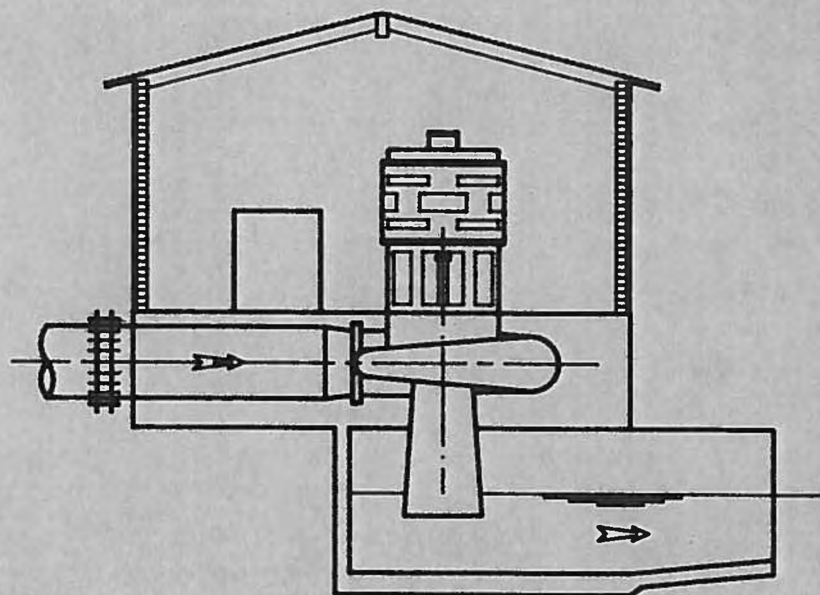
HANALEI RIVER HYDROELECTRIC PROJECT

KAUAI, HAWAII



Before the

STATE OF HAWAII DEPARTMENT OF LAND and NATURAL RESOURCES

CONSERVATION DISTRICT USE APPLICATION

FOR

ISLAND POWER COMPANY INC.

PREPARED BY:

Bingham Engineering
100 Lindbergh Plaza 2
5160 Wiley Post Way
Salt Lake City, Utah 84116
(801) 532-2520

JUNE 1986

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

DEPARTMENT MASTER APPLICATION FORM

FOR DLNR USE ONLY

Reviewed by ____
Date ____
Accepted by ____
Date ____
Docket/File No. ____
180-Day Exp. ____
EIS Required ____
PH Required ____
Board Approved ____
Disapproved ____
Well No. ____

(Print or Type)

I. LANDOWNER/WATER SOURCE OWNER
(If State land, to be filled in by Government Agency in control of property)

Name ____

Address ____

Telephone No. ____

SIGNATURE ____

Date ____

II. APPLICANT (Water Use, omit if applicant is landowner)

Name Island Power Company, Inc.

Address P.O. Box 625
Kalaheo, Kauai, Hawaii
96741

Telephone No. (808) 332-7010

Interest in Property ____

(Indicate interest in property; submit written evidence of this interest)

*SIGNATURE Jeff Burt

Date 6/3/96

*If for a Corporation, Partnership, Agency or Organization, must be signed by an authorized officer.

III. TYPE OF PERMIT(S) APPLYING FOR

( ) A. State Lands

(X) B. Conservation District Use

( ) C. Withdraw Water From A Ground Water Control Area

( ) D. Supply Water From A Ground Water Control Area

( ) E. Well Drilling/Modification

IV. WELL OR LAND PARCEL LOCATION REQUESTED

District Hanalei

Island Kauai

County Kauai

Tax Map Key 5-4-1:1

Area of Parcel 77.5 Acres
(Indicate in acres or sq. ft.)

Term (if lease) Maximum Allowable

ENVIRONMENTAL ASSESSMENT

FOR THE

HANALEI RIVER
HYDROELECTRIC PROJECT

TABLE OF CONTENTS

TABLE OF CONTENTS CONTINUED

TABLE OF FIGURES

A. IDENTIFICATION OF APPLICATION

Island Power Company, Inc., a Hawaii Corporation, whose business address is P.O. Box 625, Kalaheo, Kauai, Hawaii 96741; hereby applies to the State of Hawaii, Department of Land and Natural Resources for a permit to construct and operate a hydroelectric power facility on the Hanalei River located approximately 4 miles southeast of Princeville, Kauai, Hawaii TMK 5-4-1:1 and 5-4-2:3. The entire project will be located on land owned by the State of Hawaii which is zoned "Conservation District" Subzone, who's boundaries are identified as "K-6 Hanalei". The majority of land needed for the project is within Resource (R) subzone and a minor portion of the land is within Protective (P) subzone. The type of use requested is classified as a "Conditional Use".

The applicant will also utilize water which arises on the land mentioned above, for the purpose of generating electricity. The use of this water will be non-consumptive in nature.

The requested term for the lease of lands from the State of Hawaii is the maximum period allowed under current regulations.

B. DESCRIPTION OF PROPOSED USE AND STATEMENT OF OBJECTIVES

1. Proposed Use

The proposed Hanalei River Hydroelectric Project will make use of land and water owned by the State of Hawaii for the purpose of generating electricity. All of the land needed for the project has been designated Conservation District use, with the majority of land being within Resource (R) Subzone and a minor amount of land within Protective (P) Subzone.

The project will divert water from the Hanalei River by means of a concrete diversion weir approximately 10 feet high, at an elevation of 650 feet above MSL. The water will be conveyed through an above ground pressure penstock approximately 26,600 feet long, varying in diameter from 42 inches to 56 inches. Additional diverison of water will also be made from several of the larger tributaries to the Hanalei River on its westerly side.

The penstock will route the water to a powerhouse approximately 45' W X 50' L X 30' H, which will contain two pelton turbines and generators. The powerhouse will be situated on the westerly bank of the Hanalei River and will discharge the water back into the river just upstream from the China Ditch Diversion at an approximate elevation of 50 feet above MSL. A new above ground 69 KV transmission line approximately 4,200 feet long will interconnect to the existing Kauai Electric Transmission Line near the Hanalei Homesteads. The existing Kauai Electric Transmission Line will be upgraded to 69 KV, between the point of interconnection and the Princeville Substation, which is an approximate distance of 13,350 feet. The electricity will be sold to Kauai Electric, which will be distributed to their customers.

A new access road approximately 12 feet wide, will be constructed along the penstock route which will allow access from the existing road near the Hanalei Homesteads to the diversion weir. Continuous use of the lands for operation and maintenance of the proposed project will be necessary.

2. Statement of Objective

Unlike many new energy developments, the technology of hydropower has been firmly established. Over the past decade, hydropower as a renewable energy resource has rekindled interest for its role in alternative energy development nationally and in the State of Hawaii. The Island of Kauai, similar to most insular areas, is highly dependent upon petroleum-based fuels for the production of electricity. This condition has led to relatively high costs of energy production and reliance on a potentially volatile worldwide fuel market. The goal is to alleviate oil dependence in energy production and greater energy self-sufficiency for the Island of Kauai.

The economic aspects of the project are significant and beneficial. The benefits are derived solely from displacement of energy from Kauai Electric's system assuming fuel price escalation and power-on-line effective date of 1988. The project would contribute significantly toward the goals of alleviation of oil dependence and increased energy self-sufficiency. The Hanalei River Hydroelectric Project, as currently proposed, will cost $15 million to construct and would produce approximately 28.7 million kilowatt hours of electricity per year or about 9% of the total energy consumed on the island of Kauai. The Project would supplant the need to import 59,000 barrels of oil annually and service an equivalent of 5,400 households or 17,350 individuals, assuming the current rates of fuel oil utilization and household demands are maintained.

C. DESCRIPTION OF THE AFFECTED ENVIRONMENT

1. LOCATION

The Project is located in the upper reaches of the Hanalei Valley above the existing wildlife refuge on the Hanalei River. The Project begins at river mile 5.2. The powerhouse will be located approximately 5.2 miles from the mouth of the Hanalei River at Hanalei Bay. The diversion weir will be constructed on the Hanalei River approximately 11.1 river miles upsteam from the mouth of the confluence with the Kaapoko Stream at an approximate elevation of 650 feet msl. An above-ground pipeline varying in diameter from 42 inches to 56 inches and approximately 26,600 feet long will convey the water from the new diversion weir to the powerhouse. The flow from the powerhouse will be discharged and returned to the natural channel of the Hanalei River just upstream of the China Ditch diversion and well upstream of the wildlife refuge. Location maps and plans are included in Section N of this Application.

2. TOPOGRAPHY

The Project lies in steep, rugged mountainous terrain bordering the Hanalei River. The Project will follow along the length of the Hanalei River. Maps showing the topography of the area are included in Section N. A more thorough discussion of the topograpy in the project area is found in Section F of this Report.

3. SITE IMPROVEMENTS

The only land improvements in the exsiting Project boundary include trails for hiking and hunting. A diversion from the Hanalei River to the Wailua River exists approximately one-half mile above the Project and taro farms and homesteads exist below the site. However, within the site boundary there are no site improvements. The China Ditch diversion is located immediately below the Project below the point where the flow returns from the powerhouse to the natural Hanalei River channel. A more thorough discussion of site improvements is found in Section E -- Existing Utilities, Access and Use.

4. EXISTING UTILITIES

There are no existing utilties in the Project boundary. However, there are utilities in the vicinity immediately below the Project. The area below the Project is consists of existing taro farms and homesteads and utilities serve the homesteads. There is also a Hanalei substation which lies approximately one-half mile below the Project. Power from the Project will intertie into the existing substation. A more thorough discussion of site improvements is found in Section E -- Existing Utilities, Access and Use.

5. VEGETATION

The vegetation on the project area presents a mosaic of different vegetation types, principally the result of past disturbances and of topographic features.

The upper one-half portion of the project area is the least disturbed, the vegetation along the bottom of valley and along the streamside is a mixture of native and introduced plant species. The valley narrows in this portion of the project area and, in some places, the steep valley slopes come down to the streamside. On these steeper slopes the vegetation is composed principally of native rain forest species. Here one may find an open to closed 'ohi'a forest (Metrosideros collina ssp. polymorpha), 7 to 10 meters tall. Other native species found in this forest include hame (Antidesma spp.), 'ahakea (Bobea sp.), kawa'u (Ilex anomala), papala-kepau or aulu (Pisonia spp.), manono (Gouldia terminalis), 'ama'u (Sadleria cyatheoides), and hapu'u (Cibotium spp.).

Extensive areas on some of the steeper slopes are covered by dense mats of uluhe fern (Dicranopteris spp.) with a few scattered 'ohi'a trees.

On the lower portion of the study area introduced species increase and are dominant. Along the streamside, guava (Psidium guajava) scrub, 3 to 6 meters tall, forms the dominant vegetation. Locally common in some of the more broad, level places along the stream are dense thickets of lantana (Lantana camara). California grass (Brachiaria mutica) is the most abundant ground cover in this section of the project area along the stream.

Parts of the valley bottom, especially along the streamside, were no doubt cultivated at some time by the Hawaiians. Plants introduced or used by the Hawaiians are occasionally encountered on the project area. These include taro (Colocasia esculenta), mai'a or banana (Musa X paradisiaca), 'ohe or bamboo (Schizostachym glaucifolium), hau (Habiscus tiliaceus), ti (Cordyline terminalis), 'awa (Piper methysticum), and 'ohi'a-'ai or mountain apple (Syzygium malaccensis).

A report on the flora found on the project area will be prepared for the Environmental Impact Statement (EIS) which is required for this project. A botanical survey to inventory the flora, describe the major vegetation types, and search for species considered rare, threatened or endangered by the federal and state governments will be conducted. Potential environmental problems or concerns regarding the effects of the proposed project (construction activities and infrastructures) on the vegetation, as well as the reduced water flow on the surrounding vegetation, will be discussed in the EIS.

6. ARCHEOLOGICAL/HISTORICAL SITES

A two-day field reconaissance of the proposed project area did not disclose any sites of archeological or historical significance in the immediate project boundary. However, there are evidences of taro farming and other uses throughout the lower reaches of the Hanalei Valley. A comprehensive archeological and historical investigation of the entire project area is planned for later this summer. The results of this report will be forwarded to the Department and will be included in the Environmental Impact Statement completed for the Project.

7. WILDLIFE

AMPHIBIANS AND REPTILES

There are no endemic amphibians or land reptiles in the Hawaiian Islands. All, therefore, have been introduced (either intentionally or accidentally) by man. None are endangered species and none are of significance for an environmental impact assessment study.

AMPHIBIANS

1. American Bullfrog, Rana catesbeians

This "was probably one of the first species of amphibians to be introduced into the Hawaiian Islands and may have been one of the frogs that was imported prior to 1867." Bullfrogs are serious predators on the small downy young of the endangered Hawaiian waterbirds.

2. Wrinkled Frog, Rana rugosa

This frog was introduced to Hawaii from Japan in 1986 (McKewon, 1978). It is most common in mountain streams. The wrinkled frog is common in the river at higher elevations.

3. Giant Neotropical Toad, Bufo marinus

This toad was first introduced to the islands in 1932, "when Dr. C.E. Pemberton brought 148 adult toads from Puerto Rico. "In a little over two years more than 100,000 descendents of the original stock were distributed through Dr. Pemberton's activities throughout the islands." This toad is "the commonest species of amphibian" in Hawaii. These toads are active primarily at night, and is undoubtedly is found along the Hanalei River.

REPTILES

1. Blind Snake, Typhlina bramina

"This small, secretive snake was apparently introduced from the Phillipines in the dirt surrounding plants that were brought in for landscaping the campus of the Kamehameha Boys School in Honolulu. These blind, worm-like snakes are rarely seen until they are flooded from underground burrows by heavy rains or unless one looks for them under branches and leaf litter on the ground.

2. Skinks and Geckos

Eight species of skinks (family Scincidae) and geckos (family Gekkonidae) are found on Kauai, although one species (azure-tailed skink, Emoia cyanura) is now thought to be rare there.

BIRDS OF THE LOWER HANALEI RIVER SYSTEM

Three general groups of birds occur in the Hawaiian Islands: 1) Endemic birds ae those that are unique to Hawaii and occur naturally nowhere else in the world (Berger, 1981); 2) Indigenous or Native birds, those whose total range in the Pacifica Basin includes the Hawaiian Islands; and 3) Introduced or alien birds, those brought to the islands by man. I refer to the "Lower Hanalei River System" because our observations were made from approximately 1,250 feet downward.

ENDEMIC BIRDS

ORDER ANSERIFORMES, FAMILY ANATIDAE, DUCKS, GEESE AND SWANS

Koloa or Hawaiian Duck, Anas wyvilliana

This endangered species occurred on all of the main islands except Lanai and Kahoolawe into the 1940's. Birds inhabit both lowland areas (e.g., the Hanalei taro patches and the refuge) and mountain streams.

Pueo or Hawaiian Short-eard Owl, Asio flammeus sandwicheniss

The Pueo is a permanent resident on all main islands. On Kaui it has been found in relatively dry areas as well as in the ohio rain forest at Kokee and the upper reaches of the Waialae stream. The steep slopes along the sides of the river do not provide either habitat for foraging for or for nesting.

ORDER PASSERIFORMES, FAMILY DREPANIDIDAE, HAWAIIAN HONEYCREEPERS

This is Hawaii's unique bird family. However, approximately 40 percent of the species are extinct and another 40 percent are classified as threatened or endangered. The vast majority of honeycreeper species occur well above 1,000 feet on Kauai: for example, at Kokee State Park and the Alakai Swamp region. They do not adapt well to exoctic vegetation, and all nests of the two common species (Amakihi, Apapane) found on Kauai have been built in ohila trees (Berger, 1981). No honeycreepers were seen during two days along the Hanalei River, however, two species have been seen along the Wainiha River during December, 1982.

Amakihi, Hemignathus virens stejnegeri

The Amakihi was described scientifically in 1782, but the first nest of the Kauai race was not found until 1964 (Berger, 1981). The species is most comon in the ohia forests of the Kokee and Alakai Swamp regions (Richardson and Bowles, 1964).

Apapane, Himatione sanguinea

This undoubtedly is the most abundant of the surviving species of honeycreepers. This species typically inhabits ohia-koa forests.

In any event, the proposed project should have no adverse effect on any honeycreeper because the large number of introduced plant species up to, and beyond, the 1000 foot elevation does not provide adequate habitat for the nesting activities of these birds, and the majority of Kauai honeycreepers inhabit ohia-koa forests well above 1000 feet elevation.

INDIGENOUS BIRDS

These birds are native to the Hawaiian Islands but are not unique to them. In this category are 22 species of sea birds, the Hawaiian Black-crowned Night Heron, and a number of migratory species that spend their winter or nonbreeding season in the islands. I have been unable to find any evidence that any of the sea birds or the heron inhabit the upper reaches of the Hanailei River. I did find two of the winter residents there.

ORDER CHARADRIIFORMES, FAMILY SCOLOPACIDAE, SANDPIPERS, CURLEWS, AND SNIPE

1. Wandering Tattler, Hetersscelus incanus

This species is a regular winter resident in the Hawaiian Islands.

FAMILY CHARADRIIDAE, PLOVERS

INTRODUCED OR ALIEN BIRDS

ORDER CICONIIFORMES, FAMILY ARDEIDAE, HERONS AND EGRETS

1. Cattle Egret, Bubulcus ibis

ORDER GALLIFORMES, FAMILY PHASIANIDAE, PHEASANTS, QUAIL, FRANCOLINS

2. Ring-necked Pheasant, Phasianus colchicus

According to the Division of Forestry and Wildlife, Unit C, "includes many small ridges of improved pasture interlaced with gullies of thick vegetation". "Ring-necked pheasants, Japanese quail, lace-necked doves and barred doves may be havested here."

ORDER COLUMBIFORMES, FAMILY COLUMBIDAE,
PIGEONS AND DOVES

3. Lace-necked or Spotted Dove, Streptopelia chinensis

The species now is common to abundant on all main islands and, like the other doves in Hawaii, is classified as a game bird.

The Lace-necked Dove is common in residential areas, in dry kiawe habitat, in pasture and agricultural land, and in open areas in the mountains.

4. Barred Dove, Geopelia striata

It has been a remarkably successful introduction and it now is abundant on all of the islands.

Doves avoid dense forests; they are common in residential areas, cutover fields, pasture, and along jeep trails wherever there is a supply of weed seeds. It occurs in the lower regions of the valley.

ORDER STRIGIFORMES, FAMILY TYTONIDAE, BARN OWLS

5. Barn Owl, Tyto alba pratincola

Barn Owls were brought to the islands (1958 through 1963) in the hopes that they would control rats in the sugarcan fields. The did not. Barn Owls in Hawaii often roost and nest in small caves on steep cliffs.

ORDER PASSERIFORMES, FAMILY TIMALIIDAE,
BABBLERS AND LAUGHING-THRUSHES

6. Medolious Laughing-trush, Garrulax canorus

7. Red-billed Leiothrix, Leiothrix lutea

The species was first imported from San Francisco for liberation on Kauai in 1918; birds from the same source were released on Oahu in 1928, and that same year other birds were imported from the Orient and released on Oahu. This species is generally very hard to find on Kauai.

FAMILY TURDIDAE, THRUSES AND BLUEBIRDS

8. Shama, Copsychus malabaricus

FAMILY ZOSTEROPIDAE, WHITE-EYES AND SILVER-EYES

9. Japanese White-eye, Zosterops j. japonicus

FAMILY STURMIDAE, STARLINGS AND MYNAS

10. Common Indian Myna, Acridotheres tristis

MAMMALS

ENDEMIC MAMMALS

The only endemic Hawaiian land mammal is the Hawaiian bat (Lasiurus cinereus semotus), a subspecies of the American hoary bat. The Hawaiian bat occurs primarily on the island of Hawaii.

INTRODUCED MAMMALS

All of these alien species have proven highly detrimental to man, his buildings, products, some of his agricultural crops, as well as to the native forests and there animal life.

Some of these mammals were first brought to the islands by Captians Cook and Vancouver. Feral cattle, goats (Capra hircus), sheep (Ovis aries), and pigs (Sus scrofa) have been destroying the Hawaiian forests since 1800, and they continue to do so today. Pig trails, wallows, and other signs were conspicuous at all elevations along the Hanalei River.

With the possible exception of the house mouse (Mus musculus), all of the smaller introduced mammals prey on birds and their nests and eggs. These small mammals include the roof rat or black rat (Rattus rattus), Polynesian rat (Rattus elegans), Norway rat (Rattus norvegicus), and the small Indian mongoose (Herpestes auropunctatus), as well as feral cats (Felis catus), and feral dogs (Canis familiaris). The diurnal mongoose is readily seen on the other islands, and, although mongooses were apparently sighted on Kauai several years ago, we did not find any in the remote area.

8. FISHERIES

NATIVE FISHES IN HANALEI RIVER, KAUAI, AND THE POTENTIAL IMPACT OF HYDROELECTRIC DEVELOPMENT: A PRELIMINARY STUDY

Amadeo S. Timbol
Kauai Community College
3-1901 Kaumualii Highway
Lihue, Kauai, Hawaii 96766

and

Donald E. Heacock
Division of Aquatic Resources
Department of Land and Natural Resources
P. O. Box 1671
Lihue, Kauai, Hawaii 96766

ABSTRACT

Hanalei River is among the top ten pristine streams in the State (Timbol 1977). Seven fish species reside in the river. Five are endemic. One endemic is considered depleted on other islands (Miller 1972), except on Kauai where it supports a seasonal fishery jointly exploited by commercial and recreational fishermen. A hydroelectric facility is proposed to be built which will affect the habitat of these endemics. Potential adverse impacts include blockage of diadromous fish migration, dewatering of about 6 km of mainstream out of a total of 18 km, and mortality of fish, eggs and larvae related to the operation of the hydroelectric facility. Mitigative measures suggested are continuous water flow over the diversion weir, installing a "fish chute" and fish screen, minimum instream flow of 36 cfs, avoiding plant operation during peak fish migration, and replacing fish stocks with hatchery reared fish.

INTRODUCTION

The native Hawaiian freshwater fishes are unique, having evolved on small, geographically isolated land masses. There are only five freshwater native fishes, four of which are endemic. Apart from their socio-economic values, these endemics have intrinsic biological values (Parrish et al. 1978). Any resource development plans that may impact their limited, insular freshwater habitat must be considered carefully, including cumulative impacts.

Hanalei River on the island of Kauai is one of the most pristine streams in the State based on faunal inventory, species composition and diversity (Timbol 1977). There is now a proposal to divert water from the Hanalei River in order to generate electricity. Our purpose is threefold. First, to gather, interpret, and integrate existing biological data on the distribution and relative abundances of fishes in the Hanalei River. Second, to determine the possible impacts that the construction and operation of the hydroelectric facility will have on the native fishes. Third, to suggest mitigative measures to ensure the survival of these economically and biologically important fishes in the Hanalei River.

Previous work on Hanalei River involved the ecology of aquatic macrofauna (Timbol 1977), and an environmental impact assessment for the Hanalei National Wildlife Refuge located adjacent to the lower reaches of the stream (Wilson Okamoto and Associates 1979). A related study dealt with food sources of endangered waterbirds in the Hanalei National Wildlife Refuge (Broshears and Moriarty 1979).

The opinions, findings, conclusions, or recommendations in this paper are those of the authors and do not necessarily reflect those of the Kauai Community College or the Department of Land and Natural Resources.

Physiography and Climate

Hanalei Valley is located on Kauai's north shore. It is long, relatively narrow, and extends from the sea to Mount Waialeale. For the first 13 km the valley floor ascends to an elevation of only 180 m. In the remaining 5 km, the valley floor rises to 1,500 m. Its width varies from 3 to 5 km. The drainage area is about 60 km^2.

Annual rainfall varies from about 200 cm near the coastline to about 1,000 cm at the head of the valley (Taliaferro 1959). The average monthly air remperature is in the lower 20's (°C). The average wind velocity is about 11 km/h and blows predominantly from the east (Ramage and Oshiro 1977).

Hanalei River and Location of Proposed Facility

Long term flow rate for Hanalei River average 227 cfs. In 1975, flows varied from 24 cfs to 21,600 cfs. According to USGS records, flows in excess of 36 cfs occur 99.2% of the time (USGS 1976).

The proposed hydropower facility is shown in Fig. 1. The location of the diversion weir, penstock, and powerplant in relation to the stream channel and drainage basin are shown in this figure. Surface flow will be diverted at 195 m elevation, conveyed through a penstock (pipe) for about 6 km and released downstream as tailwater after passing through turbines in the powerhouse located at about 35 m elevation.

MATERIALS AND METHODS

Data used in this paper were collected in 1977 and 1982. The 1977 data (Timbol 1977) were obtained by electroshocking and the 1982 data by underwater visual observations (Heacock, unpublished). The effectiveness of electroshocking on warmwater fishes is discussed by Larimore (1966), and in insular streams by Maciolek and Timbol (1980). Advantages of fish observations using snorkel gear over electroshocking are discussed by several authors (Northcote and Wilkie 1963, Goldstein 1978, and Zalewski 1985). Also, potential sources of bias using electroshocking to sample fish are discussed by Maciolek and Timbol (1980), while those for snorkeling methods are discussed by Griffith and Schill (in press).

The resulting list of fishes observed in the Hanalei River was checked for endangered and threatened species using the following publication list: Deacon *et al*. (1979), USFWS List of Endangered and Threatened Species (1977), and Miller (1972).

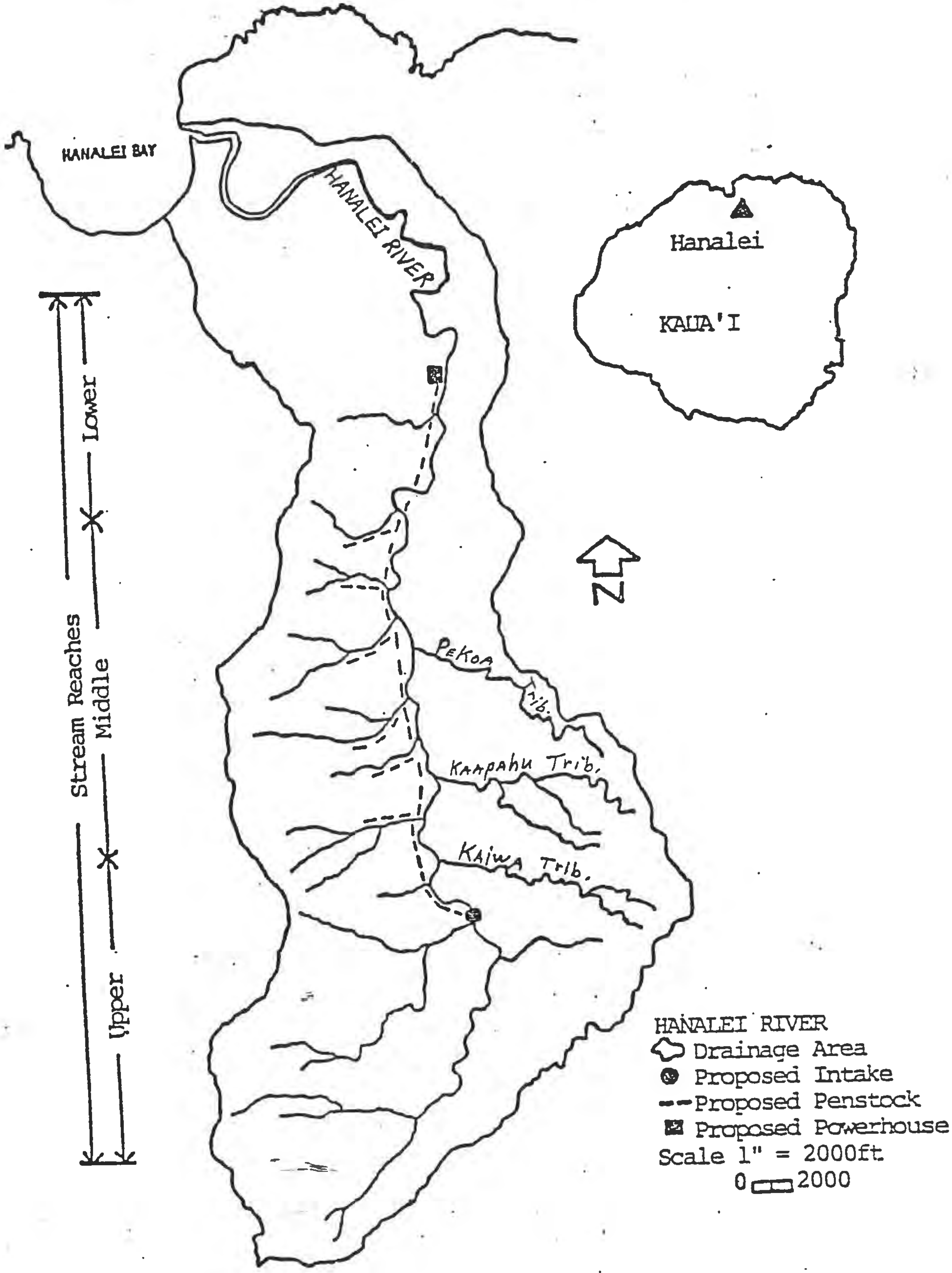


FIGURE 1. Map of Hanalei River, Kaua'i, showing proposed hydropower facility.

Terms used in the text are: depleted, which means that the organisms are still found in numbers adequate for survival but have been heavily depleted and continues to decline substantially (Miller 1972); rare are those not under immediate threat of extinction but occur in small numbers; endangered are those that are actively threatened with extinction; and threatened species include those which are depleted, rare, or endangered. Additional terms needing clarification are: endemic, which means occuring naturally in Hawaii only; indigenous means occurring naturally in Hawaii and elsewhere; native includes both indigenous and endemic; and alien means that the animal was brought to Hawaii either accidentally or intentionally.

For purposes of this report, abundant (+++) means many individuals, from 6 to 20 or more, were observed per 20 m^2 (standard) sampling area. Common (++) indicates that between 2 and 5 were observed or caught, while uncommon (+) means that only one was sighted or caught, and absent (0) means it was neither seen nor collected.

Distribution and Relative Abundances

Data collected five years apart show seven fish species: 3 are endemic, 2 indigenous, and 2 alien (Table 1). The most important component of the fish community is the 'o'opu-nakea (*Awaous stamineus*) which is listed as threatened (Deacon *et al*. 1979, Miller 1972). A decline in its population density is a good indication of serious stream degradation.

The 'o'opu-nakea is the largest (up to 35 cm) of the freshwater gobies and it is found in all stream reaches, from sea level to the head waters at 500 m elevation. The life history of this endemic goby has been studied by Ego (1956) and is illustrated in Fig. 2. During their spawning season (August through December) 'o'opu-nakea migrate downstream and deposit their eggs on stones in the lower reaches of the stream. The eggs hatch in 24 hours and the larvae are carried out to sea by water currents. The larvae spend between 4 and 7 months in the ocean as part of the zooplankton. They return to streams as transparent fry (postlarvae) and start upstream migration to their places of permanent residence where they attain sexual maturity in a year. The 'o'opu-nakea is an obligately diadromous animal and needs suitable environmental conditions throughout the stream channel to enable both its larvae to drift downstream to reach the sea, and its postlarvae to migrate upstream. On Kauai, the 'o'opu-nakea supports a seasonal (April through December), joint recreational and commercial fishery.

Two other native gobies are found in Hanalei River: the indigenous 'o'opu-naniha (*Awaous genivitatus*) and the endemic 'o'opu-nopili (*Sicyopterus stimpsoni*). The former is small (up to 15 cm) and characterized by a broad, slanting blotch extending from below the eye downward and backward across the cheek. It lives primarily in brackish water in the lower reaches of the river, but has been observed 1.5 km above the estuary. The 'o'opu-nopili grows to 18 cm, is found in all stream areas, but mostly in the lower reaches. 'O'opu-nopili females can produce several thousand eggs (Tomihama 1972). The larvae are swept to sea, become planktonic, then metamorphose into postlarvae at stream mouths and begin their upstream migrations; a life cycle essentially the same as that of the 'o'opu-nakea. The

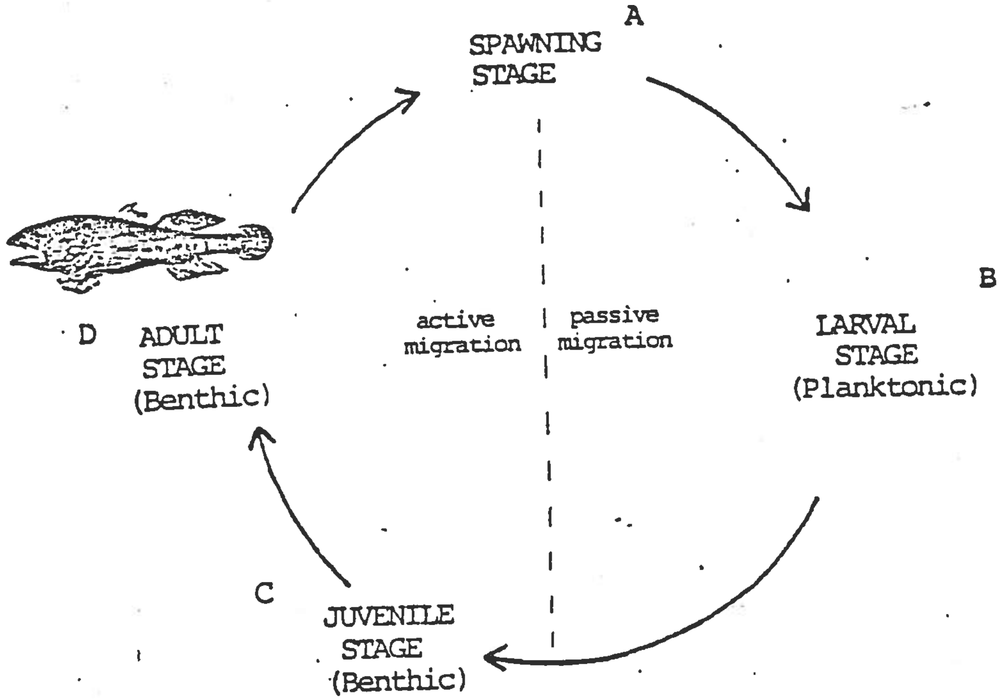
TABLE 1. Fishes in the Hanalei River, Kauai.

Scientific Name	Local Name	Origin	Listing[1]
1. *Awaous stamineus*	'o'opu nakea	endemic	depleted on Oahu[2], special concern[3]
2. *Awaous genivitatus*	'o'opu naniha	indigenous	none
3. *Sicyopterus stimpsoni*	'o'opu nopili	endemic	none
4. *Eleotris sandwicensis*	'o'opu akupa	endemic	none
5. *Kuhlia sandvicensis*	aholehole	endemic	none
6. *Sarotherodon mossambicus*	tilapia	alien	none
7. *Xiphophorus helleri*	swordtail	alien	none

[1] Considered as endangered of threatened in official register or scientific publication.

[2] Depleted means the species still occurs in low numbers but continues to decline at a rate substantially greater than can be sustained (Miller, 1972).

[3] Deacon *et al.* (1979).



A - Spawning takes place on rocks in estuaries during the months of August through November. Eggs are laid on rocks and guarded by the adults. Eggs hatch in about 24 hrs and larvae are passively swept to sea (Ego 1956).

B - Larvae (hinana) are translucent, surface-swimming, and are passively transported inter-island and inter-stream by ocean currents. The larval stage lasts about 4 to 6 months (Ego 1956).

C - Juvenile fish are benthic and actively migrate upstream with the aid of their fused pelvic fins which function as a ventral, suctorial organ.

D - Adults actively migrate downstream during the months of August through November, assisted by heavy freshets, and spawn on rock substrate in the estuarine portion, or extreme lower reaches, of the stream.

FIGURE 2. Life history of 'o'opu-nakea, *Awaous stamineus*.

'o'opu-nopili, because it requires clean fresh water flowing in considerable volume through a comparatively unaltered stream channel, and since it is not subject to harvesting (as is the 'o'opu-nakea), has been suggested by Timbol and Maciolek (1978) as an indicator species for a pristine stream.

The absence of certain animals in a particular habitat, such as Hanalei River, could be as ecologically significant as their presence. Absent in Hanalei River was the endemic goby, 'o'opu-alamo'o (Lentipes concolor), a threatened species (Deacon et al. 1979).

Table 2 compares the relative abundances of the seven fish residents. There was no species decline or increase from 1977 through 1982. Two species ('o'opu-nakea and 'o'opu--nopili) are found in all reaches of the stream. They, however, are more abundant (+++) in the lower reaches. Their population densities decline with elevation: common (++) in the middle reaches and uncommon (+) in the upper reaches.

The 'o'opu-naniha and 'o'opu-okuhe (Eleotris sandwicensis) are found primarily in the lower reaches, but also extend into the middle reaches of the river (see Fig. 1). The distributional pattern of these two species is a function of the river basin topography. The river profile is gently sloping for the first 5 km. However, in the remaining 2 km the valley floor climbs rapidly (Wilson Okamoto and Associates 1979). Thus, even the 'o'opu-okuhe, which lack the fused suctorial fins of gobiid fishes, and the 'o'opu-naniha, a goby which prefers slow flowing water, are able to inhabit the middle reaches of Hanalei River.

The tilapia (Sarotherodon mossambicus), an alien species, fortunately is still found only in the lower reaches of the stream. Tilapia are believed to be important competitors with, and possibly predators of, the native stream biota (Maciolek 1984). Additionally, the live-bearing swordtail (Xiphophorus helleri) is found in both lower and middle reaches, and has also been able to invade the upper reaches of the river.

There appear to be no significant differences between the relative abundances in 1977 and 1982 (Table 2). Apparent difference, however, in the abundances of 'o'opu-okuhe and tilapia (rows 4 and 5) is a function of data collection methods used in 1977 (electroshocking) and 1982 (snorkeling, see Materials and Methods) and behavior of these fishes. The 'o'opu-okuhe are cryptic and hide under boulders and other materials when disturbed. As a result, direct underwater observations using snorkel gear tend to underestimate the abundance of this species. Similar observations regarding cryptic species have been made in U.S. mainland streams (Platt, Megahan and Minshall 1983). In contrast, 'o'opu-okuhe is extremely susceptible to electroshocking (Maciolek and Timbol 1980). It is therefore, not surprising that 'o'opu-okuhe abundance was underestimated in the data collected in 1982.

The tilapia, on the other hand, is an ideal fish to estimate by visual methods because it holds its territory even in the presence of an underwater observer. In contrast, the effect of electroshocking on tilapia range from disturbance to only some immobilization (Maciolek and Timbol 1980). Thus, tilapia are likely to be underestimated in the electroshocking data (lower, 1977 column).

TABLE 2. Relative abundances of fishes in Hanalei River, Kaua'i.

Stream Reaches: (elevation in meters)	Upper (365-427M)		Middle (122-183M)		Lower (6-60M)	
	1977[1]	1982[2]	1977[1]	1982[2]	1977[1]	1982[2]
1. *Awaous stamineus*	+	(x)	++	(+++)	+++	(+++)
2. *Awaous genivitatus*	0	(x)	0	(+)	++	(++)
3. *Sicyopterus stimpsoni*	+	(x)	+	(++)	++	+
4. *Eleotris sandwicensis*	0	(x)	0	(+)	+++	(+)
5. *Kuhlia sandvicensis*	0	(x)	0	(0)	++	(++)
6. *Sarotherodon mossambicus*	0	(x)	0	(0)	+	(+++)
7. *Xiphophorus helleri*	0	(x)	+++	(+++)	+++	(+++)

[1]Samples collected by electroshocking methods, July-August, 1977 (Timbol and Environmental Impact Studies Corp., 1977).

[2]Sampling done by underwater observations (ie. snorkeling methods), June, 1982, (Heacock, unpubl.).

Legend:
(x) = no data available
0 = absent
+ = uncommon
++ = common
+++ = abundant

Potential Adverse Impacts and Mitigative Measures

The potential adverse impacts of hydropower development on fishery resources on the U.S. mainland have been studied by Rochester, Lloyd and Farr (1984) and Boreman (1977). No definitive studies have been done to access the potential impacts hydroelectric facilities may have, or are having, on the Hawaiian stream biota. Timbol (1977, 1983) and USFWS (1978) have done short term studies.

There are at least three major concerns relative to the proposed hydropower facility in Hanalei River. These are: 1) the potential blockage of diadromous fish migration, 2) reduction of instream flow due to water diversion, and 3) mortality of fish passing through penstock and turbines.

In order to divert water to power the turbines, a diversion weir will be built across the river. The weir may form a physical barrier to both upstream migration of the juvenile gobies and the downstream migration of the spawning adults (e.g. 'o'opu-nakea, Awaous stamineus). Although no definitive studies have been made on the effects of such weirs on the 'o'opu-nakea, similar installations have reduced or eliminated anadromous fish populations in many drainage basins elsewhere (Baxter 1977).

Mitigative measures to ensure upstream and downstream fish migration include that ample water be left flowing over the weir at all times (e.g. 12 cfs according to Wilson Okamoto and Associates 1979). To compliment this "ample flow", a "fish chute" should be designed into the downstream face of the weir to facilitate upstream movement of these benthic fishes. Okamoto and Associates (1979) recommended that a fish chute should have a 1:4 slope and be covered with river rocks. Other fish-passage structures have been suggested in order to facilitate fish migration around weirs (Cramer and Oligher 1964, Boreman 1977, Ruggles 1980, Gloss and Wahl 1983).

The diversion of water will reduce instream flow in about 6 km of the channel between the intake upstream and the release downstream. Surface water flow in this dewatered section will be limited to the amount supplied by seepage, ground water and tributary streams (e.g. Kaiwa Stream, Pekoa Stream). This reduction in flow could result in sediment accumulation, stagnant pools, and elevated water temperatures. There will also be the loss of aquatic habitat, and a possible decrease in the carrying capacity of the stream.

Mitigative measures include ensuring enough instream flow to protect the diadromous fishes. This flow should be no less than the natural minimum flow of the river which is 36 cfs (USGS 1976). Studies on minimum instream flow requirements of Hawaiian native gobies are now underway (Kinzie et al. 1984 , Kinzie and Ford 1982).

The effects of entrainment in penstocks on Hawaiian native fishes have not been studied, although hydroelectric facilities in Hawaiian streams have been in place for some time (e.g. Wainiha River Hydroelectric facility was built in 1906). In a study of fingerling salmon, the U.S. Army Corps of Engineers (1960) found that if the penstock contains air and the fingerlings become acclimated to increased pressure, they may be killed during rapid decompression. Mitigative measures include keeping the fish out of the penstock with the use of fish screens, wing-deflectors, and other structures (Boreman 1977) in order to minimize entrainment by ensuring fish passage around the weir.

In addition to high pressures in the penstock, entrained fish are killed instantaneously as they hit turbine blades or sustain injuries which result in delayed mortality (Rochester, Lloyd and Farr 1984). Delayed mortality is related to stress, physiological deterioration and increased predation. Eggs and early larval stages of fish and other aquatic organisms are particularly vulnerable to entrainment (Boreman 1977).

In order to minimize turbine-induced fish mortality, intake structure design and location must allow for the downstream passage of fish without entrainment into the weir (Boreman 1977). Also, plant operation should be avoided during peak fish migrations.

Finally, fish stocks lost due to the development of hydroelectric facilities can be replaced by hatchery-reared fish (Rochester, Lloyd and Farr 1984). The aquaculture and release of 'o'opu-nakea into streams has great potential for fishery enhancement and should be investigated.

LITERATURE CITED

Baxter, R.M. 1977. Environmental effects of dams and impoundments. Ann. Rev. Ecology and Systematics 8:255-283.

Boreman, J. 1977. Impacts of power plant intake velocities on fish. FWS/OBS-76/20.1. USFWS, National Power Plant Team, Power Plant Project, Ann Arbor, Michigan.

Broshears, R. and D. Moriarty. 1979. Aquatic habitat and aquatic food sources for endangered waterbirds at Hanalei National Wildlife Refuge. Unpublished report.

Cramer, F.K. and R.C. Oligher. 1963. Passing through hydraulic turbines. Trans. Am. Fish. Soc. 93:243-259.

Deacon, J.E., G. Kobetich, J.D. Williams, S. Contreras and others. 1979. Fishes of North America: endangered, threatened, or of special concern. Trans. Am. Fish. Soc. 101:239-252.

Ego, K. 1956. Life history of freshwater gobies. Freshwater Game Fish Management Research Project No. F-4-R. Honolulu. Terr. Haw.

Gloss, S.P. and J.R. Wahl. 1983. Mortality of juvenile salmonids passing through Ossberger crossflow turbines at small-scale hydroelectric sites. Trans. Am. Fish. Soc. 112:194-200.

Goldstein, R.M. 1978. Quantitative comparison of seining and underwater observation for stream fishery surveys. Prog. Fish Cult. 40(3): 108-111.

Gosline, W.A. and V.E. Beck. 1965. Handbook of Hawaiian Fishes. Honolulu: Univ. of Hawaii Press. 372pp.

Griffith, J.S. and D.J. Schill. In press. Underwater observations as a technique for assessing fish abundance in large western rivers. Trans. Am. Fish. Soc.

Kinzie, R.A., III, and J.I. Ford. 1982. Population biology in small Hawaiian streams. WRRC Technical Report No. 147. Prepared for U.S. Dept. of Interior, Water Resources Research Center, Univ. of Hawaii at Manoa, Honolulu, Hawaii. 60pp.

Kinzie, R.A.,III, J.I. Ford, A.R. Yuen, and S.J.L. Chow. 1984. Habitat utilization curves for native Hawaiian stream fishes. WWRC Special Report No. 6:20:84. Interim Progress Report for Div. of Water and Land Dev., Dept. of Land and Natural Resources. Water Resources Research Center, Univ. of Hawaii at Manoa. Honolulu. 68pp.

Larimore, R.W. 1969. Fish population and electrofishing success in a warm-water stream. J. of Wildl. Management 25(1):1-12.

Maciolek, J.A. 1984. Exotic fishes in Hawaii and other islands of oceania, 131-161. In: W.R. Courtney, Jr. and J.R. Stauffer, Jr. (eds). Distribution, biology and management of exotic fishes. John Hopkins Press, Baltimore.

Maciolek, J.A. and A.S. Timbol. 1980. Electroshocking in tropical insular estuary. Prog. Fish Cult. 42(1):57-58.

Miller, R. 1972. Threatened freshwater fishes of the United States. Trans. Am. Fish. Soc. 101:239-252.

Northcote, T.G. and D.W. Wilkie. 1963. Underwater census of stream fish populations. Trans. Am. Fish. Soc. 92(2):145-151.

Parrish, J.D., J.A. Maciolek, A.S. Timbol, C.B. Hathaway, Jr. and S.E. Norton. 1978. Stream channel modification in Hawaii. Part D: Summary Report. FWS/OBS-78/19. USFWS National Stream Alteration Team, Columbia, Missouri. 18pp.

Platts, W.S. W.F. Megahan, and G.W. Minshall. 1983. Methods for evaluating stream, riparian and biotic conditions. General Technical Report INT-138. Ogden, UT: U.S. Dept. of Interior, Forest Service, Intermountain Forest and Range Experiment Station. 70pp.

Ramage, C.S. and N.E. Oshiro. 1977. Kauai Wind Power Survey. Dept. of Meteorology, Univ. of Hawaii at Manoa.

Rochester, H. Jr., T. Lloyd, and M. Farr. 1984. Physical impacts of small-scale hydroelectric facilities and their effects on fish and wildlife. U.S. Fish and Wildl. Serv. FWS/OBS-84-19. 191pp.

Ruggles, C.P. 1980. A review of downstream migration of Atlantic salmon. Canad. Fish and Aquatic Sciences Tech. Rept. 952.

Taliaferro, W. J. 1959. Rainfall of the Hawaiian islands. Rep. No. R12. Hawaii Water Authority, Honolulu, Hawaii.

Timbol, A.S. for EDAW Inc. 1983. A survey of aquatic macrofauna in Wainiha River, Kauai. Environmental Impact Statement on Wainiha Hydroelectric Project. McBryde Sugar Co. Ltd. Eleele, Kauai. 15pp.

Timbol, A.S. for Environmental Impact Study Corp. 1977. A report on the aquatic survey of stream macrofauna for the hydroelectric power study for Hawaii. Report prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Honolulu, Hawaii.

Timbol, A.S. and J.A. Maciolek. 1978. Stream channel modification in Hawaii. Part A: Statewide inventory of streams; habitat factors and associated biota. FWS/OBS-78/16, U.S. Fish and Wildl. Serv. National Stream Alteration Team, Columbia, Missouri. 157pp.

Tomihama, M.T. 1972. The biology of Sicydium stimpsoni: a freshwater goby endemic to Hawaii. B.S. (Honors) thesis, Univ. of Hawaii at Manoa, Honolulu.

U.S. Army Corps of Engineers. 1960 Effects of structures at main Columbia River dams on downstream migration of fingerlings, 46-64. In: Progress report on fisheries engineering program. North Pacific Division, U.S. Army Corps of Engineers. Portland, Oregon.

U.S. Dept. of the Interior, Fish and Wildl. Serv., Ecological Services Division, "Hydroelectric Power Study," Honolulu, Hawaii, Mimeo. Report, September 1978. 37pp.

U.S. Fish and Wildl. Serv. 1977. Endangered and Threatened Wildlife and Plants. Republication of list of species. Federal Register Vol. 42, No. 135. Part V. July 14, 1977. pp. 36420-36431.

U.S. Geological Survey. 1976. Water Resources Data for Hawaii and Other Pacific Areas. Water Year 1975. USGS Water Data Rept. HI-75-1. USGS Wat. Res. Div., Honolulu. 401pp.

Wilson Okamoto and Associates, Inc. 1979. Environmental Impact Assessment, Hanalei National Wildlife Refuge. U.S. Fish and Wildlife Service, Honolulu.

Zalewski, M. 1985. The estimate of fish density and biomass in rivers on the basis of relationships between specimen size and efficiency of electroshocking. Fish. Res. 3:147-155.

D. GENERAL DESCRIPTION OF THE TECHNICAL, ECONOMIC, SOCIAL AND ENVIRONMENTAL CHARACTERISTICS OF THE PROPOSED USE.

1. Technical

Island Power Company, Inc. proposes to construct and operate a hydroelectric powerplant on the Hanalei River, Island of Kauai, State of Hawaii. The project will cost approximately $15 million dollars to construct and will generate about 28.7 million kilowatt hours of electricity per year. The powerplant will have a maximum generating capacity of approximately 6,000 kilowatts with a maximum hydraulic capacity of 165 cubic feet per second ("cfs").

The proposed project will utilize stream flows from the upper Hanalei River and its tributaries to generate hydroelectric power.

A new diversion weir will be constructed on the Hanalei River approximately 11.1 river miles upstream from the mouth at the confluence with the Kaapoko Stream at an approximate elevation of 650 feet above MSL. The intake structure will be screened to prevent entrainment of fish. Screening criteria will be established in conjunction with the U.S. Fish & Wildlife Service and the Department of Land & Natural Resources. An above ground pipeline varying in diameter from 42 inches to 56 inches and approximately 26,600 feet long will convey the water from the new diversion weir to a powerhouse approximately 5.2 river miles upstream from the mouth at an approximate elevation of 50 feet above MSL. The flow will then be discharged from the powerhouse and return to the natural channel of the Hanalei River just upstream from the China Ditch Division.

Provisions will be added for minimum by-pass flows at the new diversion to protect the existing fish and wildlife values in the area. The amount of flows to be by-passed is currently being determined by the U.S. Fish & Wildlife Service and State of Hawaii Division of Aquatic Resources.

A new 69 KV transmission line approximately 4,200 feet in length will be constructed to interconnect the project with Kauai Electric at the existing Lydgate Substation. The project power will be sold to Kauai Electric which will then be distributed to their customers. The existing line will be upgraded to 69 KV from the point of interconnection to the Princeville Substation which is a distance of approximately 13,350 feet.

2. Economic

The economic aspects of the project are significant and beneficial. The benefits are derived solely from displacement of Kauai Electric's system energy and assume fuel price escalation and a power-on-line effective date of 1988. The project would contribute significantly toward the goals of the alleviation of oil dependence and increased energy self-sufficiency. The hydroelectric facility would supplant the need to import 59,000 barrels of oil annually and service an equivalent of 5,400 household or 17,350 individuals, assuming the current rates of fuel oil utilization and household demands are maintained.

There will be an increase in employment opportunities for local laborers and construction companies as a result of the construction of the proposed project. Local suppliers will also be used for concrete, backfill materials and other major components of the project.

The project will cost $15 million to construct, which includes all direct and indirect construction costs, easements and rights-of-way, land and agricultural damages, and interest during construction. Operation and maintenance of the project will also involve local personnel.

The following list is an itemization of the total project costs.

COST ESTIMATES

BASIS FOR COST ESTIMATES

Construction Cost. The basic assumptions for the construction cost estimates were as follows:

a. The contractor and labor would be Kauai, Hawaii based. Labor would be performed on 6-8 hour shifts per week.

b. Construction period would be 12 months.

c. Escalation to mid-point of construction was included. Annual construction inflation would be 9 percent. Contingencies are 20 percent. However for turbine/generator and related electrical/mechanical items, based on manufacturer's bid prices, contingencies are 10 percent. Transmission line contingencies are 15 percent.

d. Excavation 1-3 feet below the surface would require blasting for rock removal. Material at the surface would be composed of loose soil, cobbles and large boulders.

e. Mechanical and electrical equipment would be from continental United States. Installation labor from the mainland would be required for turbine-generator features. Itemized costs include delivery costs to site.

f. Suitable temporary diversion will be utilized to facilitate construction of the new diversion.

g. Price level for all work is July, 1986.

Indirect Costs. Indirect costs include technical and administrative costs associated with the design and construction of the project.

a. **Engineering and Design.** These indirect costs would be for engineering efforts in the preparation of design memoranda; construction plans and specifications; and engineering during construction. All associated overhead amounts are included in the Engineering and Design totals.

b. **Supervision and Administration.** The construction contract would include contract administration and field inspection. Associated overhead amounts are included in the total.

c. **Right-of-Way Indirect Costs.** Indirect costs included the management of construction rights-of-way, easements and interagency coordination during construction.

Easements. The costs required to acquire construction rights-of-way would be borne by the developer. Lands under ownership by the State of Hawaii will be leased on a fair market value basis.

Operational and Maintenance and Replacement Costs. These costs are annual costs required to keep all facilities in good working condition and repair.

Interest During Construction (IDC). Interest during construction accounts for the capital incurred during the construction period. The computed amount is to be included in the total project investment cost and forms a portion of the average annual costs. The turbine-generator procurement process is normally an indepenedent contract. Hence, construction inflation was computed on the basis of 12 months and IDC was computed on the basis of 12 months.

COST ESTIMATE

Item	
CONSTRUCTION	
Direct Construction Costs	12,000,000
Indirect Costs	2,000,000
Subtotal	**14,000,000**
LANDS AND DAMAGES	
Lands, Easements & Rights-of-Way	200,000
TOTAL FIRST COSTS	**14,200,000**
INTEREST DURING CONSTRUCTION	800,000
TOTAL PROJECT INVESTMENT COST	**15,000,000**

E. EXISTING STRUCTURES, UTILITIES, ACCESS AND USE

1. Existing Structures, Utilities and Access

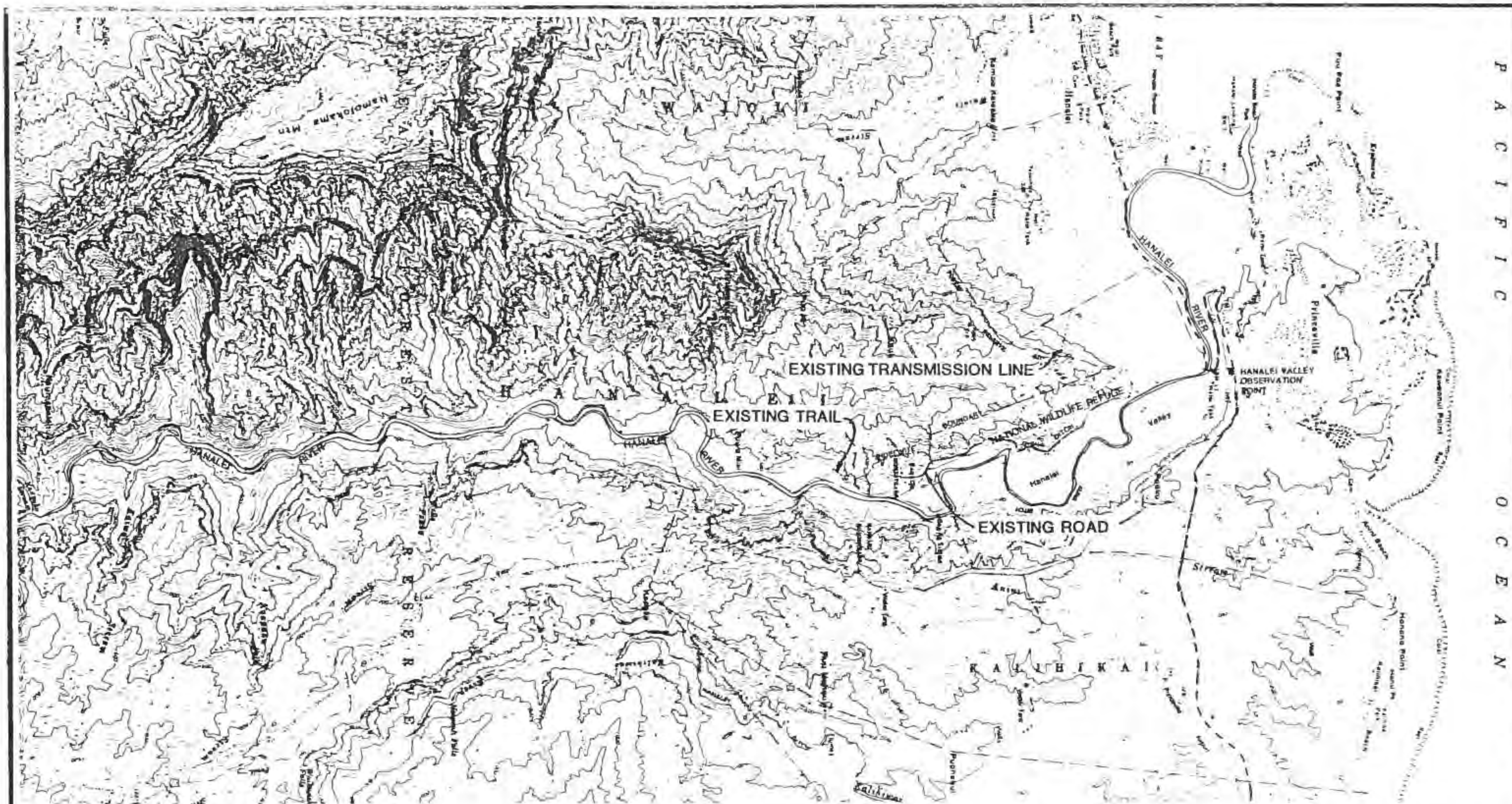
There are no existing structures or utilities in the immediate project area. There are existing diversions on the upper Hanalei River and Kaapoko Stream which route water into the Wailua River basin via the Hanalei Tunnel. These diversions are approximately 8,000 feet upstream from the proposed new diversion weir, and will not be affected by the project. There is an existing foot trail traversing along the Hanalei River beginning at the termination of the road at the Hanalei Homesteads and running up to the existing tunnel diversion in the upper part of the Hanalei Basin. The proposed new access road may parrallel, cross or replace this trail in some areas.

The proposed project will not displace, alter or interupt any existing structures or utilities in the immediate project area. However, the project will interconnect with the existing road and transmission line near the Hanalei Homesteads. The existing transmission line will be upgraded to 69 KV to accomodate the interconnection of the project into the Kauai Electric System at the Princeville Substation. The transmission line upgrade will be conducted by Kauai Electric to insure that adequate safety procedures are taken and possible power interruptions are under their control.

Figure E-1 illustrates the existing structures, utilities and access in the area.

2. Existing Use

The present use of the immediate project area is mainly for recreational enjoyment in the form of hiking, fishing, hunting or sightseeing. Some of these lands are used for the harvesting of marijuana plants but the extent of this use is unknown. All of the land needed for the project is owned by the State of Hawaii and lies within "Conservation District" boundaries. The majority of these lands are within Resource (R) Subzone with a small portion (near the upper portion of the project area) within Protected (P) Subzone.



HANALEI HYDROELECTRIC PROJECT

EXISTING STRUCTURES, UTILITIES & ACCESS

BINGHAM ENGINEERING

March 1986

608-014

FIGURE E-1

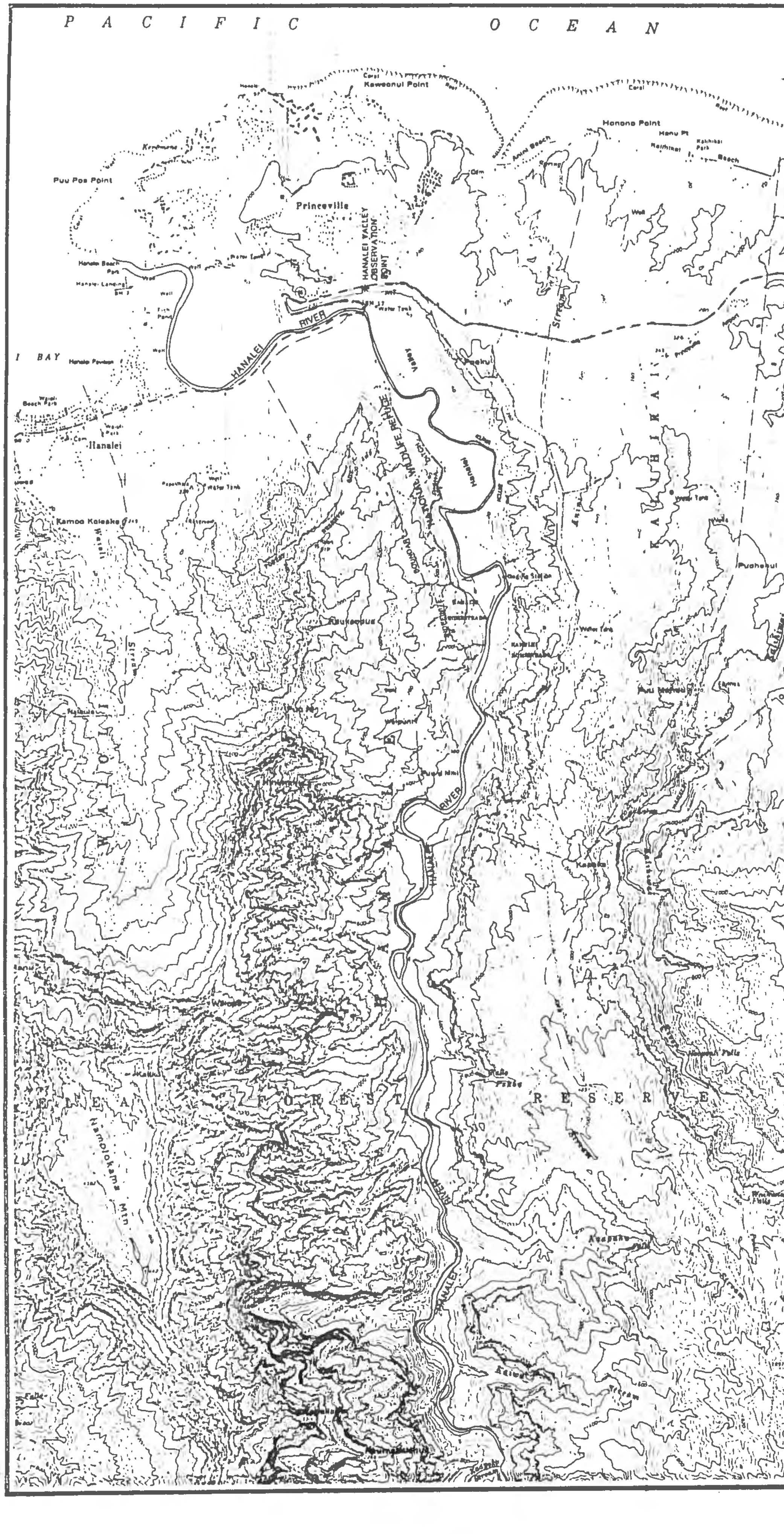
F. TOPOGRAPHY

The proposed Hanalei River Hydroelectric Project is located within an area having steep slopes and rugged terrain. A new diversion weir will be constructed at an approximate elevation of 650 feet above MSL. The main penstock approximatley 26,600 feet long will traverse along the Hanalei River to a powerhouse on the westerly bank of the river, just upstream of the China Ditch Diversion at an approximate elevation of 50 feet above MSL. The average gradiant of the main penstock will be approximately 2%. Installation of the main penstock will require construction on side slopes up to 60% or greater.

Diverions of seven tributaries on the westerly side of the river will be accomplished by constructing small concrete diversion weirs in the channel of the streams and running small feeder penstocks into the main penstock. Installation of these feeder penstocks will require construction on side slopes up to 100% or greater.

Construction of the main penstock and powerhouse in the lower 1/3 of the project area will be relatively easy as the steepness of the slopes become less severe.

Figure F-1 illustrates the contours of the project area.



HANALEI HYDROELECTRIC PROJECT

TOPOGRAPHY

BINGHAM ENGINEERING

March 1988

809-014

FIGURE F-1

G. EXISTING COVENANTS, EASEMENTS, RESTRICTIONS

The entire project area lies within "Conservation District" boundaries which is identified as the "K-6 Hanalei" Subzone.

The majority of the lands to be occupied by the project are designated as Resource (R) Subzone. The objective of this Subzone is to develop, with proper mangement, areas to ensure sustained use of the natural resources of those areas.

A minor amount of land needed for the project is designated as Protective (P) Subzone. The objective of this subzone is to protect valuable resources in such designated areas as restricted watersheds; marine, plant and wildlife sanctuaries, significant historic, archeological, geological, and volcano-logical features and sites; and other designated unique areas.

No known covenants or easement will be affected by the project.

H. DESCRIPTION OF ALL OPERATIONS TO BE CONDUCTED

The proposed project involves constructing and operating a hydroelectric power facility for the purpose of selling electrical power to Kauai Electric Company.

The project will involve the construction of a 10 foot high concrete diversion weir on the Hanalei River near the confluence with the Kaapoko Stream. Similar diversions will also be constructed on seven major tributaries to the Hanalei River on its westerly side. The main penstock will convey the water to a powerhouse and will be constructed above ground. The alignment of the main penstock will mostly follow along the westerly side of the river for an approximate length of 26,600 feet. Seven small feeder penstocks will convey flows from the major tributaries of the Hanalei River into the main penstock.

The powerhouse will contain two pelton turbines with generating units which will be located on the westerly bank of the Hanalei River. After passing the turbines, the water will be discharged back into the natural channel of the Hanalei River just upstream from the China Ditch Diversion.

A new road will constructed to allow access from the existing road near the Hanalei Homesteads to the powerhouse and along the main penstock to the diversion weir.

A transmission line will be constructed to interconnect the powerplant to the existing Kauai Electric Transmission line near the Hanalei Homesteads.

Long-term operation of the project will involve periodic maintenance of all diversion weirs. It will be necessary to protect the above ground penstock by coating it every 5 years with a coal-tar epoxy which can be applied with a brush or sprayer. Continuous access to the diversion weirs will be necessary to perform routine cleaning and maintenance of trashracks and screens.

No on-site housing will be needed for the project.

I. COMMENCEMENT AND COMPLETION DATES

The proposed project will begin construction prior to December 31, 1986 and will be completed by July 1, 1988.

J. TYPE OF USE REQUESTED

The type of use requested for this application is a "Conditional Use" which is a use other than what is permitted within the subzone. The boundaries of the subzone were established as "K-6 Hanalei", who's permitted uses are identified as Protective (P) and Resource (R).

K. AREA OF PROPOSED USE

The approximate area of the propsed use is 77.5 acres. The breakdown of the area needed for the project goes as follows:

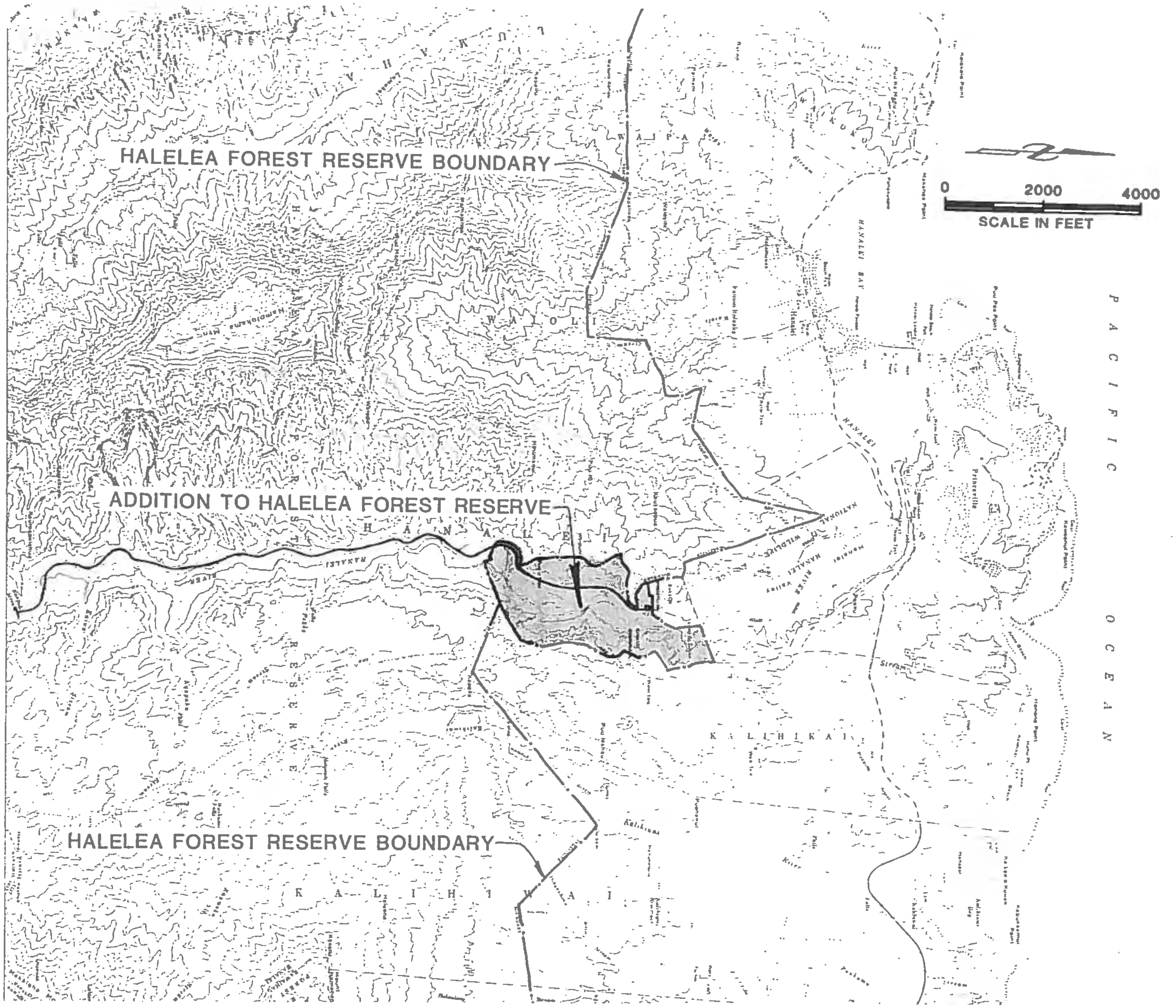
Main Diversion Weir	1.0 Acres
Additional diversion weirs	4.0 Acres
Main Penstock	30.5 Acres
Feeder Penstocks	15.0 Acres
Access Road	20.0 Acres
Powerhouse	2.0 Acres
Transmission Line	5.0 Acres
Total	**77.5 Acres**

L. NAME AND DISTANCE OF NEAREST TOWN OR LANDMARK

The proposed project area is approximately 4 miles southeast of Princeville, Kauai, Hawaii TMK 5-4-1:1, 5-4-2:3.

M. BOUNDARY INTERPRETATION

The proposed project lies entirely within "Conservation District" lands of the Halelea Forest Reserve located in the Hanalei District. A recent addition was made to the Halelea Forest Reserve which added 567 acres of land near the Hanalei Homesteads. Figure M-1 illustrates the Halelea Forest Reserve boundary with relationship to the project. Figure M-2 illustrates the recent addition to the forest reserve on a larger scale.

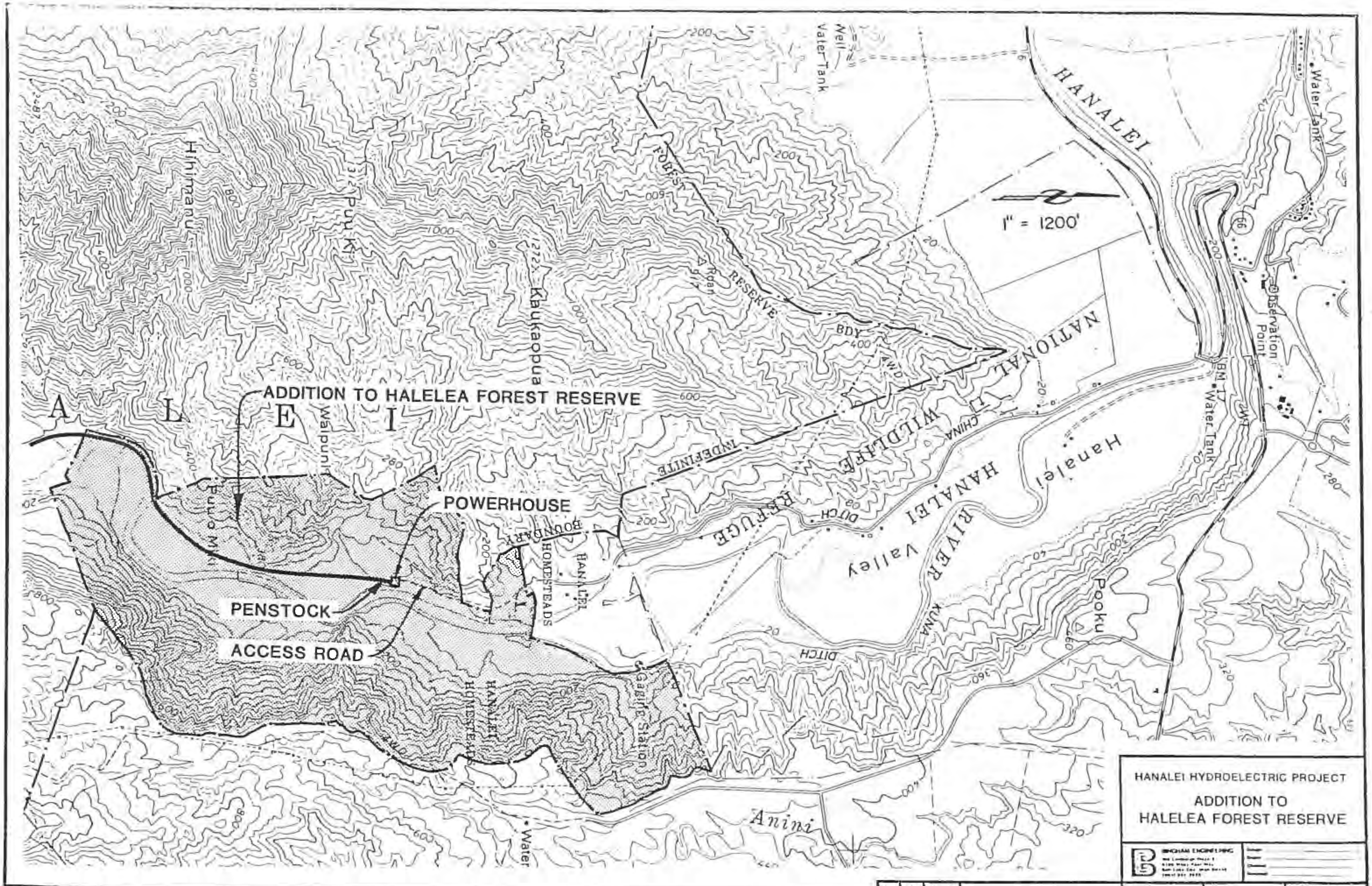


HANALEI HYDROELECTRIC PROJECT

HALELEA FOREST RESERVE BOUNDARY

BINGHAM ENGINEERING

FIGURE M-1



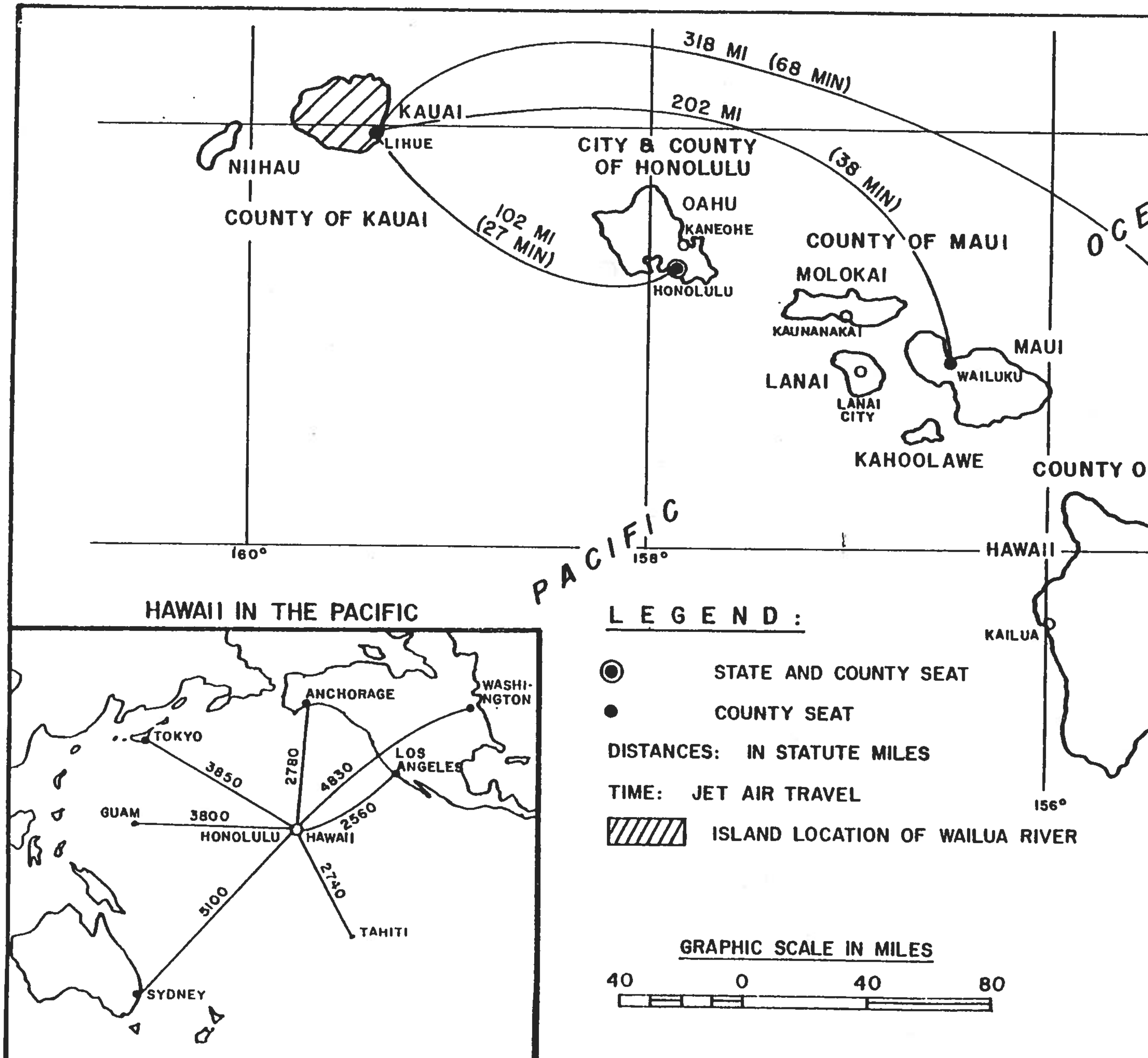
HANALEI HYDROELECTRIC PROJECT

ADDITION TO HALELEA FOREST RESERVE

BINGHAM ENGINEERING

FIGURE M-2

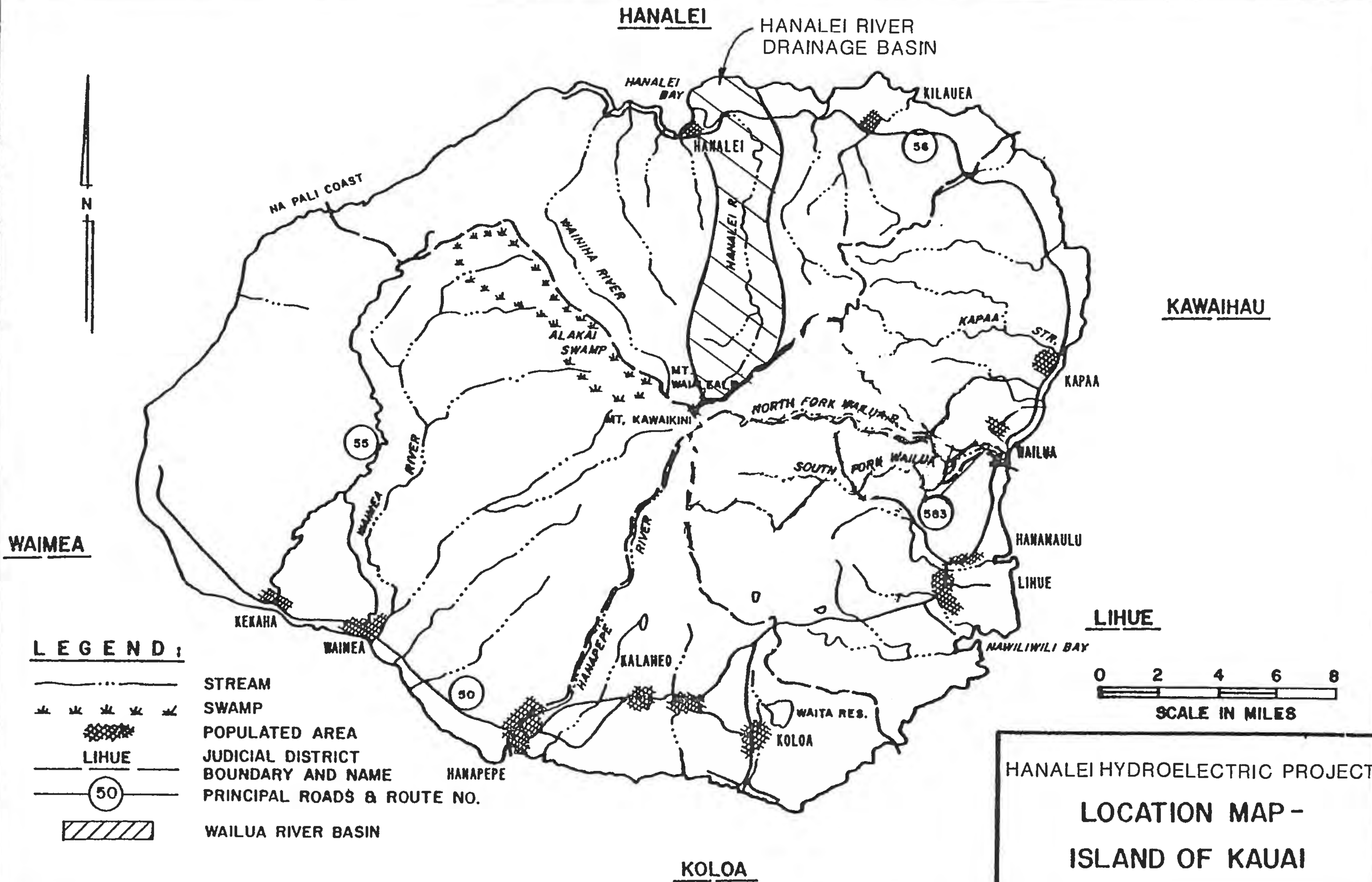
N. PROJECT MAPS AND DRAWINGS



HANALEI HYDROELECTRIC PROJECT

LOCATION MAP
STATE OF HAWAII

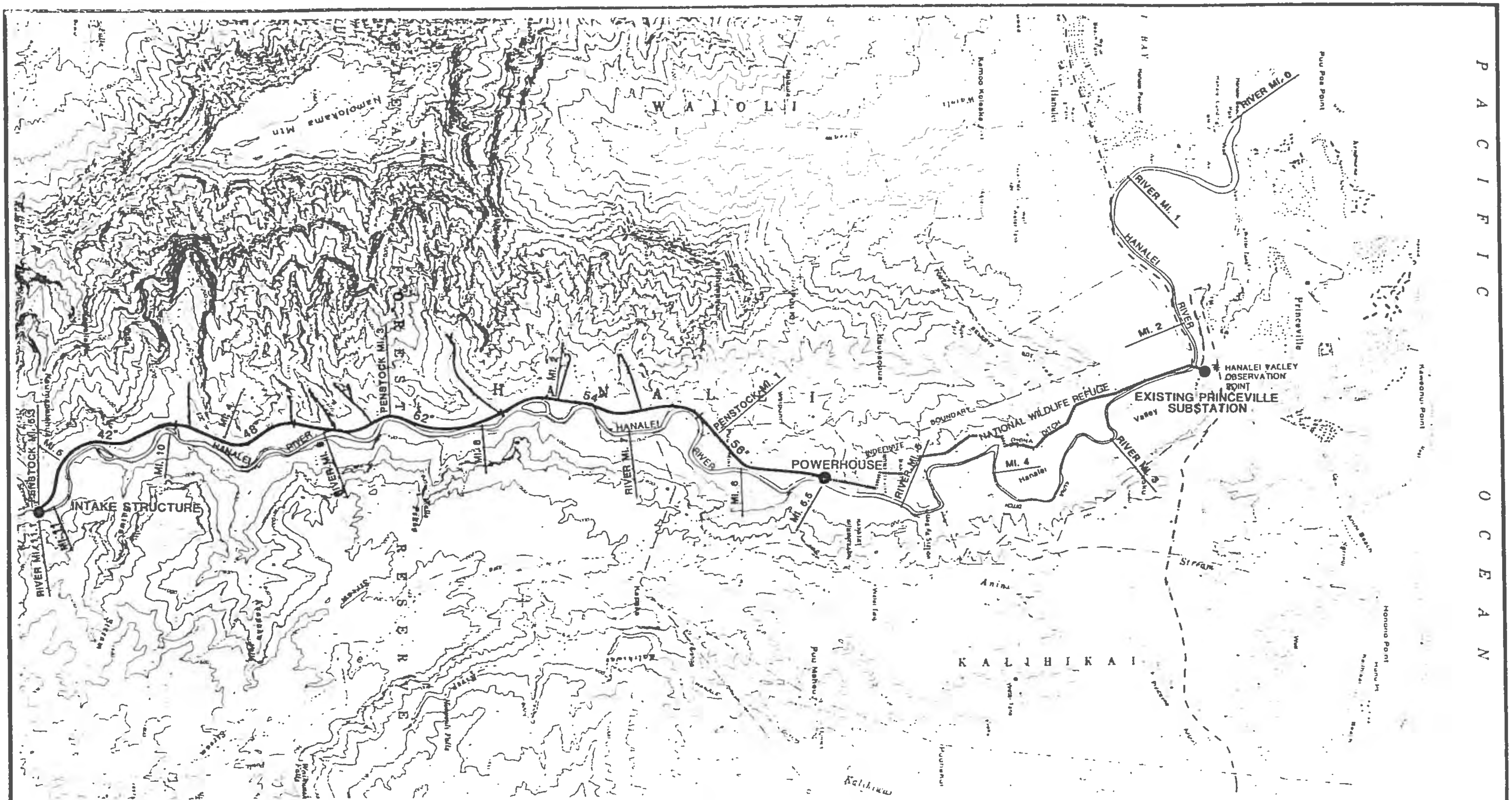
FIGURE N-1



HANALEI HYDROELECTRIC PROJECT

LOCATION MAP -
ISLAND OF KAUAI

FIGURE N-2



LEGEND

- PENSTOCK
- TRIBUTARY PENSTOCKS
- UPGRADED EXISTING POWERLINES
- 56" PENSTOCK DIAMETERS

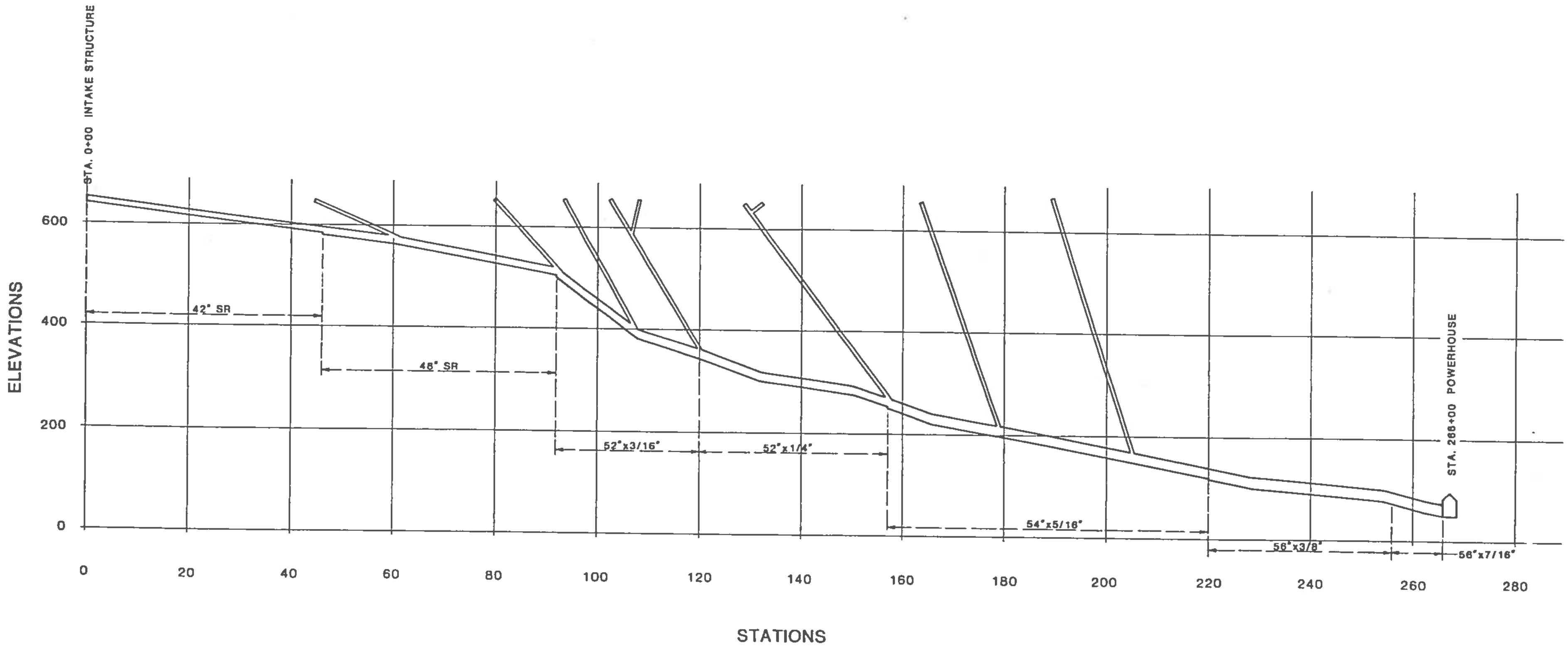
1400' 700' 0' 1400' 2800'

HANALEI HYDROELECTRIC PROJECT

PROPOSED SITE FACILITIES

BINGHAM ENGINEERING

Date March 1986 | Project # 609-014 | FIGURE N-3

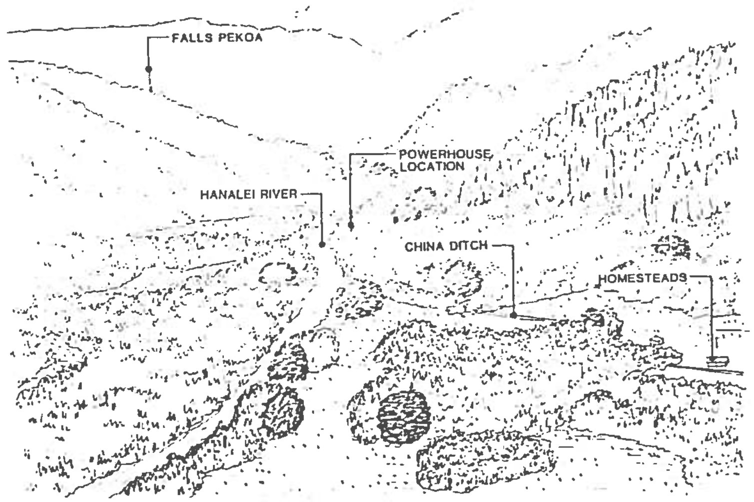


HANALEI HYDROELETRIC PROJECT

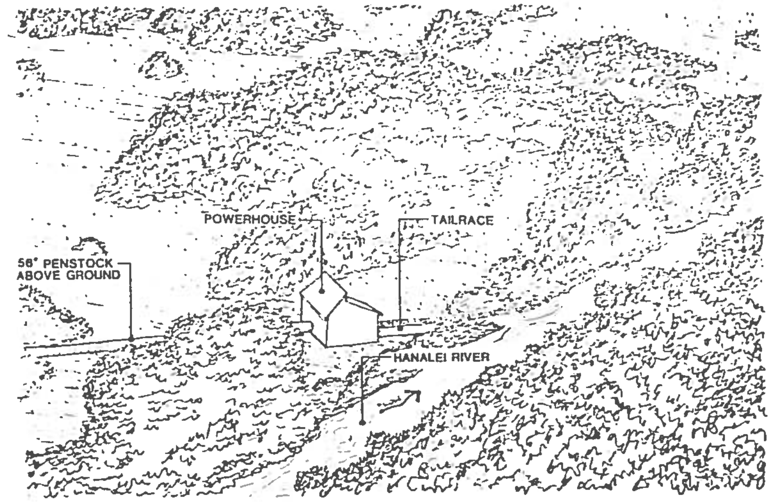
PENSTOCK PROFILE

BINGHAM ENGINEERING

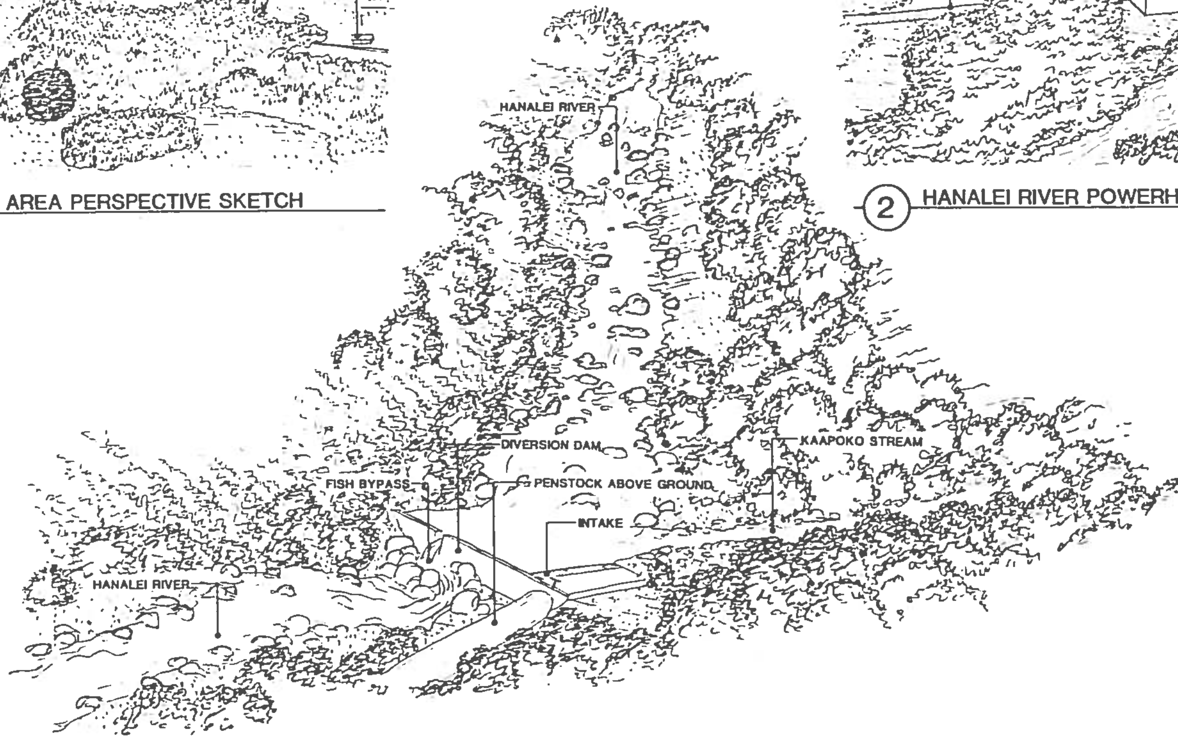
FIGURE N-4



(1) HANALEI RIVER DRAINAGE AREA PERSPECTIVE SKETCH



(2) HANALEI RIVER POWERHOUSE PERSPECTIVE SKETCH



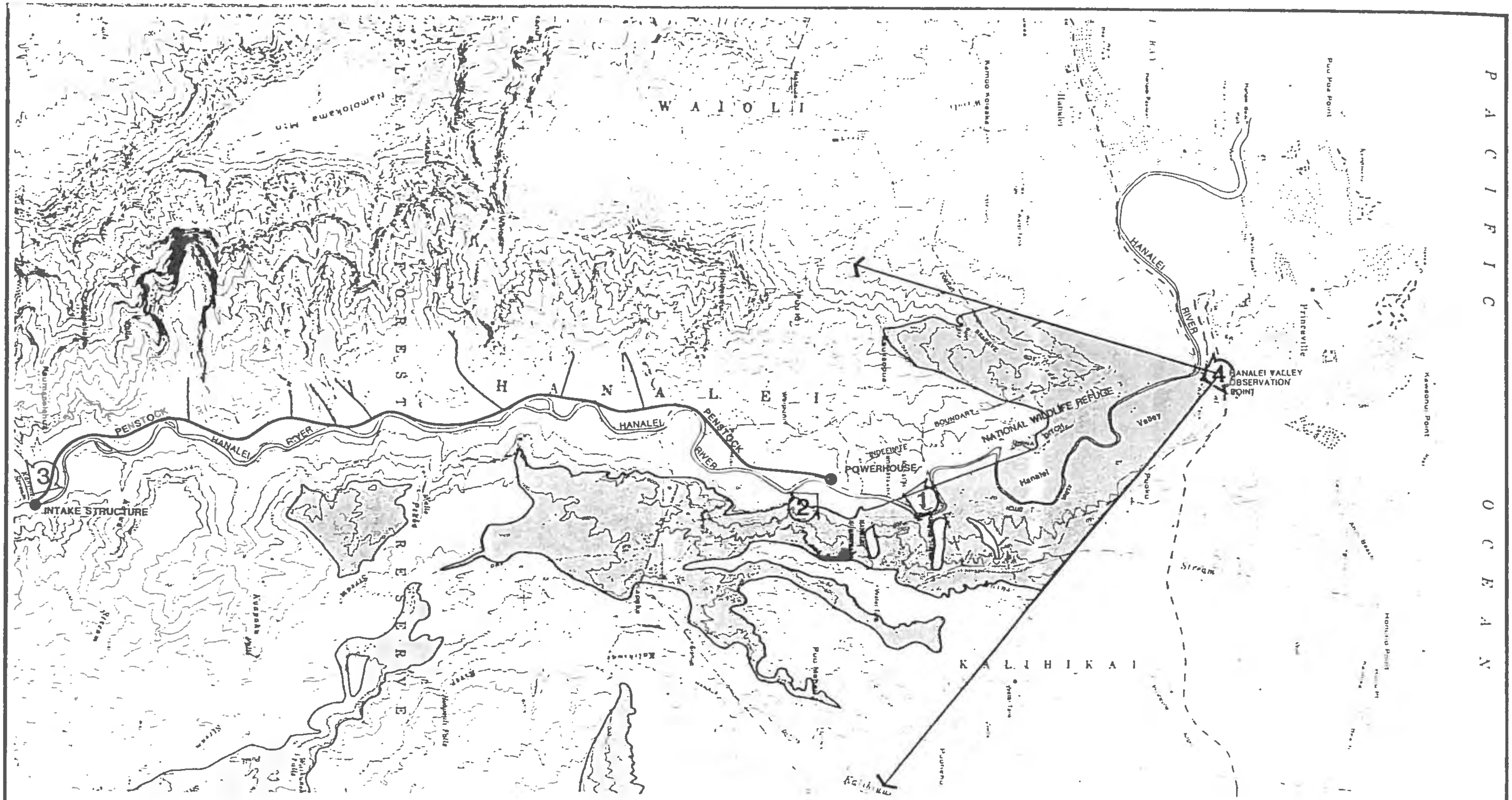
(3) HANALEI RIVER DIVERSION STRUCTURE PERSPECTIVE SKETCH

HANALEI HYDROELECTRIC PROJECT

PERSPECTIVE SKETCHES

BINGHAM ENGINEERING

FIGURE N-5



LEGEND

AREA SEEN FROM THE HANALEI VALLEY OBSERVATION POINT

(1) PHOTOGRAPH & PERSPECTIVE SKETCH LOCATIONS

(4) PHOTOGRAPH LOCATION ONLY

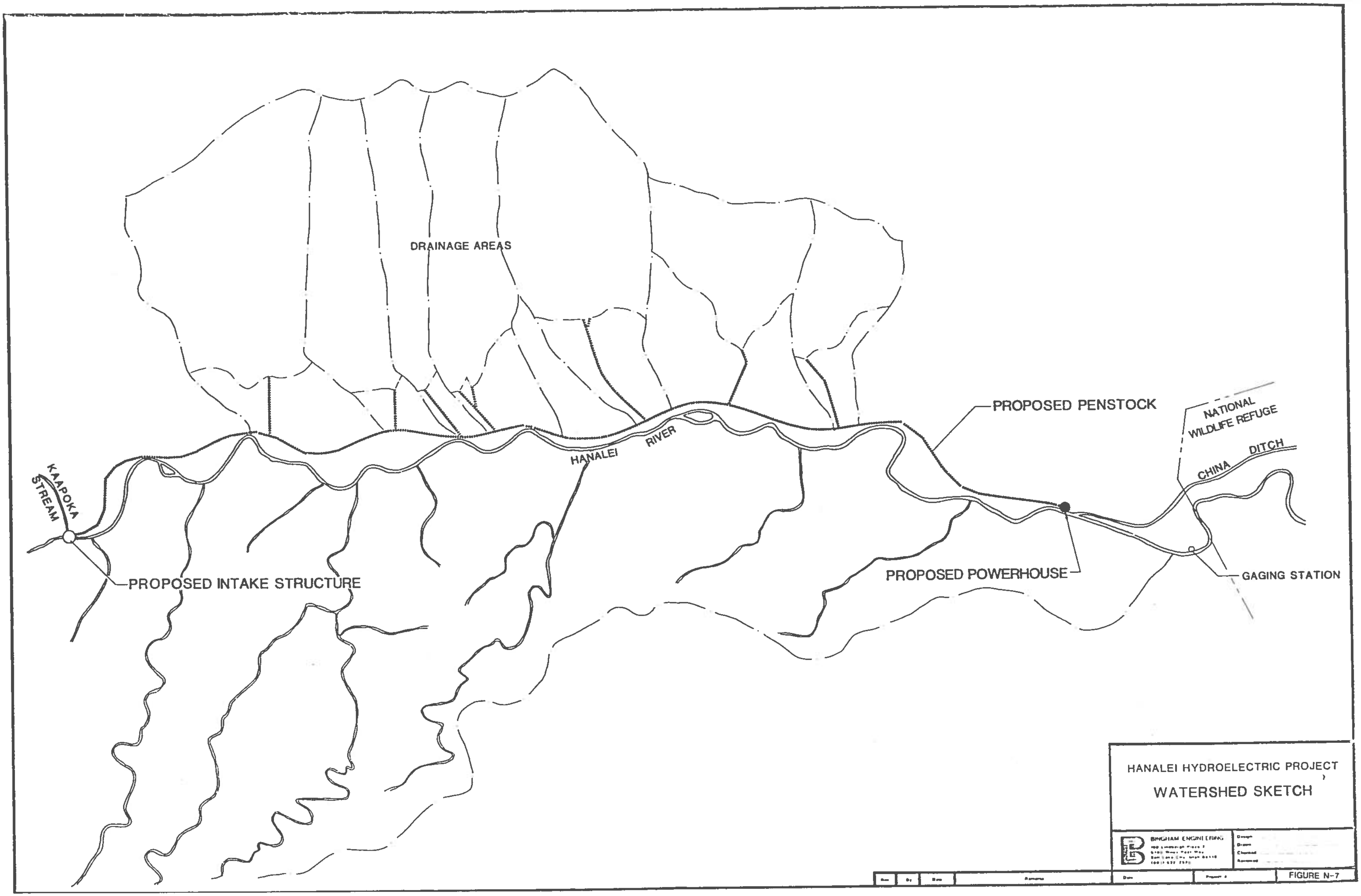
1400 700 0 1400 2800

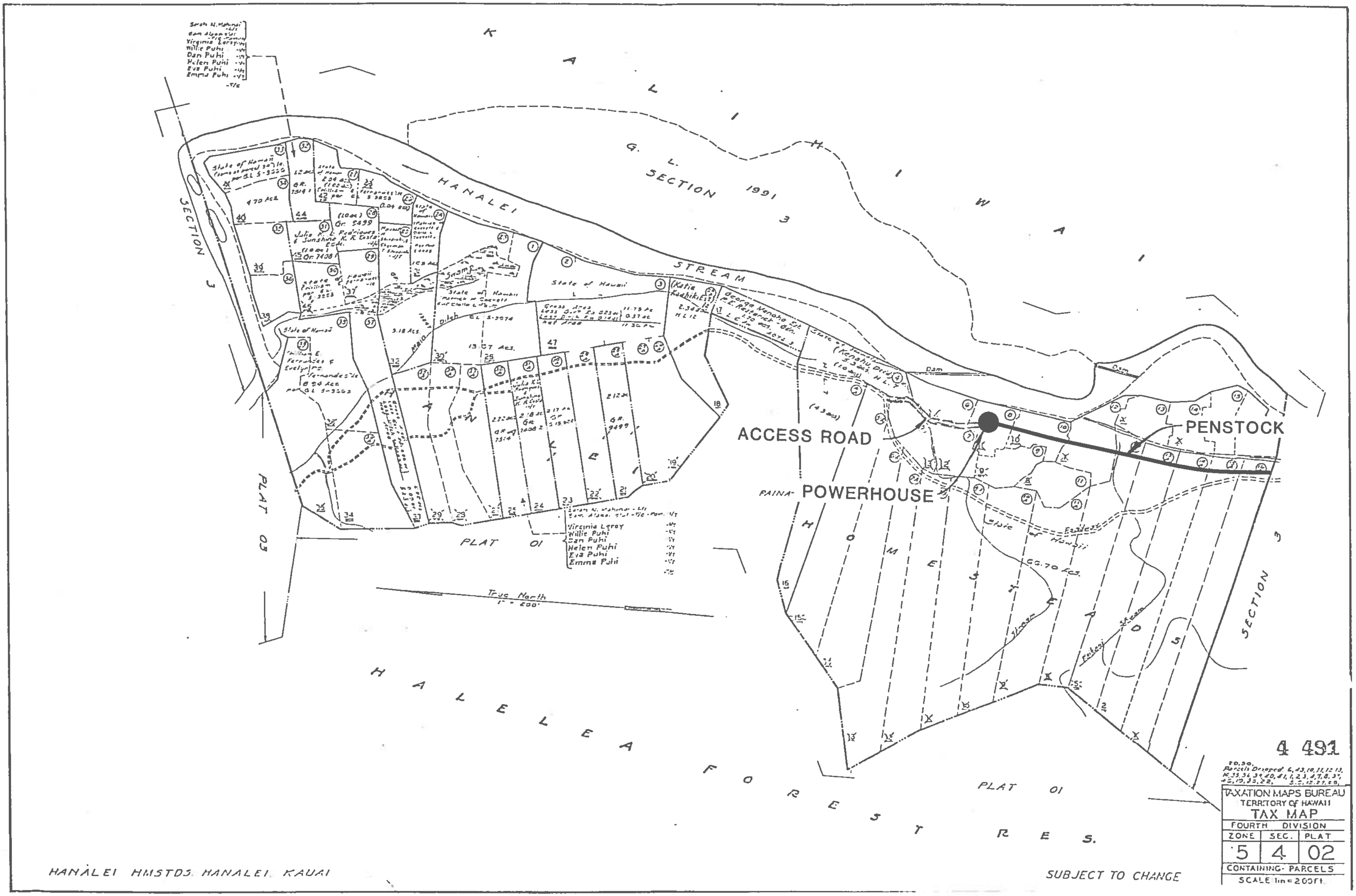
HANALEI HYDROELECTRIC PROJECT

VISUAL ANALYSIS MAP

BINGHAM ENGINEERING

Date March 1986 | Project # 609-014 | FIGURE N-6


DRAINAGE AREAS
PROPOSED PENSTOCK
NATIONAL WILDLIFE REFUGE
CHINA DITCH
KAAPOKA STREAM
HANALEI RIVER
PROPOSED INTAKE STRUCTURE
PROPOSED POWERHOUSE
GAGING STATION
HANALEI HYDROELECTRIC PROJECT
WATERSHED SKETCH
BINGHAM ENGINEERING
FIGURE N-7


PENSTOCK
ACCESS ROAD
POWERHOUSE
KALIHIWAI
G. L. SECTION 1991
HANALEI STREAM
HALELEA FOREST RES.
PLAT 01
PLAT 03
SECTION 3
True North
1" = 200'
4 491
TAXATION MAPS BUREAU
TERRITORY OF HAWAII
TAX MAP
FOURTH DIVISION
ZONE 5
SEC. 4
PLAT 02
CONTAINING PARCELS
SCALE 1in=200ft
SUBJECT TO CHANGE
HANALEI HMSTDS. HANALEI, KAUAI