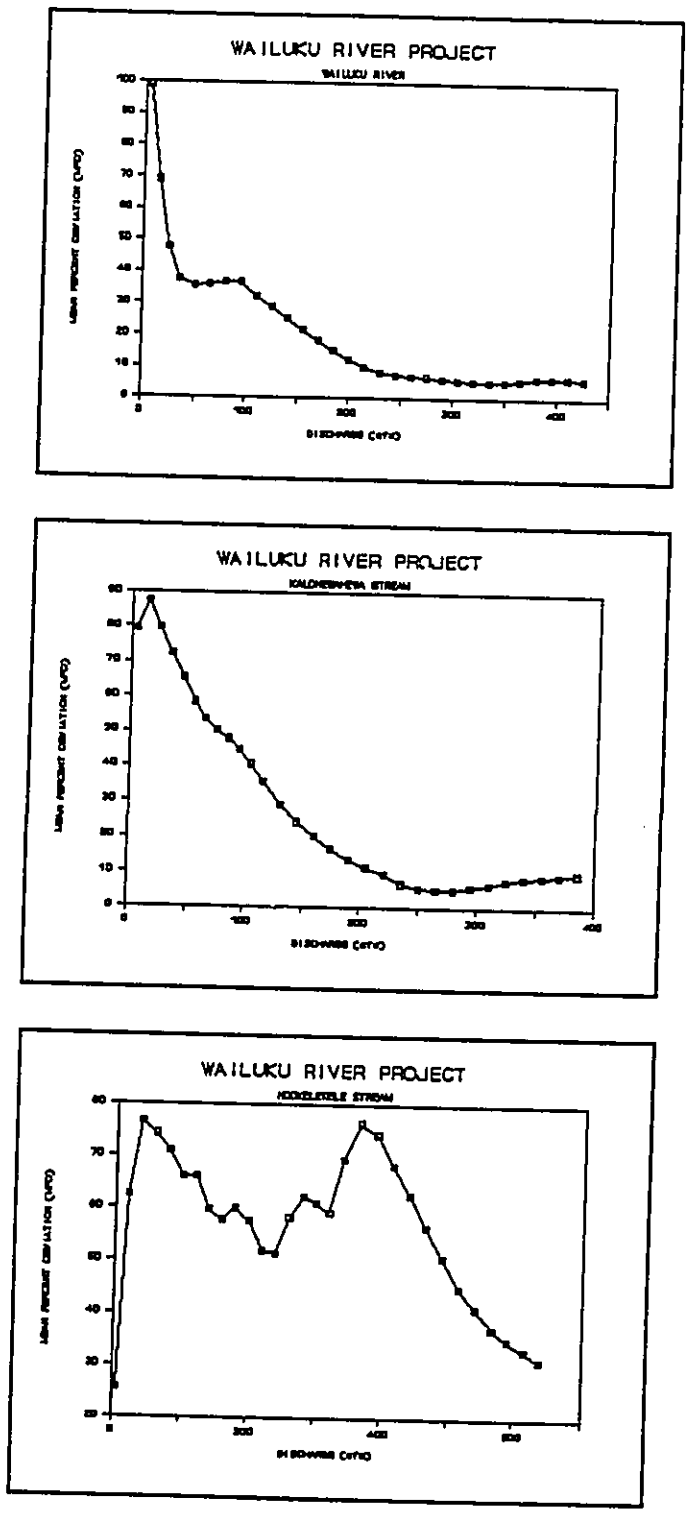
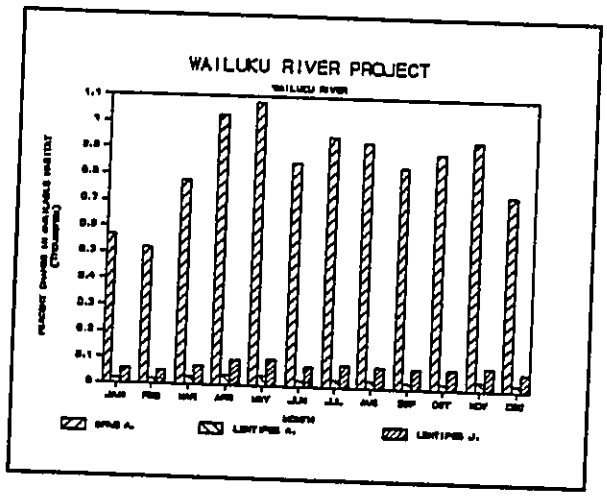
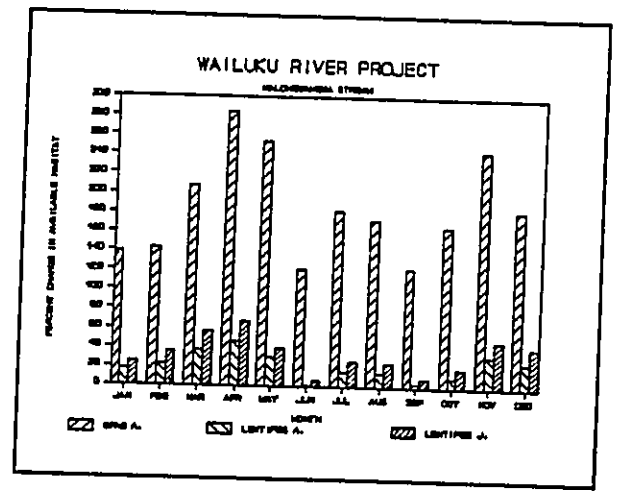
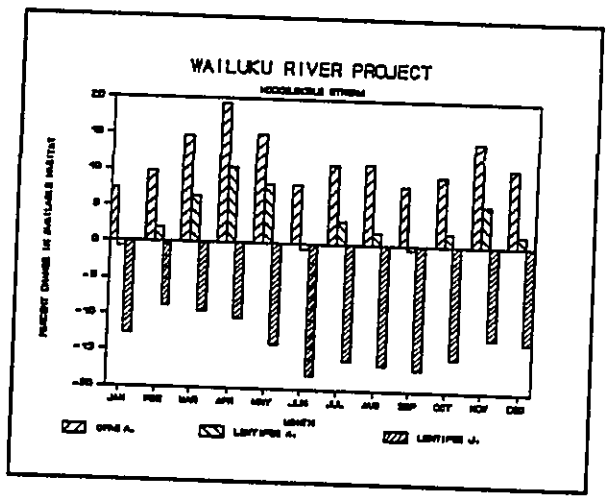


Figure 6. Relationships between MPD and discharge for Lentipes adult and juveniles and Opae adults for the Wailuku River and the Kalohewahewa and Hookelekele Streams.







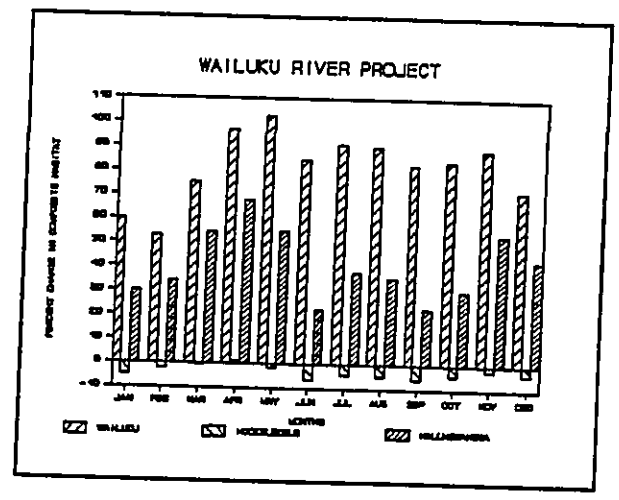


Figure 7. Mean monthly percent change in WUA and MPD's for Lentipes adults and juveniles and Opae adults at each station.

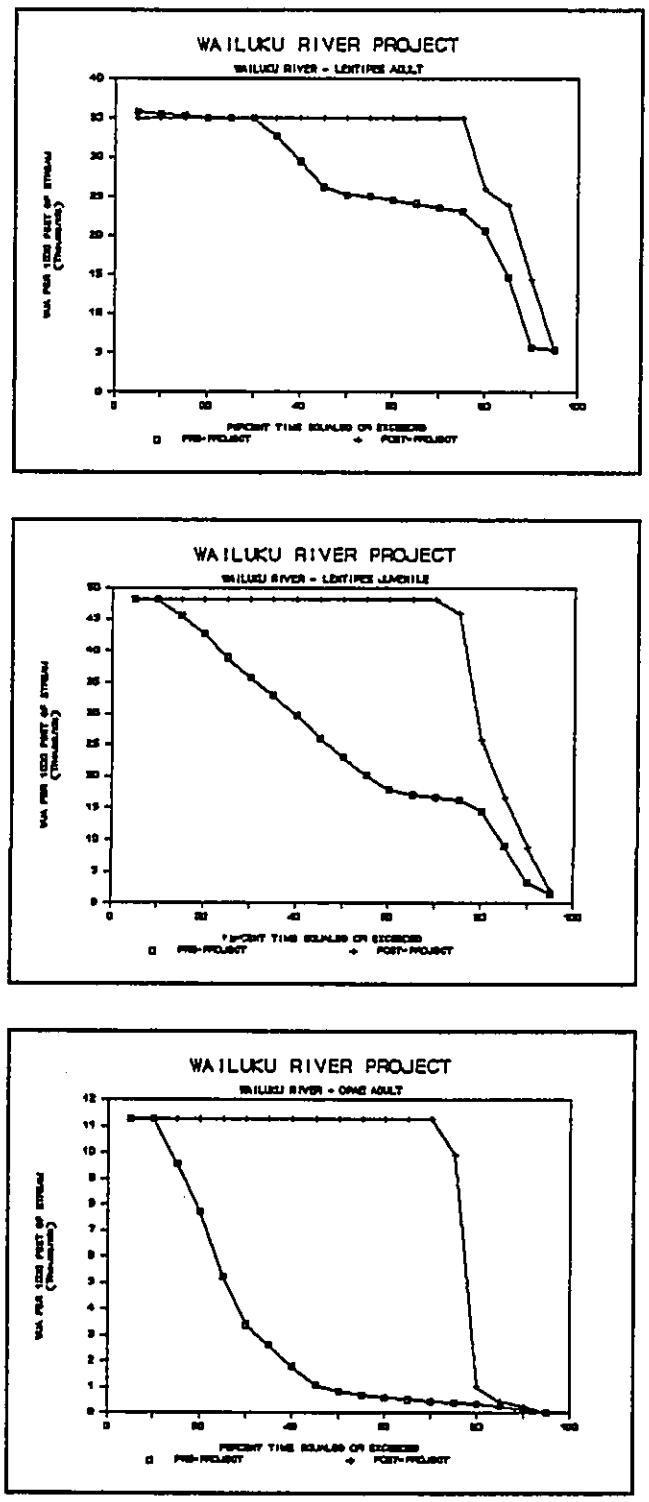


Figure 8. Habitat duration curves for pre- and post project conditions within the Wailuku River for Lentipes adults and juveniles and Opae adults.

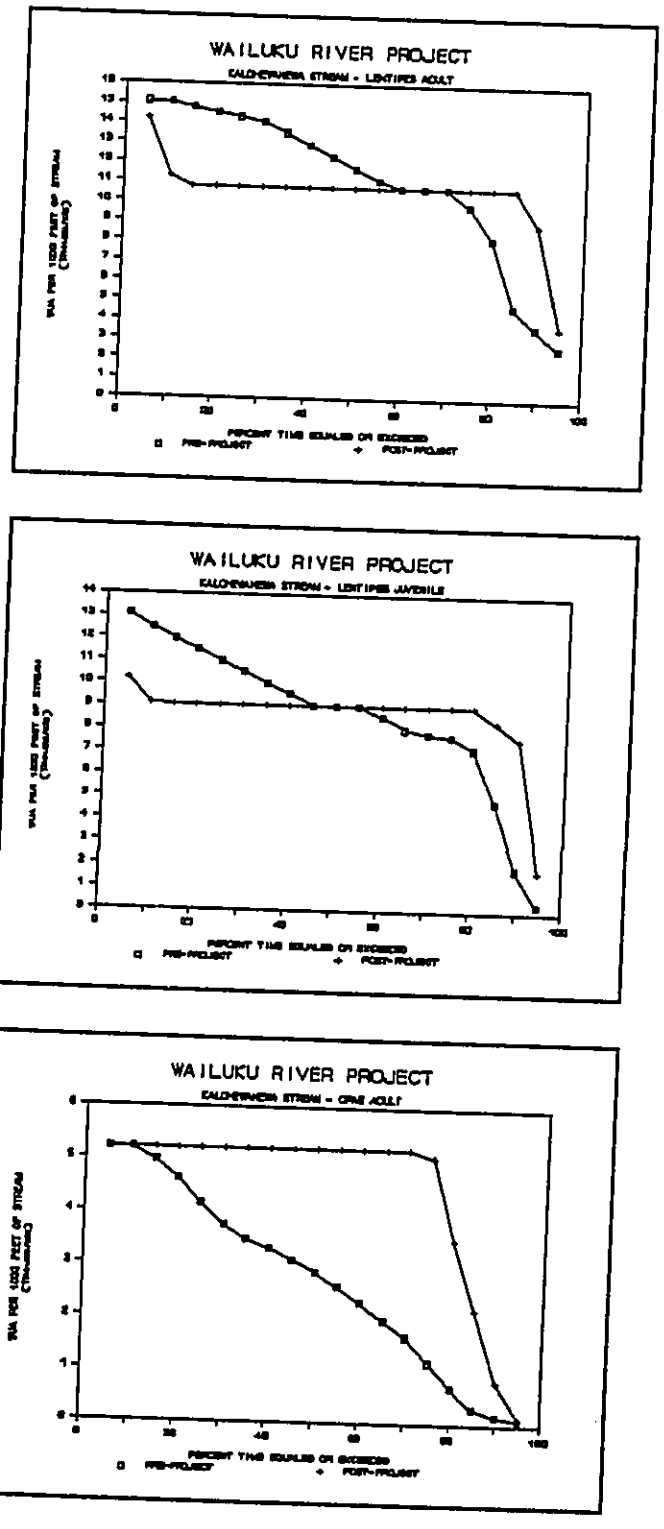


Figure 9. Habitat duration curves for pre- and post project conditions within the Kalohewahewa Stream for Lentipes adults and juveniles and Opae adults.

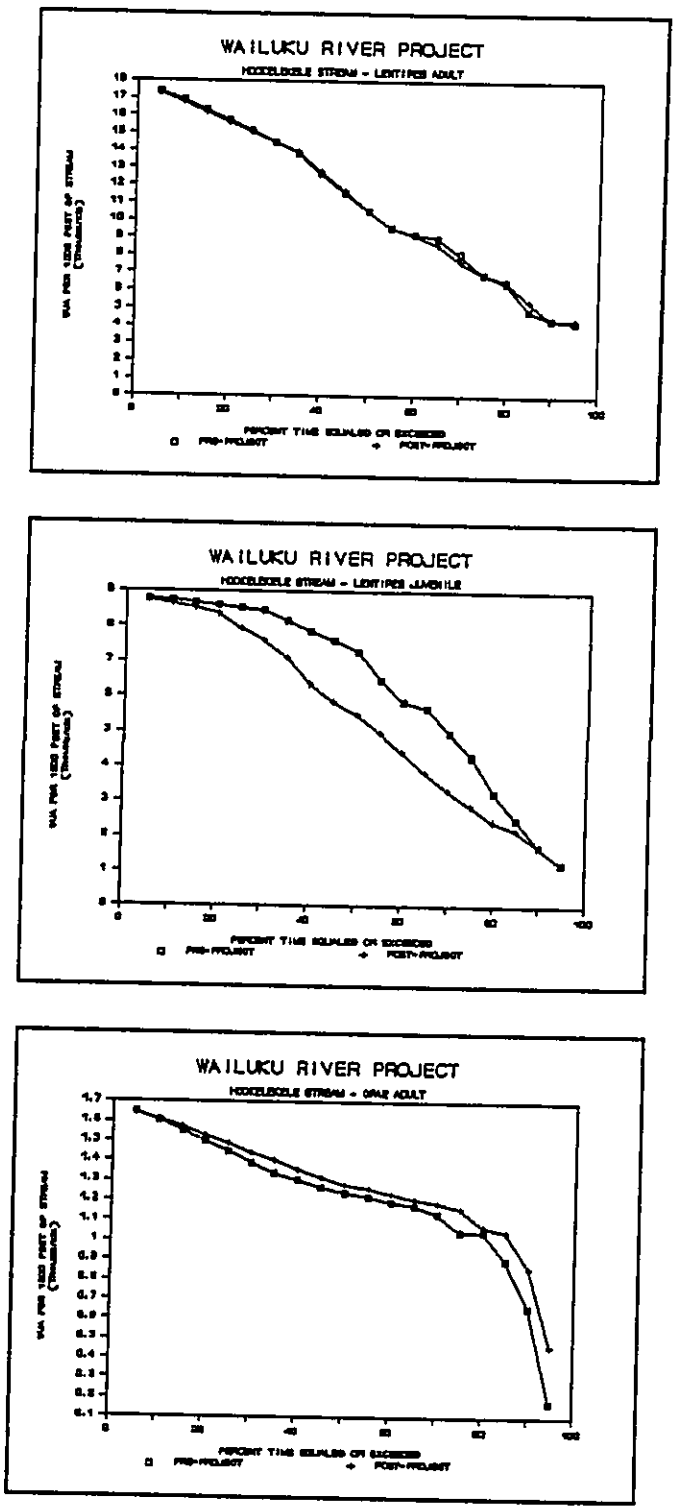


Figure 10. Habitat duration curves for pre- and post project conditions within the Hookelekele Stream for Lentipes adults and juveniles and Opae adults.

These results demonstrate that the proposed operating regime and bypass flows within the Wailuku River and the Kalohewahewa Stream result in a net increase in the available habitat for Lentipes adults and juveniles as well as for the atyid for all months. The community responses also show a net positive gain in available habitat in all months for these stations as indicated by the MPD results. The results for the Hookelekele Stream however, show that a net reduction in available habitat for the Lentipes juveniles occur in all months, while adults show only a marginal reduction (1 percent) during January and June. The atyid on the other hand show a net positive increase in available habitat for all months. The community responses at this station show that the overall reductions in available habitat is in general less than 6 percent for all months. The interpretation of the results for the Hookelekele Stream, need to be considered with the following observations in mind.

First, as noted previously, a review of the initial S.I. curves for Lentipes adults by species experts within the USFWS resulted in a change in the velocity curve (see Figure 1). The velocity curve for the juveniles was not modified. The original S.I. curves for the adults and juveniles in the draft EIS based on fitting the available frequency data resulted in S.I. curves for both life stages that were essentially the same as the un-modified curve for the juveniles (see Figure 2). Modification of the juvenile curve for velocity to a form similar to that of the adults would result in the impact analyses for this life stage to be similar to the results reported for the adults. This is easily supported by the fact that the substrate curves for the adults and juveniles are identical and the depth curves are essentially identical (compare Figure 1 and 2). Finally, no known collections of Lentipes juveniles have been recorded for the entire Wailuku River system. Although the associated impacts suggest that altered flow regimes may reduce available Lentipes juvenile habitat based on physical parameters of depth, velocity and substrate at this station, the available data indicates that the Hookelekele Stream (and the Wailuku River system in general) may have other biological and physical factors that may preclude the use of this system by this life stage in significant numbers. This is also supported by the fact that only 25 total adult Lentipes have been recorded from the entire Wailuku River system and the majority of these observations were obtained from approximately 2000 feet within the Hookelekele Stream.

Conclusions

The impact analyses on the aquatic resources of the Wailuku River system for the Wailuku River Hydroelectric Project indicate that the proposed operating regimes and bypass flows result in net positive increases in available habitat within the Wailuku River and Kalohewahewa Streams for the Lentipes adults and juveniles and the atyid. The only negative impacts associated with the project occur for the Lentipes juveniles within the Hookelekele stream, however in light of the net positive impacts for the adults at this station and in consideration of the available biological data for the Wailuku River system in general, these impacts are considered to be non-significant. The biological data that supports this conclusion are that only 25 total Lentipes adults have been observed within the entire Wailuku River system, no juveniles have ever been recorded and the population densities for this species are very low relative to other Hawaiian stream systems.

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APPENDIX D

Archaeological Reconnaissance

WAILUKU RIVER HYDROELECTRIC PROJECT: ARCHAEOLOGICAL RECONNAISSANCE

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September, 1986

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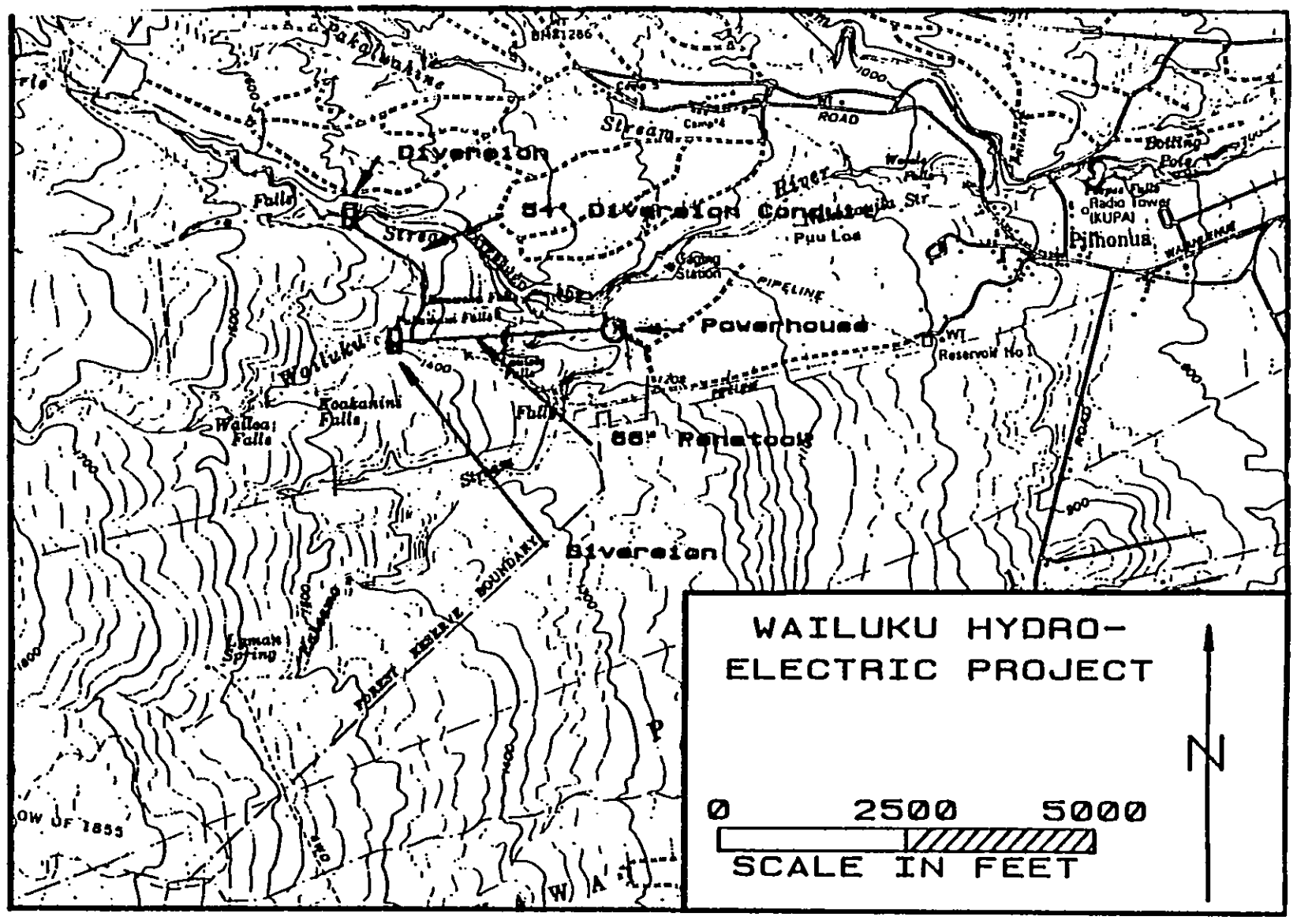
I. INTRODUCTION

This report presents the results of an archaeological reconnaissance that was conducted at the location of the proposed Wailuku River Hydroelectric Project, Hilo, Hawaii. The project, which was conducted in December 1985, consisted of a literature search and a field inspection of the project site. The purpose of the work was to determine the presence or absence of sites of archaeological or historical interest that might be located within the project area, to assess the significance of the sites, to determine whether any sites present were eligible to either the State or National Registers of Historic Places, and to make recommendations for any further archaeological work that might be necessary.

The project is located on the Wailuku River eight miles west of Hilo, between the elevations of 1100 and 1400 feet. Even though the rights-of-way of the proposed Hookelekele Stream diversion and the proposed penstock had been previously marked with plastic ribbon, the extremely dense vegetation represented a moderate hindrance to the conduct of the fieldwork. The terrain represented no hindrance whatsoever. Approximately 80 per cent of the proposed alignment was inspected in two days by one person on foot.

II. PREVIOUS ARCHAEOLOGICAL WORK

Inspection of archaeological site location maps and State and National Register of Historic Places information on file at the State Historic Preservation Office, Department of Land and Natural Resources revealed that there are no sites in the project area listed on either the State of Hawaii or the National Registers of Historic Places, nor have any been determined to be eligible to either of those registers. Alfred E. Hudson's volume "The Archaeology of East Hawaii," a typescript manuscript the original of which is on file at the Bernice P. Bishop Museum, was also consulted. This study was concerned primarily with sites located at or immediately adjacent to the coast, and no sites were recorded in the vicinity of the project area. A reconnaissance of the intake and power plant locations and the adjacent tributary streams, pastureland and forest reserve had been conducted by Cox [1983], who found no sites.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54" Diversion Conduit
Powerhouse
55" Penstock
Diversion
Pilhonua
Radio Tower
(KUPA)
Puu Loa
Gaging Station
PIPELINE
Reservoir No 1
Wailuku
Koakanini Falls
Wailoa Falls
Stream
River
ROAD
FOREST RESERVE BOUNDARY
Lyman Spring
Bolting Pole
1000
1400
1600
1700
1800
900

III. LAND USE TO 1900

McEldowney's [1979] literature search of land use patterns in the Hilo area had as its northern limit the Wailuku River, but her comments are nevertheless applicable to the present situation. As the survey area is situated in what she refers to as Zone III [Lower Forest Zone], there is little likelihood of any sites being present:

> "Use of this zone, from roughly 1,500 to 2,500 ft elevation, revolved around the gathering of forest resources needed for a variety of wood, feather, and fiber products, and for the collecting of supplemental food crops grown in small forest clearings and along streams. This includes the celebrated and specialized crafts of cutting *koa* for canoes and catching birds for feather-decorated objects. Historic accounts suggest that a cluster of small huts, small religious shrines, and numerous paths were frequented by a family unit or group of workers for these purposes. The probability of finding structural or artifactual evidence of these activities appears low due to the temporary nature of the huts and the dense character of the ground cover, which would quickly close unused paths and cleared areas. Streams and springs, the presence of feral cultigens, and tall stands of koa could be indicators of greater site probability" [McEldowney 1979:25].

Kelly, Nakamura and Barrère [1981] chronicled historic events in the Hilo area from the earliest historic period to the present. Early nineteenth century life was centered around both aquatic resources in Hilo Bay and agricultural pursuits in the adjacent marshes. Utilization of the interior, which would include the vicinity of the project area, was less intensive but still of great importance:

> "From it came woods for housebuilding and other needs, *olona* and *'ie'ie* fiber for cordage and basketry, *mamaki* for tapas, and food plants such as bananas, plantains, taro, and yams, planted along streams and in small forest clearings. Also in this zone grew the

great *koa* trees used to hew the war canoes for which the Hilo chiefs were famous in ancient times. The exploitation of this zone was in-tensified during the 1790s, when Kamehameha was preparing for his assaults on neighboring island chiefdoms" [Kelly et al. 1981:7]

The period from 1815 to about 1830 was marked by intensive sandalwood exploitation, but this activity would have left little or no evidence in the project area:

> "Kamehameha retained the monopoly on the sandalwood trade until his death, and between 1815 and 1819 he had given enough piculs of wood to purchase six foreign vessels, as well as an assortment of foreign goods from tea to guns and ammunition. Probably one of his own ships made calls at Waiakea [on Hilo Bay] to pick up sandalwood collected there for direct or transhipment to China.
>
> "After the death of Kamehameha and the accession of his son Liholiho, the new king's favored chiefs were permitted to share in the trade. Their reckless exploitation of this great natural resource, in return for vessels and luxuries that lay unused in storehouses, resulted in ruinous debts to themselves and death and deprivation to the commoners were forced to abandon their own livelihoods to gather and transport the wood to the beaches. By the early 1830s the depletion of the forests and the financial plight of the chiefs brought an end to the trade" [Ibid:26].

Serious missionary work in the Hilo area, which had a profound effect on land use patterns, dates from the early 1820s:

> "Pursuant to the recommendations of the Hawai'i Missionary delegation and with the consent of Liholiho and his chiefs, the head mission at Honolulu sent two missionary families to take up a station in Hilo. On January 24, 1824, Joseph and Martha Goodrich and Samuel and Nancy Ruggles landed at Ka-nuku-o-ka-manu. Their first night at Waiakea was spent

in a canoe shed on the beach. The next day they moved into a house belonging to Ka'ahumanu, at the site they chose for the new Waiakea mission, 'near the landing and only a quarter of a mile from a fresh water pond' [approximately the site of the Hilo Iron Works].

"The missionaries had been placed under the protection of Koahou, the representative of Ka'ahumanu and therefore of the government. Koahou was a son of Kamanawa, the chief of Hilo, during Kamehameha's time. Under his direction a meeting house and a dwelling house were constructed at the mission station, thatched with *lauhala* and tied with *'ie'ie* fiber. On May 19, 1824, church services were held in this first Christian meeting house built in Hilo.

"Despite the apparent receptiveness of the people during Ellis' previous visit just six months before, the missionaries found them almost completely indifferent to their efforts to teach them the *palapala*. Ma'alo, the chief at Waiakea, and Namaha, the chiefess at Pi'ihonua, were openly opposed to schooling and Koahou did nothing to encourage it. It took several months to win them over, but once this was accomplished the people followed, and Christian schools and churches became established in Hilo. By April of 1825 schools were operating and people were attending church services with some regularity, according to the missionaries' journals and letters" [Ibid:28-9].

Again, no direct evidence of these activities is present in the project area. However, events during the period from 1840 to 1898, which witnessed increasing Western involvement, did effect adjacent lands which were put into extensive sugar production by Mauna Kea Sugar Company:

"Beginning with a three-month visit to Hawai'i Island by the United States Exploring Expedition, from December 9, 1840, to March 5, 1841, and culminating with annexation of the Islands by the United States in 1898, American influ-

ence played a significant role in the development of Hilo.

"The United States Exploring Expedition, under the Command of Charles Wilkes, was the first United States government-sponsored scientific expedition into the Pacific. By the middle of the 19th century, the undivided use-rights system of land tenure in Hawai'i had been completely changed to conform with the American system of private ownership of land. With private property established legally by 1848, capital investment in land achieved basic security for the commercial sugar industry in Hawai'i, dominated largely by American capital. Sugar became the mainstay of the Hawaiian economy and, in 1876, was greatly encouraged by the Reciprocity Treaty between Hawai'i and the United States. In 1893, with American assistance, the Hawaiian monarchy was forcibly overthrown. The main objective of the business interests that led the overthrow was the annexation of Hawai'i as a territory of the United States. This objective was realized in 1898" [Ibid:51].

IV. RESULTS OF FIELD RECONNAISSANCE

Our field inspection revealed no evidence of significant archaeological or historical remains. The only cultural feature noted was a ditch [indicated on the U.S.G.S. Piihonua Quadrangle as a dashed black line running from Hookelekele Stream to Wailuku River] which coincides with the proposed location of the Hookelekele Stream diversion channel. The ditch, which was probably constructed for irrigation by the Mauna Kea Sugar Company, is no longer in use and has fallen into extreme disrepair. Indeed, except for the fact that it runs nearly parallel to the contour, the feature is indistinguishable from a natural streambed. Because of its poor condition it was neither photographed nor described. As there are better examples of early historic irrigation technology on the island, the Kohala Ditch and the ditch at Waipio Valley being just two, we do not feel that the feature is eligible to either the State or National Registers of Historic Places. The State of Hawaii Historic Sites Section concurred with this assessment in a meeting on September 11, 1986.

V. RECOMMENDATIONS

Construction of the Wailuku River Hydroelectric Project facilities will have no adverse effects upon sites of archaeological or historic importance or significance, and no further archaeological work is necessary in that area. As the rights-of-way of the proposed transmission line and associated access road had not been determined at the time of our survey, we were unable to inspect those areas. It is recommended that an archaeological reconnaissance of them be conducted prior to construction.

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Tammy Yoshimura
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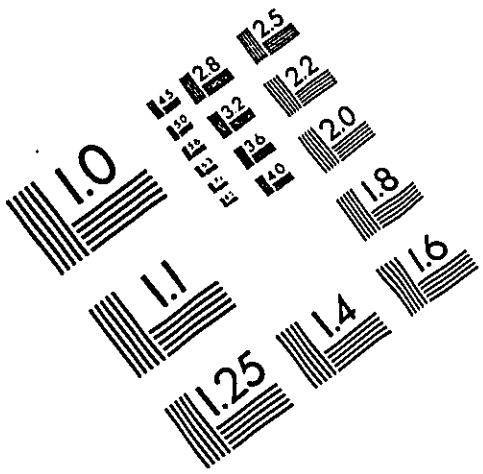

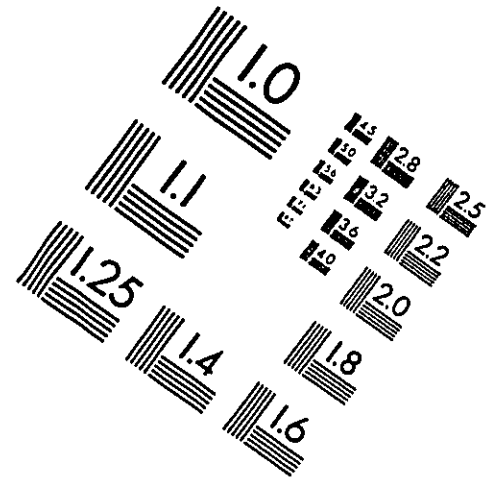

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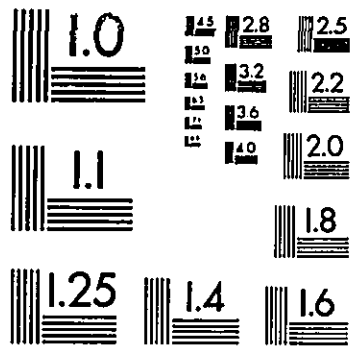

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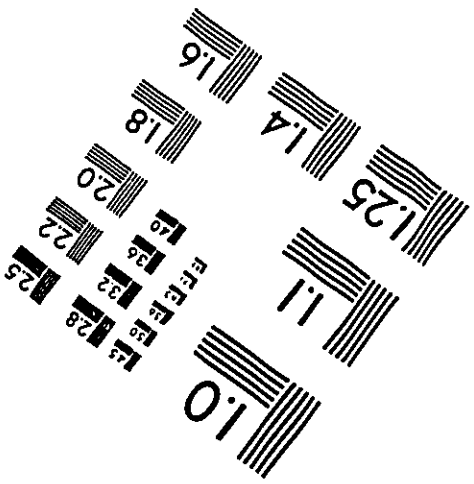

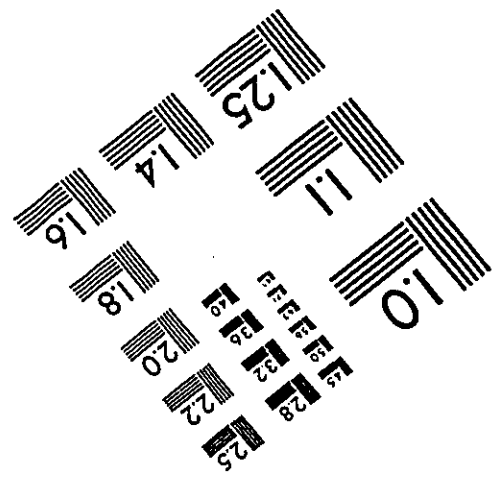

PA-3 8½"x11" PAPER PRINTED GENERAL TARGET

DENSITY TARGET

ADVANCED MICRO-IMAGE SYSTEMS HAWAII