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

FILE NO.: OA-9/6/91-2504
DOC. NO.: 1617E

SEP 23 1991

MEMORANDUM

TO: The Honorable Brian J. J. Choy, Director
Office of Environmental Quality Control

FROM: William W. Paty, Chairperson
Board of Land and Natural Resources

SUBJECT: Document for Publication in the OEQC Bulletin
Environmental Assessment for Conservation District Use Application OA-9/6/91-2504 for a Commercial Aquaculture Facility at Dillingham Quarry, Waialua, Oahu
TMK: 6-9-01: 3 and 33

The above mentioned Chapter 343 document was reviewed and a negative declaration was declared based upon the environmental assessment provided with the CDUA.

Please feel free to call me or Roy Schaefer of our Office of Conservation and Environmental Affairs, at 548-7837, if you have any questions.

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1991-10-08-OA-FEA OA-2504

Weidenbach Dillingham quarry aqua culture facility

ENVIRONMENTAL ASSESSMENT

FOR

PROPOSED FISH FARM AT FORMER DILLINGHAM QUARRY SITE

KAENA, WAIALUA, OAHU

Tax Map Key: 6-9-01: 3 and 33

APPLICANTS: Ronald P. Weidenbach and Estralita P. Weidenbach

dba Hawaii Fish and Shellfish Company

53-270 Kamehameha Highway

Hauula, Hawaii 96717

PREPARED FOR: Department of Land and Natural Resources

State of Hawaii

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Honolulu, Hawaii 96809

PREPARED BY: Ronald P. Weidenbach 6/1/91

Ronald P. Weidenbach Date

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I. SUMMARY

The applicants propose to establish a small commercial freshwater aquaculture facility on a portion of the former Dillingham rock quarry site located in Kaena, Oahu. The applicants would utilize the existing rainwater-filled excavation pit of approximately seven acres and several small areas of relatively level land located around the pit for floating cage culture and above-ground tank culture. The primary culture species would be the locally occurring freshwater Chinese catfish Clarias fuscus and Hawaiian sunfish Oreochromis mossambicus.

The proposed action has been carefully planned around the quarry site's existing physical features, so as to minimize physical alterations to the proposed project area. The technical and economic characteristics of the proposed action are based on the applicants' experience in constructing and operating their existing aquafarm in Punaluu and a pilot aquaculture facility in Waimanalo.

The proposed project area is located largely within the General subzone of the State Conservation district and within the proposed boundary of the Kaena Point State Park. The applicants are applying to use the proposed project area on a short-term or interim basis, under a revocable permit from the State Department of Land and Natural Resources (DLNR), until such time as the area may be required by the State to implement proposed long range park uses of the overall quarry site. These proposed uses include a maintenance yard, secured parking for the upland area, a moto-cross course, and a rifle range.

The proposed aquafarm would be constructed incrementally over a three-year period. Fish production would begin during the first year and would increase annually. Full production would be achieved in the fourth year. The applicants would utilize ocean shipping containers and other temporary, modular, or modularly constructed structures for essential farm support infrastructure, to facilitate farm set-up and, when necessary, its later take-down.

The quarry site has been unused for approximately 15 years, since the cessation of quarrying activities in the mid-1970s. During this time, the quarry site has been subject to trespass, littering, dumping, vandalism, theft, and arson. The applicants' use of the site would deter such illegal and often hazardous activities.

The existing environment of the quarry site has been highly disturbed for most of the past century. The flora and fauna are characterized almost entirely by exotic plants and animals: Koa-haole and Guinea grass predominate in the flora; the black-chin tilapia predominates in the aquatic fauna; common myna, zebra

dove, and finches predominate in the avian fauna; and rats, mongoose, and feral cats are the most prevalent of the mammalian fauna.

No significant negative environmental impacts have been identified relative to the proposed action. Several potential minor environmental impacts have been identified, but most of these would be positive impacts. Where minor negative impacts have been identified, appropriate mitigative measures have been suggested. Possible alternative actions have also been considered but have not been found to offer any significant benefits relative to the minor negative impacts identified with the proposed action.

The proposed aquafarm would not result in any trade-offs between short-term uses of the area and the maintenance and enhancement of long-term productivity. In addition, the proposed action would not deplete or diminish any important natural resource in an irreversible or irretrievable manner.

Aquaculture has been locally identified as an environmentally- and socially-acceptable economic development alternative to create new jobs, broaden the State tax base, and fulfill long-term State goals. The draft State Conservation Lands Functional Plan encourages both private and public sector landowners to locate, preserve, and encourage the availability of sites suitable for commercial aquaculture in the State Conservation district. The proposed action would appear to be consistent with these stated public goals.

II. APPLICANTS

Ronald P. Weidenbach and Estralita P. Weidenbach
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53-270 Kamehameha Highway
Hauula, Hawaii 96717

III. APPROVING AGENCY

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

IV. INTRODUCTION

The applicants are applying for use of approximately 18 acres of State-owned Conservation land at the former Dillingham quarry site in Kaena, to develop a small commercial freshwater aquafarm.

Accordingly, this Environmental Assessment (EA) has been prepared to evaluate the proposed aquaculture project pursuant to Chapter 343, Hawaii Revised Statutes, and in accordance with Title 11; Chapter 200, Environmental Impact Statement Rules for applicant actions, Department of Health, and Title 13; Chapter 2, Hawaii Administrative Rules, February 23, 1990, Conservation Districts, Department of Land and Natural Resources.

The quarry site, totaling approximately 147 acres, has experienced nearly a century of prior commercial use, involving large-scale farming, ranching, and quarrying activities. These former activities have resulted in extensive physical modifications of the site.

The applicants propose to utilize the quarry site's existing rainwater-filled excavation pit and several small areas of relatively level land adjacent to the pit to raise Chinese catfish Clarias fuscus, Hawaiian sunfish Oreochromis mossambicus (red color variant), and other suitable freshwater aquaculture species in floating cages and above-ground tanks. These two culture methods are well adapted to the site's existing physical features and would minimize the construction work, time, and capital costs required to implement the proposed action.

The proposed project area lies largely within the General subzone of the State Conservation district; the makai edge extends slightly into the Limited subzone. The proposed site lies entirely within the proposed boundary of the Kaena Point State Park, as delineated in the Park's long range conceptual plan (State of Hawaii, 1978). At present, the site is unencoumbered.

Proposed State Park uses of the quarry site are: a park maintenance yard, secured parking for upland park areas, a moto-cross course, and a rifle range. The State Department of Land and Natural Resources (DLNR), Division of State Parks, has indicated, however, that no recreational or related developments are anticipated at the quarry site in the near future and that they have no objections to allowing the applicants' proposed use of the area on a "short-term" basis (Uchida, 1989).

The applicants conducted an in-depth environmental assessment of the site in relation to the proposed aquaculture development activities during the period October 1989 to March 1991. This was accomplished under a right-of-entry permit issued from the Board of Land and Natural Resources.

The EA process undertaken included extensive field investigations of the proposed project area and adjacent lands, review of relevant written materials, and numerous meetings and discussions with persons in key resource and regulatory agencies. During the field investigations, collections were made of the plants and animals which could not be positively identified in the field for

later determination at the State of Hawaii, Department of Agriculture (DOA), the Bishop Museum, and the University of Hawaii at Manoa (UH). Of the written materials reviewed, three documents in particular were found to contain a wealth of useful background information for the present EA: the Kaena Point State Park Conceptual Plan, the Environmental Impact Statement for Makua-Kaena State Park, and the unpublished Environmental Assessment of the Dillingham Military Reservation.

V. BACKGROUND OF APPLICANTS AND COMPANY

The applicants and the Hawaii Fish and Shellfish Company (HFS) fishery biologist, Mr. Daniel McConnell, have had more than sixty years combined experience in local, national, and international aquaculture production and research, in fisheries and environmental research, and in farm and small business operation and management. A summary of this experience and the background of HFS is presented in Appendix I.

VI. CONSULTED AGENCIES, GROUPS, AND INDIVIDUALS

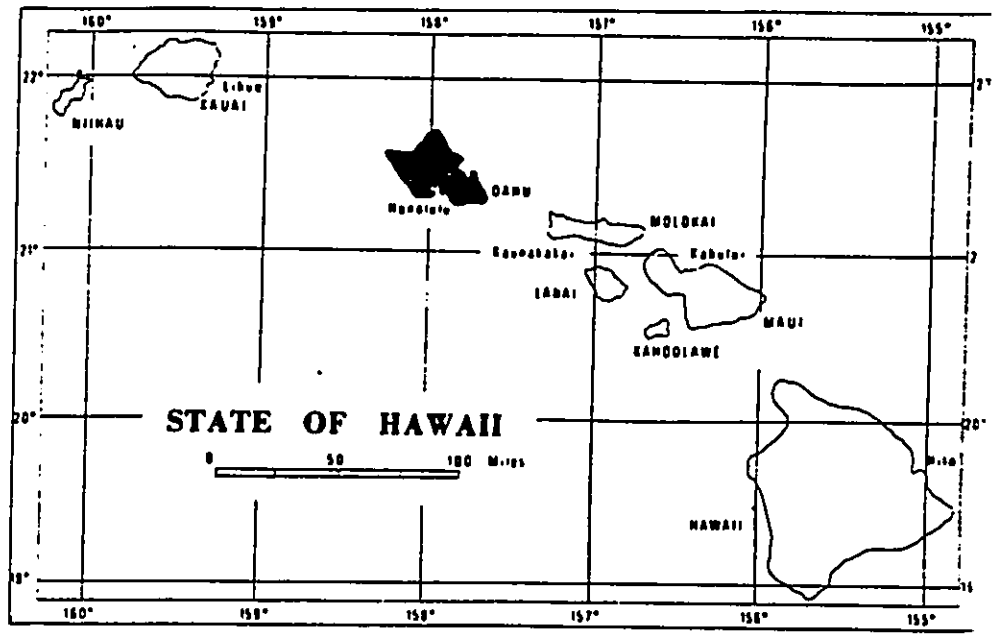
A listing of the agencies and groups contacted while preparing this EA is presented in Appendix II.

VII. PROJECT DESCRIPTION

A. Location and Site

The proposed project area is located at the former Dillingham quarry site in Kaena, on the extreme western portion of the island of Oahu, approximately 35 miles from Honolulu (Figure 1). The proposed project area is approximately 900 feet mauka of Farrington Highway, abutting the western end of the Dillingham Airfield and extending eastward towards Camp Harold R. Erdman of the YMCA (Figure 2). The proposed project involves portions of two State-owned land parcels identified by Tax Map Key 6-9-1: 3 and 33 (Figure 3).

The proposed project focuses on the quarry's water-filled excavation pit which covers an area of approximately seven acres, and on approximately two acres of old gravel roadbeds and other usable level lands located immediately to the east and north of the excavation pit (Figures 4 and 5). Total project area, including the excavation pit, the usable level lands, the cliffs and rocky slopes bordering the pit and level areas, and a security buffer area across the northern border of the property, is approximately 18 acres.



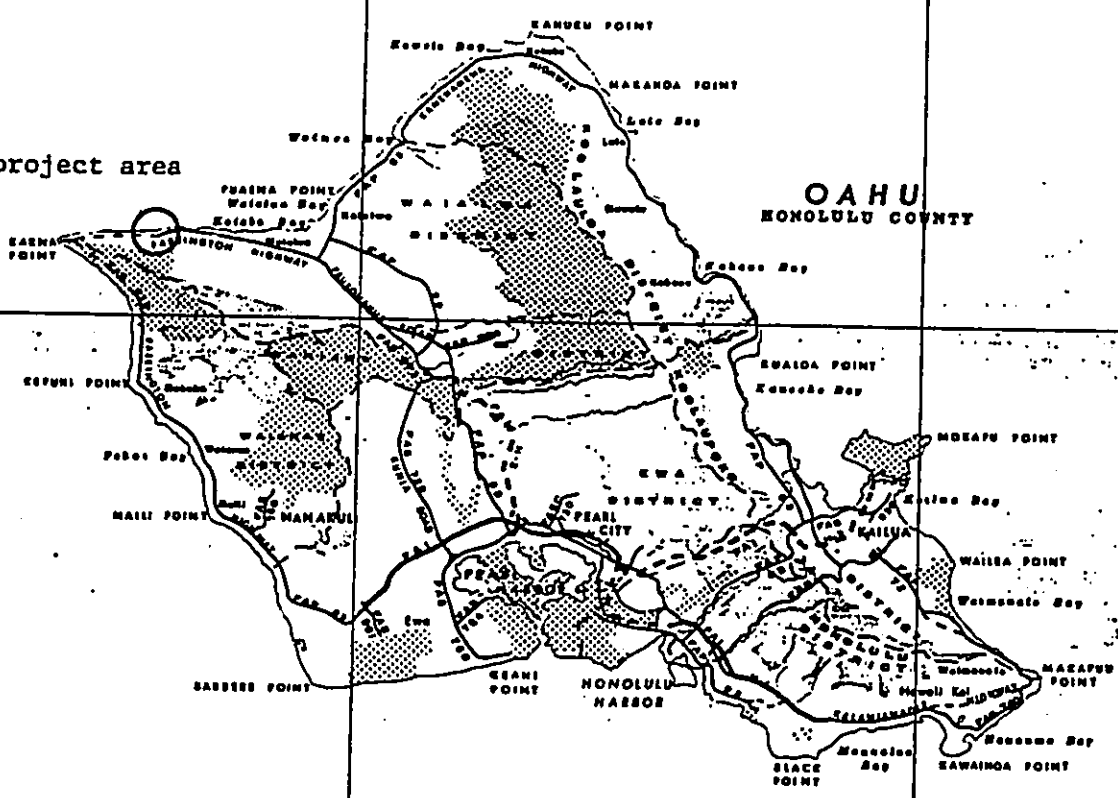


Figure 1. Location map

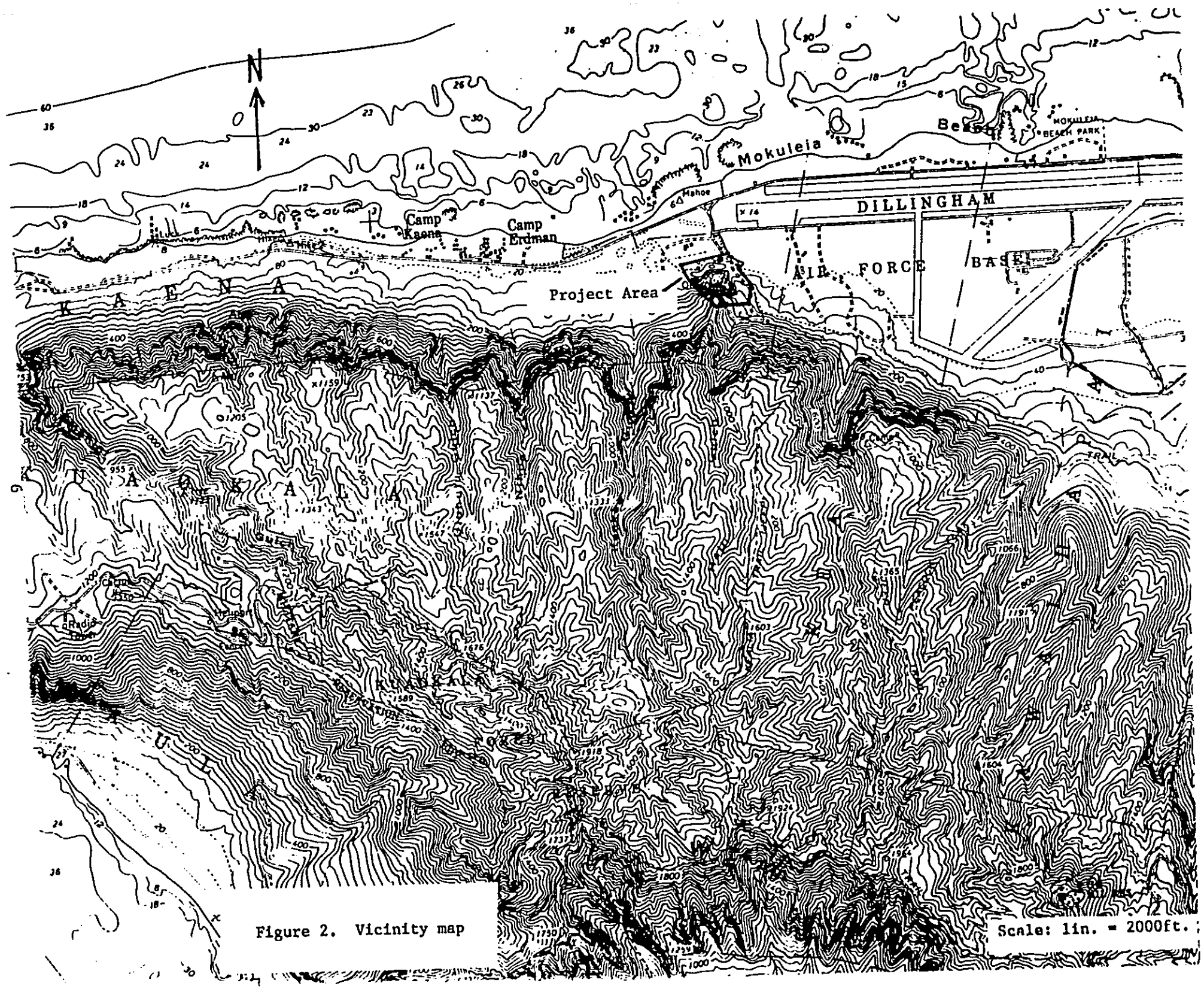


Figure 2. Vicinity map

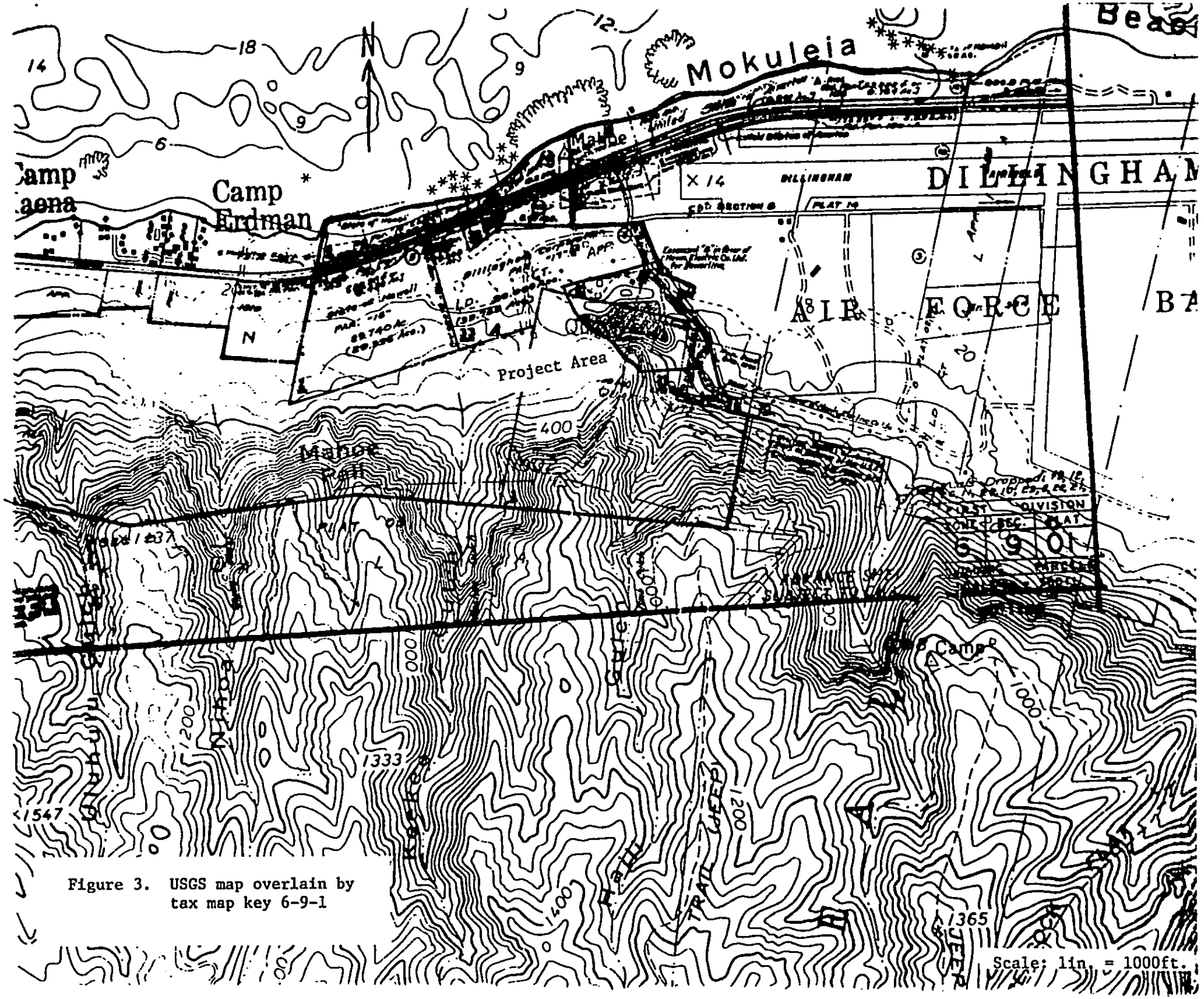


Figure 3. USGS map overlain by tax map key 6-9-1

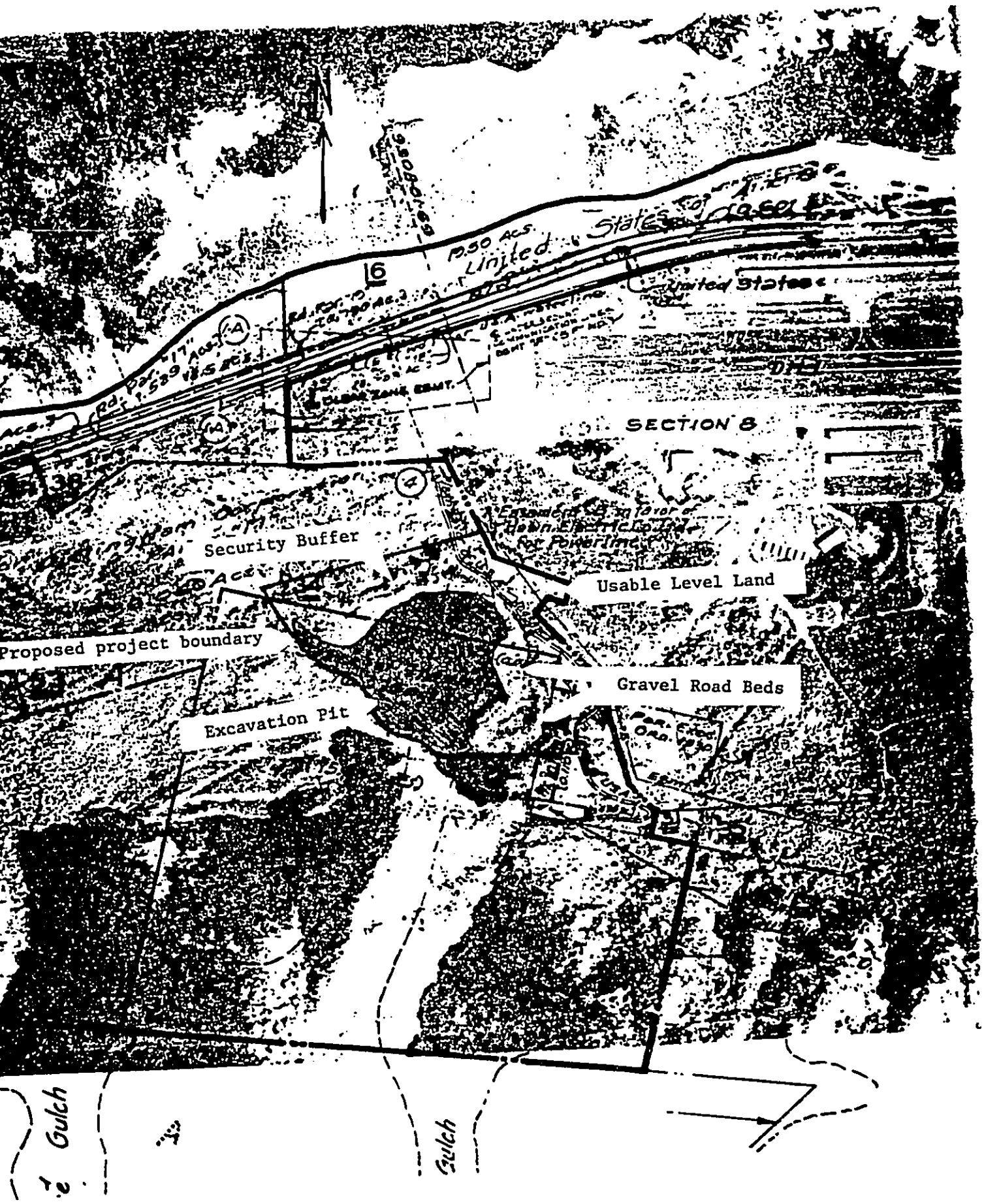


Figure 4. 1989 aerial photo of quarry site overlain by tax map key 6-9-01, with proposed project area and major features being indicated. Scale: 1in. = 500f

Figure 5. 1986 aerial photo of quarry site with the former quarry structures and various physical features being indicated.

Scale: 1in. = 200ft.

The balance of the quarry site, including the remaining portions of parcels 3 and 33, and all of parcels 2 and 36, is approximately 129 acres. These parcels are part of approximately 2,830 acres of land included in the Kaena Point State Park Conceptual Plan, being at the proposed eastern border of the Park, on the Windward Coast (Figure 6).

B. Proposed Action

The proposed action is the construction and operation of a small commercial freshwater aquafarm at the former quarry site, under a revokable permit, until such time as the area may be required by the State to implement proposed Kaena Point State Park development activities.

The applicants propose to utilize the existing water-filled excavation pit to raise various freshwater food fishes in floating cages for sale to local and mainland markets. The applicants also propose to utilize several of the old gravel roadbeds and other relatively level areas adjacent to the excavation pit for the placement of above-ground fish tanks and essential farm support infrastructure.

The cage culture operation is the primary focus of the proposed action. Chinese catfish and Hawaiian sunfish would be the primary species cultured in the cages. Grass carp Ctenopharyngodon idella, bighead carp Aristichthys nobilis, silver carp Hypophthalmichthys molotrix, channel catfish Ictalurus punctatus, and pongee Ophicephalus striata are the most likely possibilities for additional cage culture crops. All of the above fishes presently exist on Oahu in freshwater reservoirs or in existing commercial freshwater aquafarms.

The above-ground tanks would provide for multiple support and secondary purposes, including: (1) the maintenance and conditioning of broodstock fish, (2) hatchery and nursery activities for Chinese catfish, Hawaiian sunfish, and other cage cultured species, (3) the culture of aquarium fishes and aquatic plants, (4) applied research studies, and (5) the quarantine of fishes and other aquaculture animals and plants entering the site from outside sources.

C. Objectives and Justification of the Proposed Action

The quarry site has been unused for approximately 15 years, since the Hawaiian Bitumuls and Paving Company ceased their operations at the site in the mid-1970s. Subsequently, the excavation pit has served as a catchment basin, filling with rainwater and, possibly, a limited amount of basal brackish groundwater seepage; and the surrounding areas have become overgrown with scrub vegetation and exotic weeds and grasses.

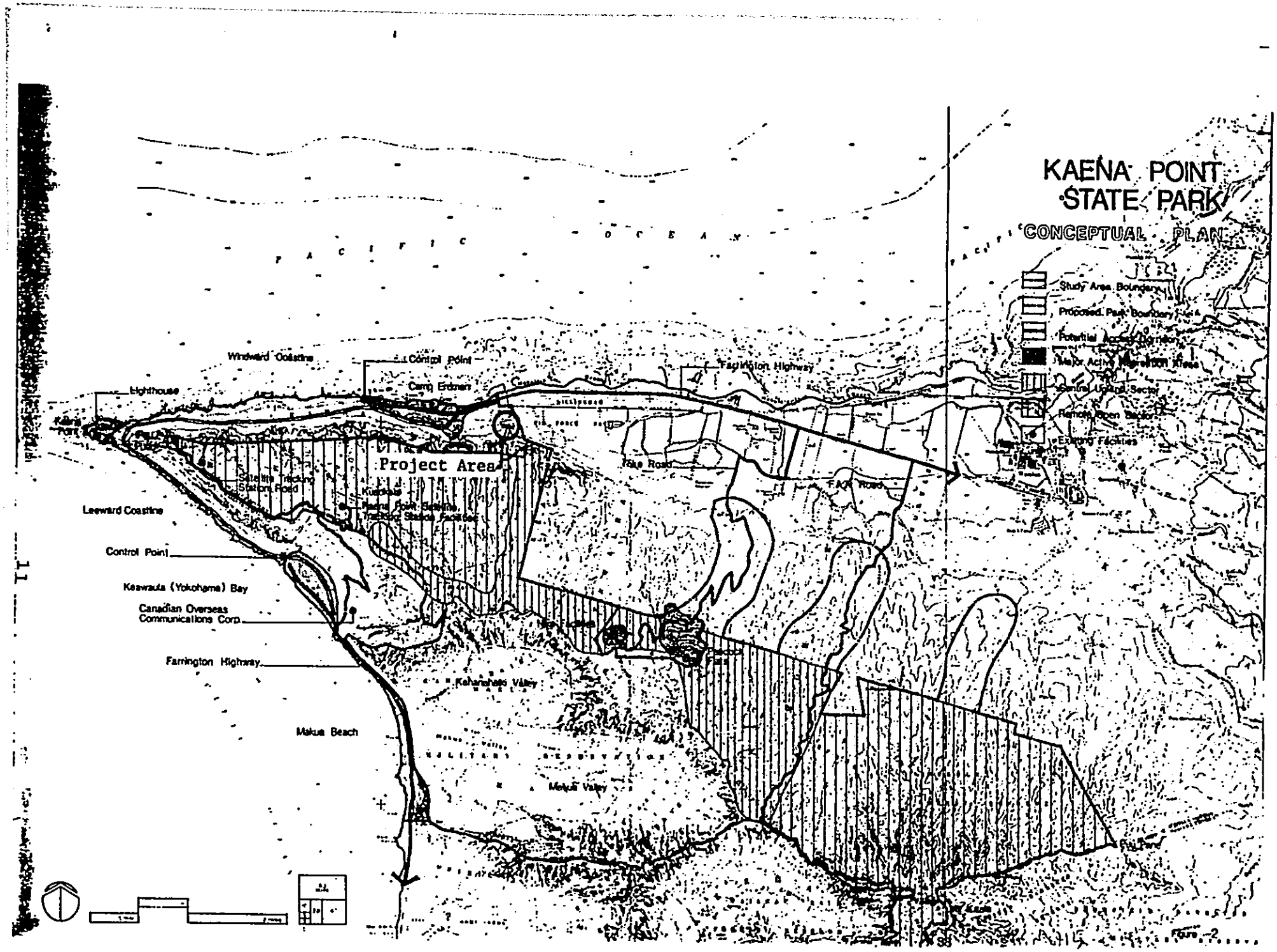


Figure 6. Proposed Kaena Point State Park boundary (State of Hawaii, 1978).

In addition, the site has been subject to trespass, littering, dumping, illegal quarrying activities, and vandalism. One drowning has occurred in the water-filled excavation pit in recent years, numerous brush fires have been set, and alcohol consumption, rock climbing, cliff diving, scuba diving, use of firearms, and the collecting of firewood from derelict quarry structures, have been commonplace occurrences.

The primary objective of the proposed action is to develop and operate a small commercial aquafarm on the eastern portion of the presently idle quarry site until such time as the area may be required for Kaena Point State Park uses. The applicants' proposed use of this area would enable HFS to expand its present Chinese catfish and Hawaiian sunfish production capacity, to diversify its product line, and in general to establish a larger and more economic local aquaculture business.

The proposed action would also help contribute to several stated or proposed public objectives. It would: (1) identify, preserve, and encourage the availability of a public site suitable for commercial aquaculture in State Conservation Lands, as proposed in Policy IA-3 of the draft Hawaii State Plan - Conservation Lands, 1990 (State of Hawaii, 1990), (2) provide an increased supply of locally grown aquaculture products for local markets and for export, thereby helping to reduce Hawaii's dependence on imported seafood products, (3) help maintain open space and the rural and agricultural character of the Kaena/Mokuleia area, and (4) provide new employment opportunities in this rural farming community.

In addition, the proposed action would: (1) help deter existing illegal activities at the site, (2) help promote Hawaii's expanding aquaculture industry through visits to the proposed aquafarm by school and other interest groups, (3) provide a site for cooperative research studies with ongoing State and University research programs, (4) help expand the overall information base on the production of aquaculture products in Hawaii, and (5) generate additional income for the State through the payment of rent and State taxes.

D. Technical Characteristics

1. Introduction

The applicants would draw upon their many years of aquaculture, fisheries, and business experience to plan, construct, and operate a successful and environmentally compatible aquafarm at the proposed project site. Floating cage culture and above-ground tank culture would be the two primary husbandry methods employed. Chinese catfish and Hawaiian sunfish would be the two initial species to be cultured. Other aquaculture products such as additional food fishes, aquarium fishes, and aquatic plants

would be cultured in the future, as available technology, market demand, and the applicants' time and finances permit.

The site's high level of solar radiation, warm temperatures, near constant exposure to the northeast trade winds, and the chemical make-up of the excavation pit water are all favorable for the proposed aquaculture project, as indicated by research trials at the site during this assessment study. The primary disadvantage of the site is its physical remoteness.

2. Floating Cage Culture

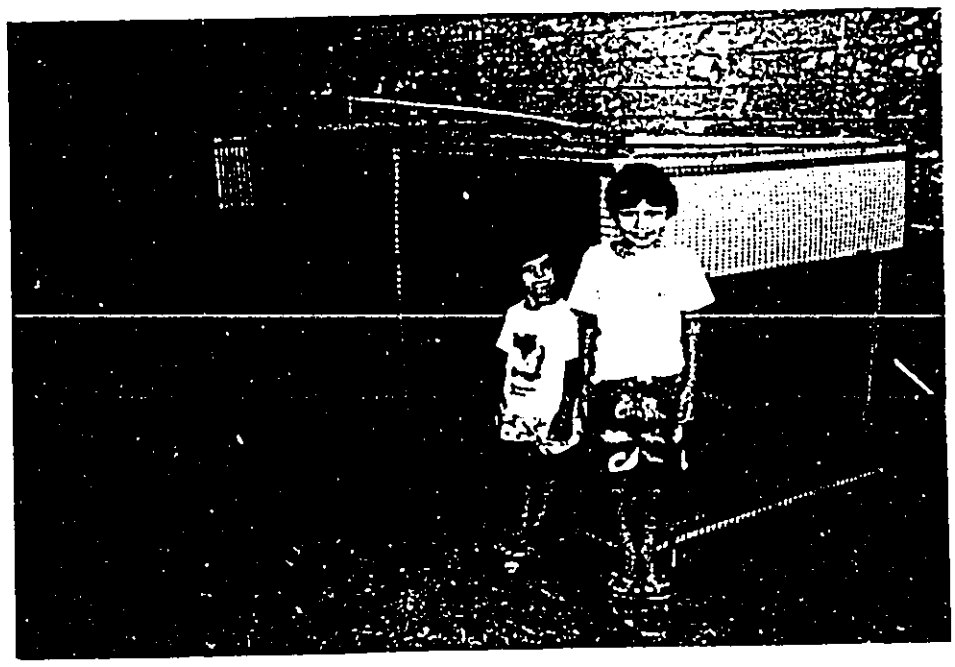
The water-filled excavation pit is approximately seven acres in size and has an average water depth of approximately 50 feet and a maximum depth of approximately 110 feet, making the net harvesting of cultured free-swimming fish, as is typically employed in Hawaii pond culture, all but impossible. Fishes reared in the pit in floating cages, however, could be readily harvested by means of a long-handled scoop net, thereby enabling productive use of such a large deep body of water.

Cage culture is a specialized form of aquaculture developing independently in Indo-China and Indonesia during the early decades of the twentieth century. Today, cage culture is widely practiced in these and other areas of Southeast Asia for the culture of catfish, carps, gobies, milkfish, and various marine fish; in Norway, Scotland, Canada, the northern United States, Bolivia, and Chile, for the culture of trout and salmon; in Japan, for the culture of yellowtail and red sea bream; and in the southern United States, for the culture of channel catfish and tilapia.

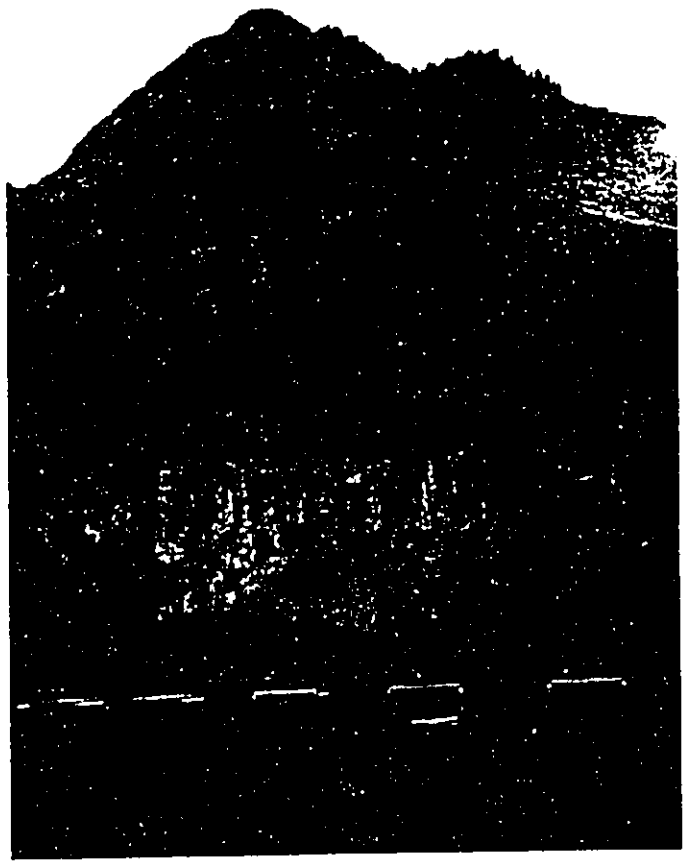
The cages to be used by the applicants would be of a floating design and, at least initially, would be rectangular in shape and of two basic sizes, both relatively small - 8ft(l) x 4ft(w) x 4ft(d) and 12ft(l) x 8ft(w) x 4ft(d) (Figures 7 and 8). These two sizes have proven to be suitable for the culture of Chinese catfish and Hawaiian sunfish at the applicants' Waimanalo and Punaluu farm sites and are sizes which are easily constructed, fed, managed, and harvested.

Larger sized floating cages may be utilized at a later date for the culture of larger or more active fishes such as the various carps and the pongee, eg., 20ft(l) x 20ft(w) x 8ft(d); and smaller cages may also be used for research trials and for rearing smaller-sized fishes.

Cage panels (sides and bottom) would be constructed of vinyl-coated welded wire or knotless nylon netting, both of which resist corrosion and rot in submerged applications, or, in part, of exterior grade plywood. The cage panels would be formed over a rigid frame of plastic pipe (Schedule 40 PVC) and/or wood. All

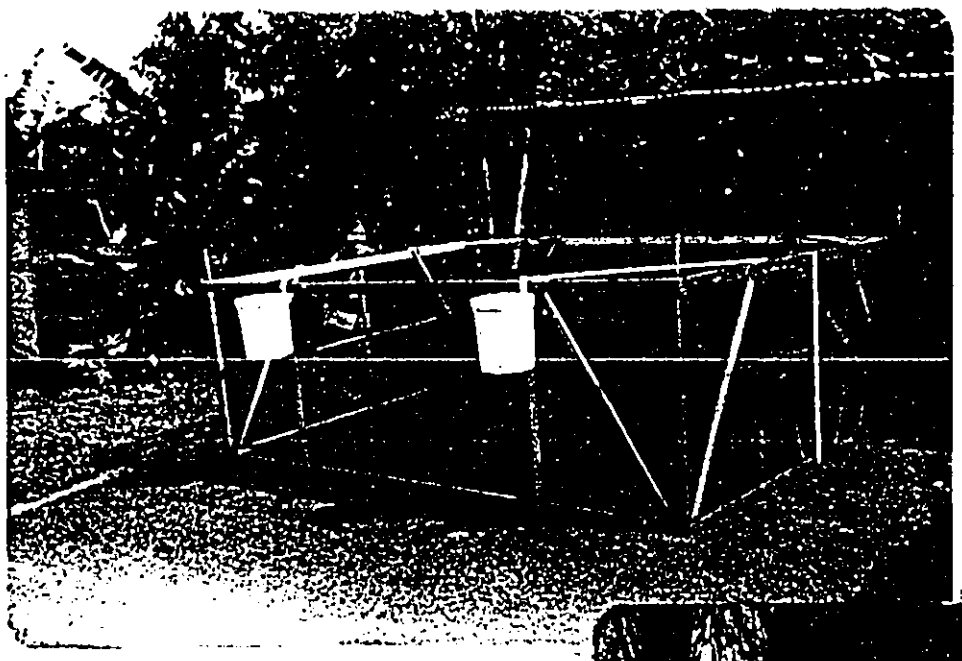


(a) Assembled vinyl-coated welded wire cages (Note: PVC frame, protective lids, and styrofoam floats).



(b) Research cages in Kaena aligned in rows and spaced eight feet apart.

Figure 7. Applicants' 8ft x 4ft x 4ft floating cages.



(a) Newly constructed cage with flotation and feed screen at Waimanalo aquafarm.

(b) Stocking cage with Chinese catfish fingerlings at Waimanalo aquafarm.

(c) Feeding Chinese catfish fingerlings at Waimanalo aquafarm

Figure 8. Applicant's 12ft x 8ft x 4ft floating cages.

fasteners used in panel and cage assembly would be of corrosion resistant stainless steel, brass, bronze, or copper.

Mesh sizes for the open panels would vary from 1/16 inch, for young fry, to 1 inch, for larger fish. The largest mesh size possible would be used for a given fish size so as to facilitate optimum water circulation through the cages. As the fish grow, they would be transferred to cages of a larger mesh size. Cage panels would be routinely cleaned, in place, of various fouling organisms, such as bryozoans, and of filamentous algae, to assure maximum water circulation at all times.

The cages would be covered by protective and securely attached lids to prevent the escape of the cultured fish, to prevent bird predation, and to deter theft and vandalism. Theft of cage cultured fish is a particular concern due to the high numbers of fish present in such a relatively small confined space. Cage lids would be constructed of vinyl-coated wire and extruded plastic netting, secured to wooden frames, or of sheets of plywood.

Cage flotation would be provided by blocks of styrofoam secured to the inside ends or corners of the cages. The freeboard or upper exposed portion of the cages above the waterline would be approximately 6 inches so as to minimize the area exposed to surface winds and wave action. The cages would be ballasted to minimize cage motion and to provide maximum protection against overturn during high winds.

The cages would be tethered by 1/16 inch stainless steel drop-lines secured to 3/16 inch stainless steel lateral cables and anchor cables. Anchors would be concrete-filled cinder blocks. The cages would be aligned in rows to facilitate routine feeding, observation, maintenance, harvesting, and management activities; and would be positioned at least eight feet apart so as to minimize the cross circulation of water between cages.

Approximately 90 8ft x 4ft x 4ft cages and approximately 30 12ft x 8ft x 4ft cages would be constructed for the proposed cage culture operation. Initially, at least, the 8ft x 4ft x 4ft cages would be used to rear Chinese catfish and the 12ft x 8ft x 4ft cages would be used to rear Hawaiian sunfish. Adjustments in the shapes, sizes, and numbers of cages, and of the species cultured may be made over time, as suggested by on-site experience.

Optimum cage stocking densities vary according to the species and size of the fish being stocked, and according to the environmental characteristics of the resident water body. The optimum stocking densities for the proposed cage culture operation would be determined over time, by experimentation and operational experience. A stocking density of 750 Chinese

catfish per 8ft x 4ft x 4ft cage and 1000 Hawaiian sunfish per 12ft x 8ft x 4ft cage is planned initially.

Both the numbers of the cages and the stocking densities would be balanced according to the carrying capacity of the excavation pit, as indicated by a routine water quality monitoring program to be conducted by the applicants. This would insure favorable growing conditions for both the cultured and resident fish populations. A discussion of this matter is presented in section VII.G.

The fish would be fed a nutritionally complete pelleted ration twice daily, from a workboat. The daily ration would be adjusted at regular intervals based on fish size and growth. Either floating or sinking pellets could be used and both would be tried to compare their relative merits under actual field conditions at the proposed project site.

Cages receiving a floating diet would be fitted with internal feed retaining rings to prevent the loss of floating pellets out of the sides of the cages. Cages receiving a sinking diet would have solid or fine-meshed bottoms to prevent the loss of sinking pellets through the bottoms of the cages.

Chinese catfish are marketable at a weight of approximately 1/2 pound and Hawaiian sunfish are marketable at a weight of approximately 3/4 pound. Grow-out time from stocking to harvest is estimated at approximately one year.

The fish would be netted from the cages by means of a long-handled scoop net. The cages would be partially harvested in place, from a workboat. Final harvesting would be accomplished by bringing the cages to shore.

3. Above-ground Tank Culture

The lands adjacent to the quarry pit are rocky or sandy, making these areas unsuited for the construction of excavated, unlined ponds. Portions of these areas, in particular the old gravel roadways, are, however, relatively level and therefore are suitable for the placement of small above-ground tanks.

Above-ground tank culture is another relatively specialized form of aquaculture. Above-ground tanks have been used in the past primarily in hatchery operations and for research, but are now being used increasingly for intensive fish and shrimp production by the aquaculture industry.

Small above-ground tanks would be set up in two areas at the proposed project site, in the hatchery/broodstock area and in the hatchery/nursery area (Figure 9). The relatively limited amount of level space present at the proposed project site precludes the

Figure 9.. Proposed siting of above-ground hatchery tanks and support infrastructure at Kaena quarry site.

use of larger tanks or of having all tank culture activities in a single area.

The tanks in the hatchery/broodstock area would be used for: (1) the conditioning and maturation of broodstock, (2) various spawning activities, (3) conducting applied research trials, (4) the quarantine of animals and plants brought to the site from other areas, and, (5) possibly, the storage and treatment of excavation pit water.

The tanks in the hatchery/nursery area would be used to: (1) grow fry to the sizes suitable for the stocking of the floating cages and, (2) possibly, for the grow-out of aquaculture species which may prove to be poorly suited for floating cage culture.

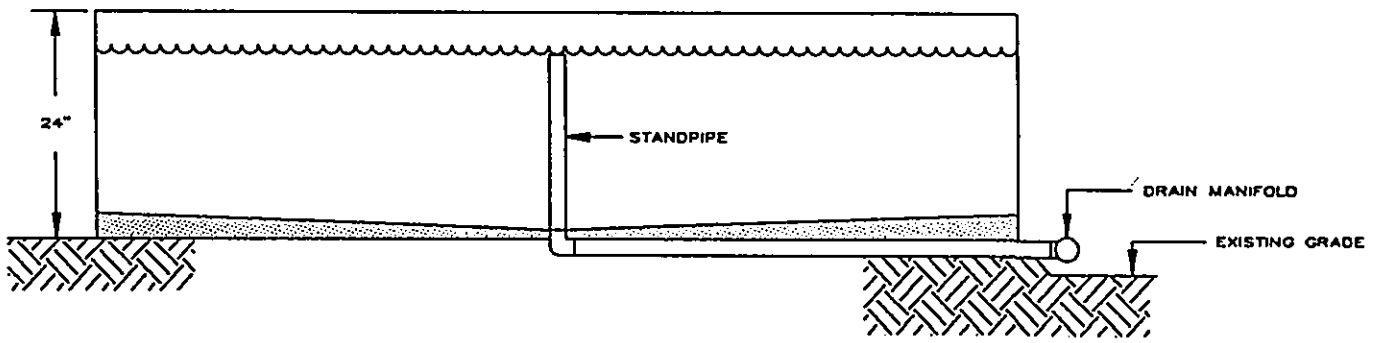
The proposed above-ground tanks would be circular in shape and would be constructed of sheets of 1/4 inch exterior grade plywood bolted together, end-to-end, with stainless steel fasteners, and fitted with PVC liners (Figure 10). Tanks of this design are relatively inexpensive and easy to construct, and are widely used by the Hawaii aquaculture industry (Figure 11).

Initially, approximately 12 24ft(dia) x 2ft(h) tanks and 40 15ft(dia) x 2ft(h) tanks would be constructed in the hatchery/broodstock area, and approximately 18 15ft(dia) x 2ft(h) tanks and 22 10ft(dia) x 2ft(h) tanks would be constructed in the hatchery/nursery area. The numbers and sizes of the above-ground tanks may be adjusted from time to time as suggested by operational experience at the site, by technological advances in the industry, and by changing needs of the proposed aquafarm and its markets.

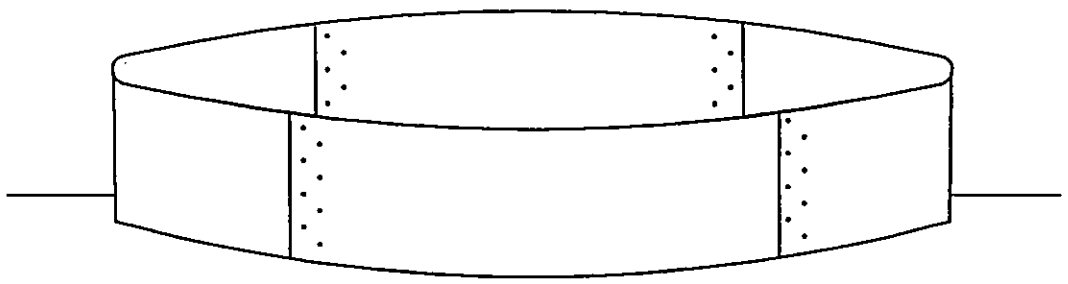
After the first six-months, all fry needs anticipated for the stocking of the proposed aquafarm would be produced by the on-site hatchery operations. Initially, fry would be brought in from another site. The use of an on-site hatchery would favor the optimum survival of fry at the time of cage stocking by minimizing the stresses due to handling and transport, and by eliminating the stress associated with a change in water chemistry.

Spawning, egg-hatching, and early fry rearing activities would be physically isolated from other hatchery, research, and quarantine activities so as to minimize the risk of disease contamination during the delicate early life history stages. This would be accomplished by the use of polyethylene-covered cold frames (temporary agricultural structures supported by lightweight arches of 1 inch PVC pipe or bolted rollformed galvanized steel) (Figures 12 and 13).

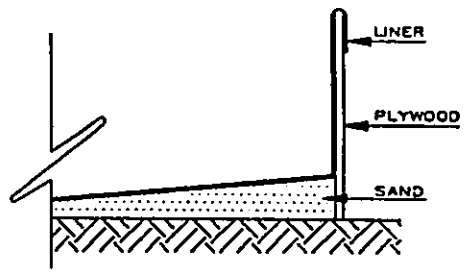
The use of temporary cold frame structures would also facilitate the maintenance of warm water temperatures during these critical



TANK CROSS–SECTION



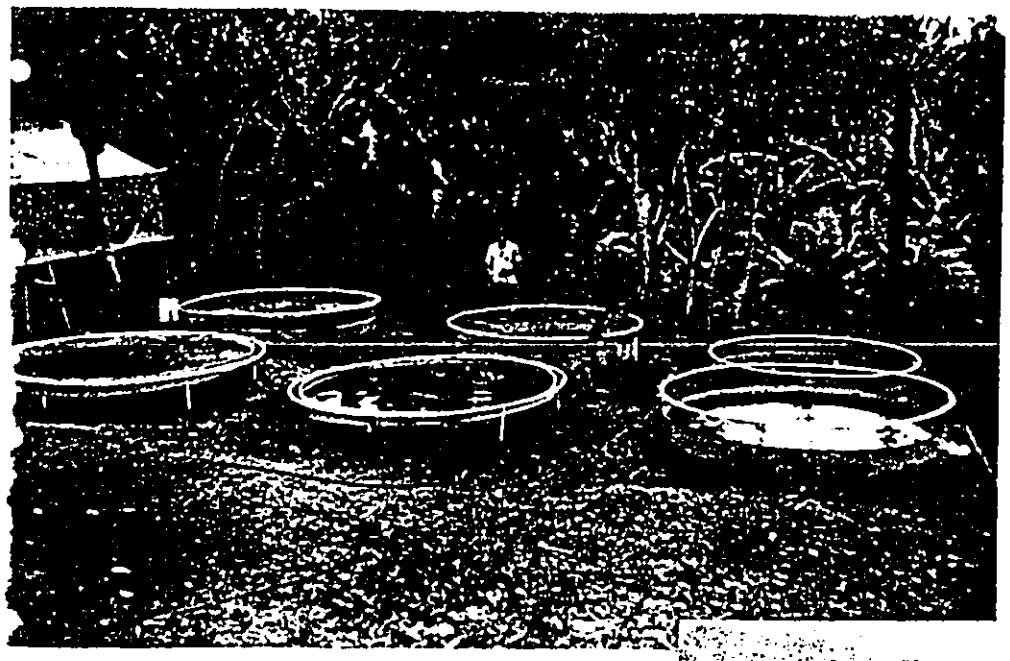
OVERVIEW OF TANK SHELL



LINER INSTALLATION

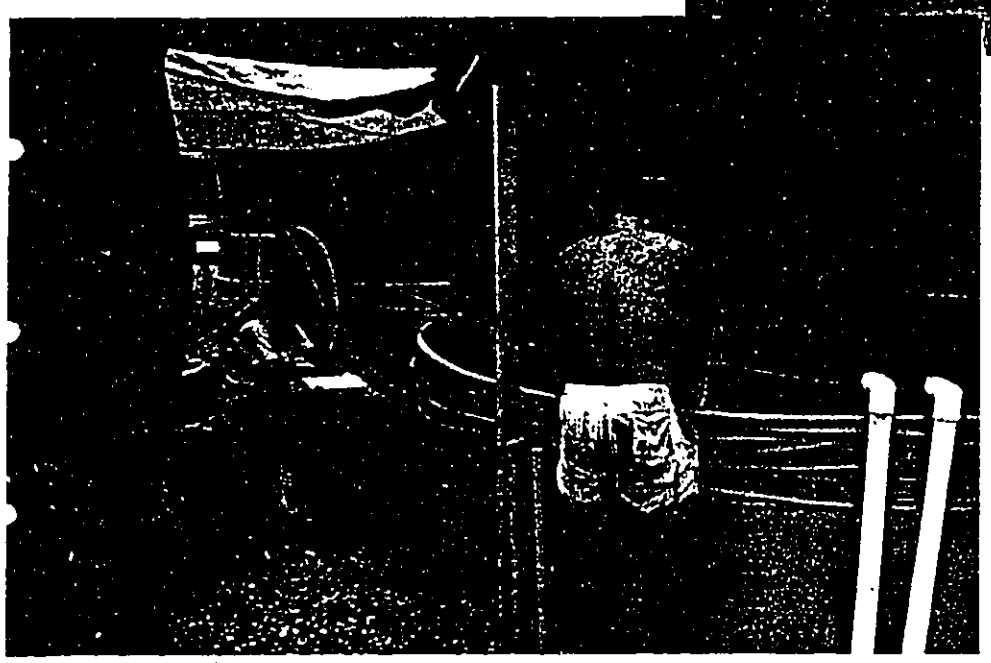
Figure 10. Circular above-ground plywood hatchery tank.

	AQUACULTURE ENGINEERING EXTENSION AG. ENG. DEPT., UNIV. OF HAWAII	
MATERIAL:	PLYWOOD LINER TANK DETAIL 24" HEIGHT, MULTIPLE WIDTHS	
SCALE: NONE	DRAWN: GREG JAKOB	OWNER: RON WEIDENBACH
SHEET: 1 OF 1	DATE: FEBRUARY 19, 1991	LOCATION: KAENA POINT, OAHU



(a) The applicants' pilot-scale hatchery in Waimanalo using 8ft. diameter circular tanks.

(b) The applicants' 12ft. diameter nursery tanks at Punaluu aquafarm.



(c) MRTC 12ft. diameter tanks with shade cloth canopies.

Figure 11. Examples of circular above-ground tanks used by the Hawaii aquaculture industry.

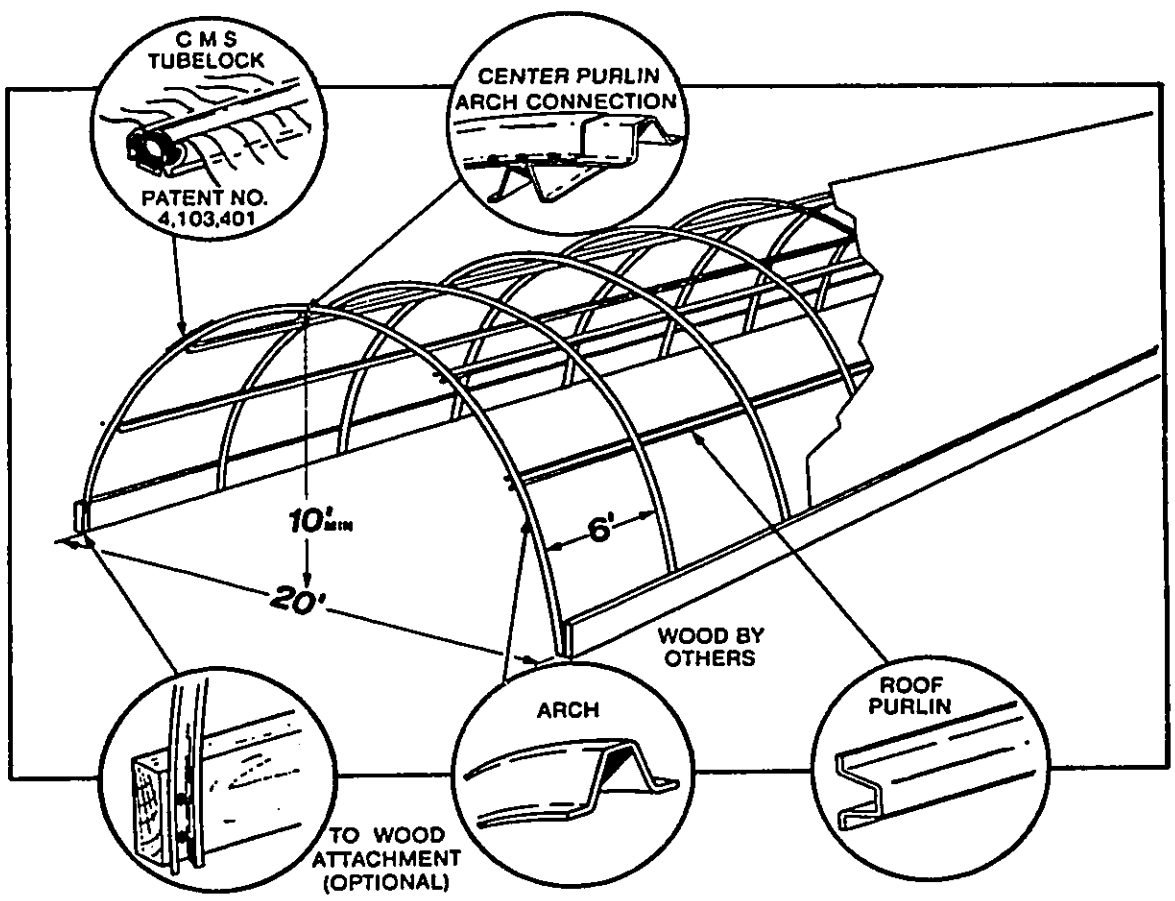
(a) Exterior view of temporary cold frame structure.

(b) Interior view of cold frame and hatchery tanks.

Figure 12. Applicants' polyethylene-covered hatchery cold frame supported by a PVC pipe frame at aquafarm in Punaluu.

CONLEY'S COLD FRAME

An economical greenhouse with surprisingly rigid structure, reliability and durability.



Standard sizes: 16′ and 20′ — other sizes available.

- Economical
- Easy to erect
- Compact for shipping
- All bolted—no welding
- Unlimited lengths
- Poly or shade covering
- All galvanized steel
- Pre-formed bows

CMS

Figure 13. An economical prefabricated temporary agricultural cold frame.

early life stages, thereby helping to provide the environmental conditions necessary for optimum fry survival and growth. The use of such structures would have the added benefits of providing a degree of security for the covered areas, and of providing protection for hatchery equipment and farm staff from Kaena's ever present salt mist and occasional rains.

The balance of the hatchery tanks would be variously covered with polyethylene film, shade cloth, or both, or left exposed, depending upon the use of a given tank. The tank coverings would likely be changed from time to time to accommodate adjustments in the species cultured and husbandry practices.

Potable well water from the U.S. Army well located at the Dillingham Airfield and operated by the State of Hawaii, Department of Transportation (DOT) would be the preferred water source for the spawning, egg hatching, and early fry rearing activities, which would be ongoing year-round. The use of well water for these purposes would help safeguard the eggs and young fry from exposure to fish diseases which are ubiquitous in surface waters.

The quarry site was previously serviced by the U.S. Army well, and the water tank for the well is located on the quarry property. If, however, the DOT is unable to resume water service from the well to the quarry site, then the applicants would pump water from the excavation pit to one or more above-ground holding tanks, and chlorinate, de-chlorinate, and filter the water in order to have an adequate supply of water for essential hatchery purposes. The chemical characteristics of the excavation pit water appear suitable for this purpose, if such a system is required.

The balance of the hatchery tanks, which would be used to rear the hardier larger fry and fingerlings, would be filled with freshwater pumped directly from the excavation pit. The water quality of the excavation pit water has been tested to be adequate for this purpose.

Water quality in the lightly- to moderately-stocked hatchery/broodstock tanks would be maintained by the use of aeration, nutrient stripping aquatic plants, and bio-filters, thereby eliminating or greatly reducing the need to continuously pump water from the excavation pit for routine water exchange. Tank discharge water, if any, would be pumped back to the excavation pit or used to irrigate landscaped portions of the proposed project area.

Water quality in the more heavily-stocked hatchery/nursery tanks would be maintained by the use of aeration, nutrient-stripping aquatic plants, and routine water exchange. Exchange water would pumped from the excavation pit to the tanks, and return to the

pit by gravity flow. The water exchange rate would be equal to approximately one complete tank exchange daily, initially, or a total of approximately 50 to 60 gallons per minute on a continuous basis for the 40 hatchery/nursery tanks. This exchange rate may be adjusted up or down over time, as on-site operational experience dictates, so as to ensure favorable water quality conditions in the tanks at all times. Water quality in the excavation pit would be maintained by balancing the total poundage of cage- and tank-cultured fish to the carrying capacity of the excavation pit, as is discussed in Section VII.G.

The tank-reared fish would be fed a nutritionally complete ration, as with the cage-reared fish. Partial tank harvests would be accomplished by means of a long-handled scoop net. Final harvests would be accomplished by draining the tanks into plastic harvest baskets.

The proposed hatchery/broodstock area is almost entirely level and ground preparation work would entail only minimal grading to smooth a few localized irregularities prior to the set up of the above-ground tanks. The proposed hatchery/nursery area is an old gravel roadbed and would require only the removal of scattered young Koa-haole scrub and Guinea grass prior to the set up of the tanks.

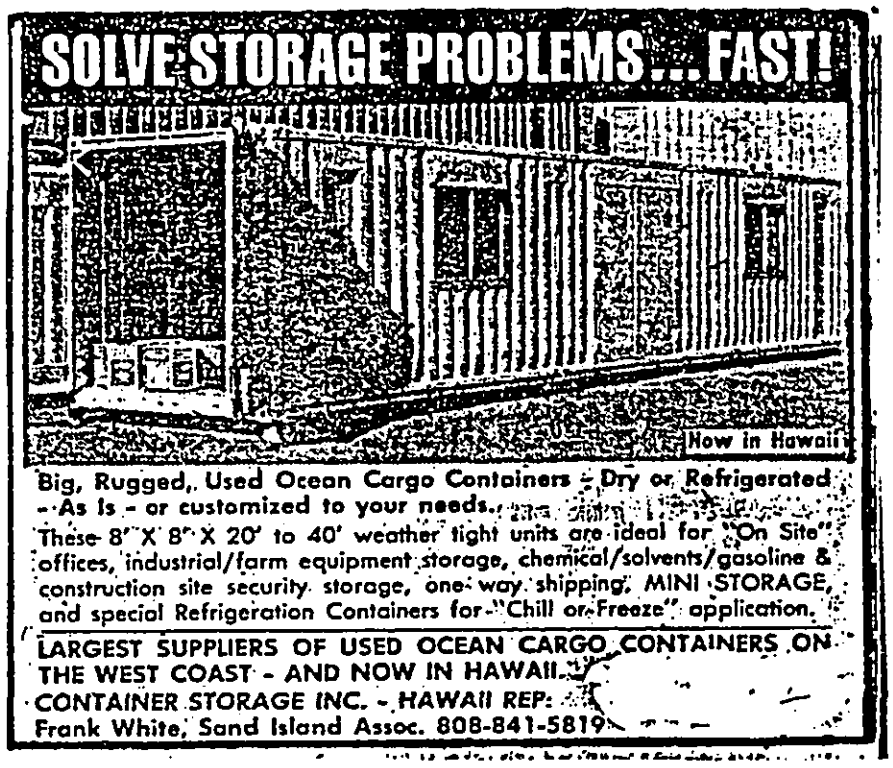
4. Farm Support Infrastructure

Farm support infrastructure would be set up at the proposed project site as necessary to operate a viable and secure commercial aquafarm. All farm structures would be temporary or modular structures, or modularly-constructed structures so as to minimize initial set up or construction time and to facilitate the later removal of the structures from the site.

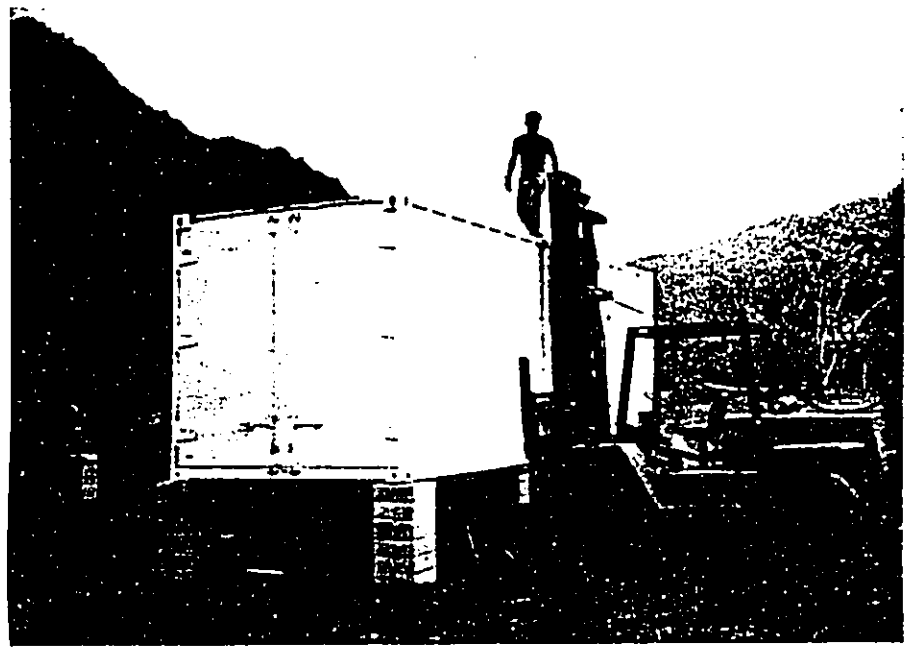
Feed and equipment storage space, and laboratory and workshop space would be provided by reconditioned aluminum ocean-shipping dry-storage containers (Figure 14). Ocean-shipping containers are widely used for these and other purposes by Hawaii's agricultural, construction, transportation, food service, and petroleum industries, and by such organizations and companies as the Honolulu Police Department, the University of Hawaii, United Parcel Service, Waldron's Feed Mill, and A Quik-Stor of Hawaii, a self-service rental storage space company (Figures 15).

Six containers would be relocated to the proposed project site in order to expedite farm start-up (Figure 16). The applicants would purchase one additional container during the first year to facilitate farm construction activities. If additional storage space is required, then additional containers would be purchased.

The containers would be set up makai of the hatchery/broodstock area, adjacent to the water tower access road, so as to

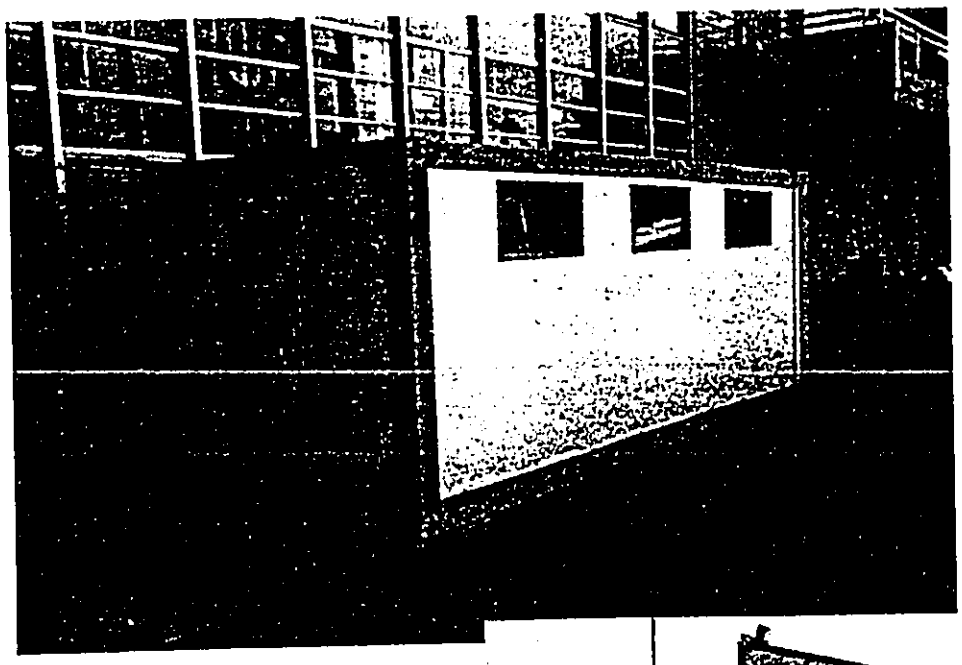


(a) An advertisement for ocean cargo containers.



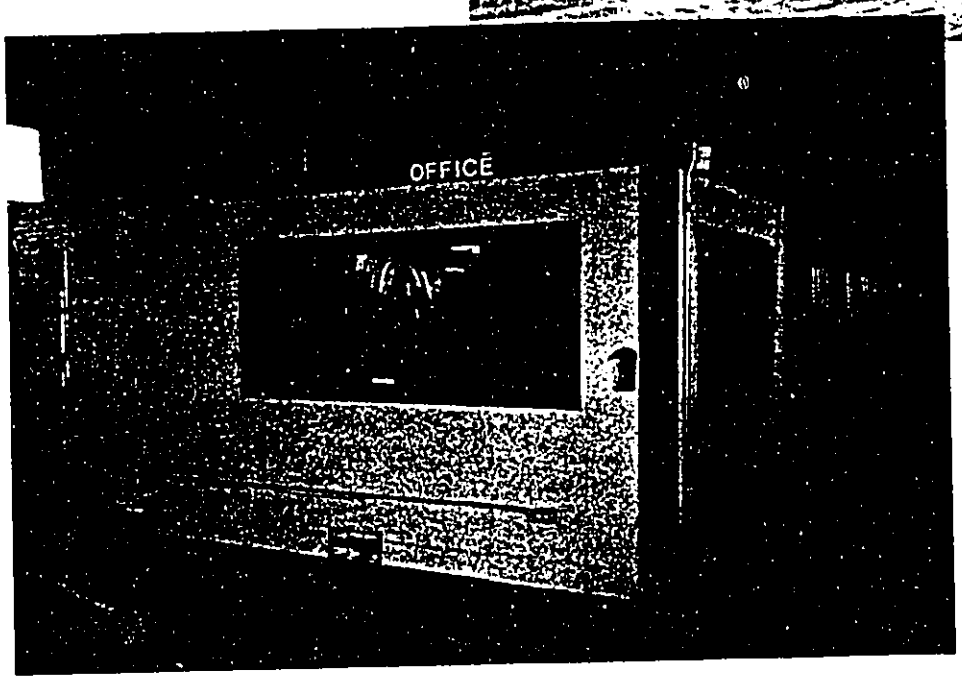
(b) Ocean cargo containers are quickly set up on job sites, and can be easily removed.

Figure 14. Ocean cargo containers are a versatile and inexpensive form of temporary storage, work, and office space.



(a) Ocean cargo container modified for storage and laboratory space at the University of Hawaii at Manoa.

(b) Double-stacked ocean cargo containers used for office space at CPM & F Express, Inc. trucking company, Sand Island.



(c) Ocean cargo containers modified for office and mini-storage space. Makiki.

Figure 15. Examples of modified ocean shipping containers presently in use on Oahu.

(a) The applicants' six containers are placed so as to provide covered work space between the containers.

(b) The containers provide protection for fish feed and farm equipment and supplies.

Figure 16. The applicants' existing ocean cargo containers are used for storage and work space at their Punaluu aquafarm.

facilitate daily farm operations and the delivery of equipment, materials, and supplies to the site, and so as to be close to the sources of electricity, telephone service, and potable water (Figure 17).

The proposed container area is almost entirely level, with the only surface irregularities being a few small mounds of soil and two concrete foundation blocks from the former quarry operation. Ground preparation would therefore require only minor alteration of the existing terrain.

A portable, pre-fabricated, or modularly constructed farm operations office of less than 1000 square feet in size would be set up or constructed on the rocky rise makai of the excavation pit. (Figure 18). It would physically overlook the proposed cage culture operation and also provide staff a partial view of the two hatchery areas, the container area, the entrance gate, and the makai property perimeter.

A hatchery office of similar size would be set up or constructed on the rocky rise mauka of the proposed hatchery/broodstock area. It would physically overlook the hatchery/broodstock area, the container area, and the entrance gate, and provide a partial view of the hatchery/nursery area.

Industry experience has shown that it is best to physically separate farm operation and hatchery functions from one another, in order to facilitate the daily operations of each, and for disease control. An alternative office site has been identified should one of the two primary office sites prove unsuitable.

The area proposed for the farm operations office is gently sloped and would require no grading prior to set up or construction. The area proposed for the hatchery office is also gently sloped and would require only minimal grading to fill in a few small localized areas of soil erosion prior to set up or construction.

The farm operations office and the hatchery office would double as staff or caretaker quarters. The round-the-clock presence of staff is essential to farm activities such as the nighttime spawning and feeding of catfish and other nocturnal species, and the nighttime and pre-dawn harvesting of fish in order to meet night and early morning mainland and inter-island flight schedules for product sales.

By physically overlooking their respective farm and hatchery operations, the two offices would also help staff provide essential round-the-clock security for the proposed aquafarm, seven days a week, to prevent trespass, theft, and vandalism. Additionally, round-the-clock security would help limit the applicants' liability exposure at the site.

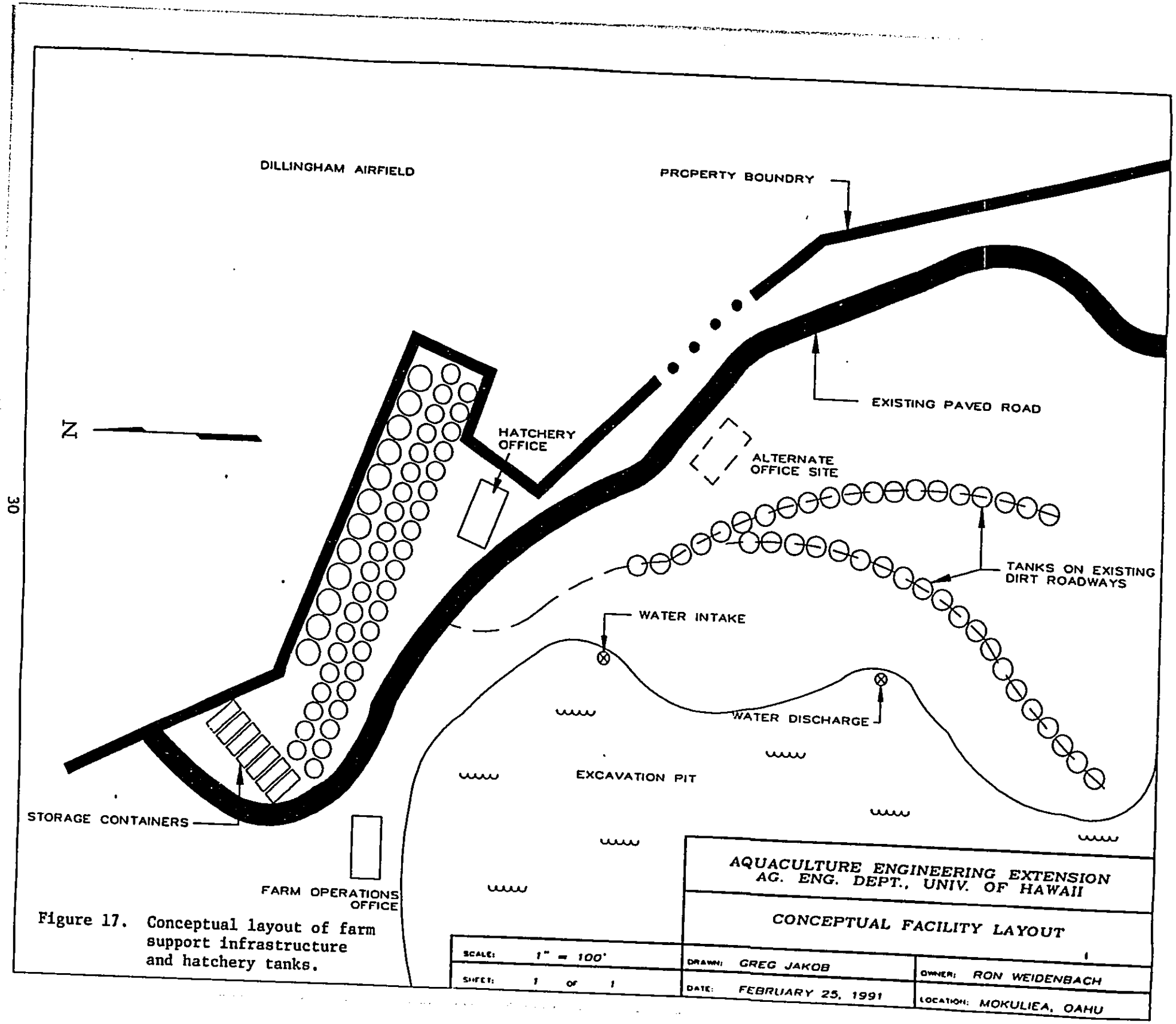
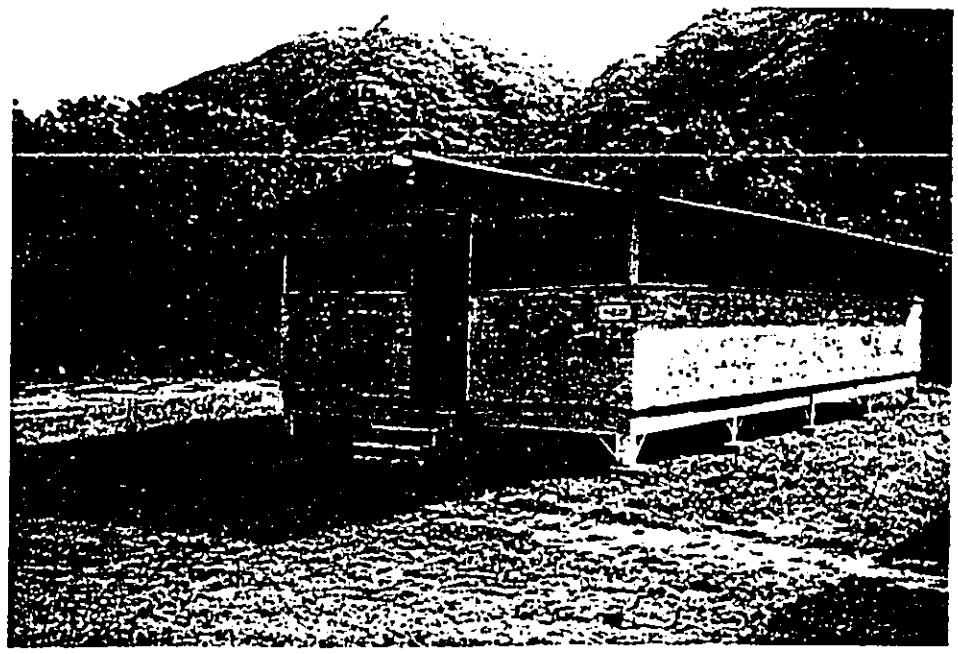
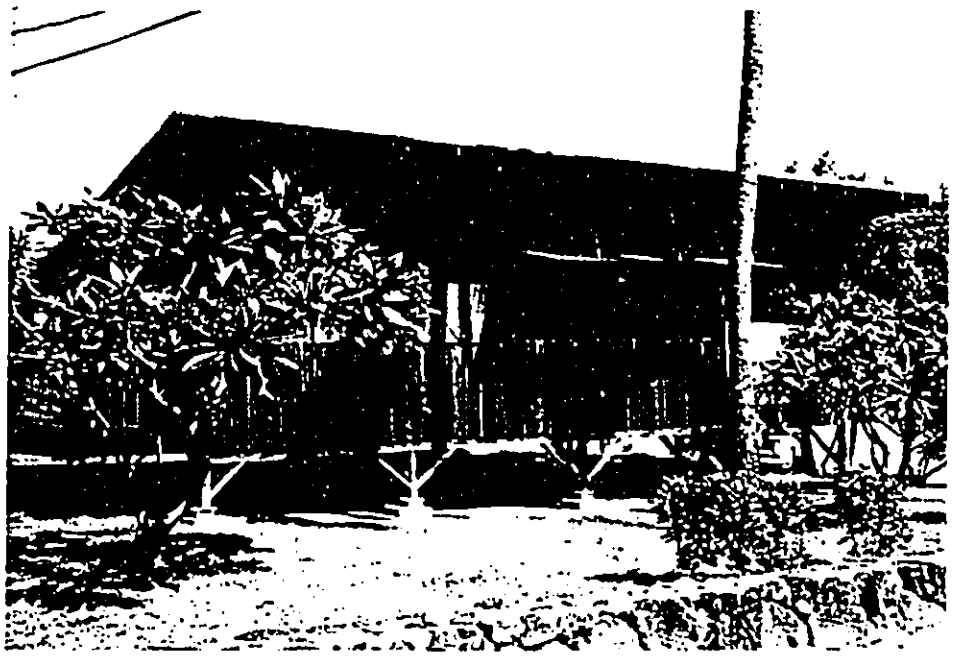


Figure 17. Conceptual layout of farm support infrastructure and hatchery tanks.



(a) One of six cabins at the Dillingham Airfield, Mokuleia.



(b) Simple rustic wooden cottage at Waimanalo Teen Center.

Figure 18. Examples of potential office structures.

Honolulu Police Department (HPD) officers covering the Mokuleia/Kaena area have advised the applicants to have staff staying at the proposed aquafarm at all times, in order to safeguard the proposed facilities and cultured fish from trespass, theft, and vandalism. During daytime working hours, the Dillingham Airfield UNICOM tower staff visually oversee activities at the airfield from the elevated vantage point of the tower and, to the extent possible, try to also watch such nearby areas as the quarry site and the Mokuleia Army Beach, reporting suspicious activities to the HPD. The tower closes at 5 p.m. daily, however, and HPD officers do not routinely patrol beyond the Mokuleia Beach Park after dark. Therefore, it would be entirely up to the applicants to insure security at the proposed aquafarm site during late afternoon and nighttime hours, and to notify HPD of any problems.

Electrical power and telephone service for the two offices are readily available at the proposed project site. Existing overhead electrical and telephone lines pass along the property boundary, adjacent to the proposed hatchery/broodstock area and container area.

Potable water service for the offices would hopefully be available from the DOT, as previously reviewed in the hatchery discussion. Alternatively, the applicants would chlorinate, de-chlorinate, and filter water pumped from the excavation pit for essential office and domestic purposes. The State of Hawaii, Department of Health (DOH), Safe Drinking Water Branch has stated that such a private water system, servicing less than 25 persons, would not be regulated under Hawaii Administrative Rules, Title 11, DOH, Chapter 20. They recommend, however, that the applicants try, if at all possible, to arrange with the DOT to reestablish potable water service to the site, as the U.S. Army well is a public water system routinely monitored by the DOH.

Sewage disposal for the proposed aquafarm would be by septic tank or other approved individual wastewater disposal system. The requirements for sewage disposal in State Conservation Lands are determined on a case-by-case basis by the DOH Wastewater Branch, as set forth in Hawaii Administrative Rules, Title 11, DOH, Chapter 62, Subchapter 1. Such a disposal system would be placed downslope and at a sufficient distance from the excavation pit to safeguard the excavation pit water from any waste contamination.

E. Economic Characteristics

The applicants' aquafarm operations in Punaluu and Waimanalo have provided the operational experience and financial information necessary to make accurate projections of results and financial analyses for the proposed aquafarm in Kaena. A business plan containing detailed business and financial information on the proposed project is available in a separate Appendix.

The proposed action would have several positive economic effects on the State's economy. It would: (1) create several skilled and semi-skilled employment opportunities during both construction and farm operation phases, (2) provide secondary benefits to certain local businesses by virtue of the goods and services purchased during construction and operation, (3) generate additional State revenues through the payment of rent and taxes, and (4) produce additional locally grown seafood products and thereby reduce the need for imports, possibly provide for additional export sales, and, in either case, favorably affect the State's balance of payments.

Chinese catfish and Hawaiian sunfish would be the two primary products grown at the proposed aquafarm. Secondary or future products may include one or more species of carps, channel catfish, pongee, aquarium fish, and aquatic plants. A determination of which of these would be grown, if any, would be made at a later date based on available technology, environmental considerations, and market conditions. Selected species would likely have similar husbandry and market characteristics as the two proposed primary species.

The applicants would sell their products in the People's Open Market, where they have been selling Chinese catfish since 1984, and to food stores, restaurants, and door-to-door vendors serving communities identified as having concentrations of residents who are preconditioned as buyers (Figure 19). There is presently an unsatisfied market demand for live Chinese catfish of perhaps 150-250,000 pounds annually in Hawaii, and for Hawaiian sunfish of perhaps 100-200,000 pounds. Market demand for these products may be increased with ongoing and proposed generic promotion efforts by the DLNR Aquaculture Development Program and the USDA Center for Tropical and Subtropical Aquaculture.

The proposed aquafarm would be established on a continuous basis over a three-year period. The first year would be used to: (1) grade and/or prepare the areas planned for the placement of above-ground tanks, ocean-shipping containers, and office structures, (2) construct 30 8ft x 4ft x 4ft and 10 12ft x 8ft x 4ft cages, (3) construct 22 10ft x 2ft hatchery tanks, (4) set up one cold frame, (5) relocate six ocean-shipping containers, (6) purchase one additional shipping container, (7) arrange for initial electrical and telephone hookups, and (8) purchase essential operating equipment.

The second year would be used to: (1) construct 10 12ft x 8ft x 4ft cages, (2) construct 30 8ft x 4ft x 4ft cages, (3) construct additional hatchery tanks, (4) set up a second cold frame, (5) set up or construct a farm operations office, (6) continue utility hookups, and (7) purchase essential operating equipment.

(a) Chinese catfish or paltat are in high demand among local Filipinos and others of South-east Asian origin.

(b) The applicants package live fish selected by waiting customers.

(c) Market demand is for live Chinese catfish weighing approximately 1/2-pound each.

Figure 19. The applicants sell live Chinese catfish at the People's Open Market.

The third year would be used to: (1) construct another 30 8ft x 4ft x 4ft cages and 10 12ft x 8ft x 4ft cages, (2) construct additional hatchery tanks, (3) set up a third cold frame, (4) set up or construct a hatchery office, (5) finalize utility hookups, (6) install farm security fencing, and (7) purchase essential operating equipment. No additional capital expenditures are planned beyond the third year, except for routine equipment replacement.

First-year farm production is forecast at approximately 7,500 pounds. Production would increase substantially in years two and three. Full farm production would occur in year four, with a projected harvest of approximately 50,000 pounds. Operating expenses would be typical of those of most of Hawaii's aquafarms. Annual rent would be determined by assessment, as is general practice with a DLNR revocable permit.

F. Social Characteristics

The Mokuleia/Kaena area is a sparsely populated rural community characterized by agricultural, ranching, equestrian, general aviation, recreational, and retreat activities. The proposed aquafarm would be established and operated in such a manner as to be socially compatible with and beneficial to the existing rural community and ongoing area activities. The proposed aquafarm would generate a limited number of short-term employment opportunities during the construction phase of the project, and long-term employment opportunities would be created by the commercial operation of the farm.

Once operational, the applicants would make the aquafarm available for visits by organized parties such as local school students and other groups who would be interested in visiting an operating aquafarm. The applicants have hosted several groups of students and visiting aquaculturists at their Punaluu and Waimanalo operations, and have enjoyed such visits: Mr. Weidenbach is a trained naturalist and a former Park Ranger with the National Park Service, whose experience includes leading visitor groups on wilderness nature hikes; Mrs. Weidenbach is a former Hawaii tour guide with experience in leading groups on a variety of local visitor activities.

The proposed aquafarm would also be made available for appropriate and compatible biological and aquaculture research studies by local and visiting scientists and students. In addition, the applicants would cooperate with and be available to assist DLNR planners and staff in their studies and planning efforts related to proposed Kaena Point State Park development activities at the quarry site.

The applicants would also assist with the elimination of physical hazards and unsightly structures which presently exist on the

proposed project area, from the former quarry operations. The applicants worked with the Hawaii National Guard, 227th Engineering Company, during the summer of 1990 when the Guard began the demolition and clean-up of major quarry structures, and would do so again if the Guard continues their clean-up efforts of the site in subsequent summers.

Following Guard demolition and clean-up efforts, the applicants would undertake a more detailed clean-up of the proposed project area, would take measures to make remaining man-made and natural hazards as safe as possible, would install perimeter fencing, and would undertake beautification efforts with the planting of cover crops and trees suited to the site's physical conditions.

Finally, trespass, littering, and various other illegal or unsanctioned activities are presently taking place at the quarry site. These would be curtailed by placing the site in aquaculture in accordance with the proposed action.

G. Environmental Characteristics

The construction and operation of the proposed aquafarm would result in no significant negative environmental impact to the project site or surrounding areas. No harmful chemicals or materials would be used in the production of the fish crops, and no discharge would occur from the excavation pit to the ocean or surrounding land areas.

The proposed action has been carefully planned around the quarry site's existing physical features. The action would preserve the site's existing natural beauty and open space, make productive use of the resource, and help conceal or diminish the negative visual impacts remaining at the site from previous quarrying activities.

The natural beauty of the area is highlighted by the cliffs and talus slopes mauka of the excavation pit. No use or physical alterations are proposed for these steep, inaccessible, and physically unstable areas.

Construction activities would be limited to the placement of floating cages and attendant structures in the water-filled excavation pit, and to the placement of small above-ground hatchery tanks and essential support infrastructure on the existing gravel roadbeds and level work areas of the former quarry operation.

The excavation pit would require no preparatory work. The land areas would be prepared by removing the koa-haole scrub and by mowing the weeds and grasses. Minimal grading would be required to level a few mounds of soil and gravel remaining from the quarry operation, and to fill in a few small erosion channels.

These activities would be accomplished according to the guidelines and under the direction of the USDA Soil Conservation Service (SCS), Hawaii Field Office.

The operation of the proposed aquafarm would result in the limited and gradual enrichment of the excavation pit water. This minor impact would be both beneficial, controllable, and reversible. The water would be enriched as a consequence of the applicant's daily feeding of the cultured fishes. Increased levels of dissolved nutrients would enter the water via the metabolites of the cultured fish and via the decomposition of small amounts of uneaten fish feed. The latter would occur primarily in the form of fine feed particulates sifting into the water during routine feeding activities.

The dissolved nutrients presently in the excavation pit water have entered the system by leaching from the rocks which form the pit, and from the sediments and organic materials which have washed or fallen into the pit from the surrounding watershed. Due to the rocky and arid nature of the site, such natural nutrient inputs have apparently been rather limited, resulting in the pit's relatively low natural productivity.

The input of additional dissolved nutrients by the proposed aquafarm operations would promote an increase in the productivity of the pit's flora and fauna. This would be beneficial to the proposed action in two ways: (1) it would provide additional natural food supplies for the omnivorous Hawaiian sunfish and the planktivorous bighead carp and silver carp, and (2) it would provide increased natural shade with increased phytoplankton density, thereby reducing containment stress.

The increased natural productivity would result in no significant negative impact to the existing environment so long as the additional quantity of nutrients added does not exceed the carrying capacity of the excavation pit. It is not anticipated that the pit's carrying capacity would ever be approached by the proposed action, given the modest 50,000 pound annual production rate projected for the proposed aquafarm and the estimated 100 million gallons of water present in the pit, which translates into a production rate of approximately 500 pounds of fish annually per million gallons of water. By way of comparison, Hawaii's freshwater prawn ponds produce an average of approximately 1,500 pounds of prawns annually per one million gallons of water, or about three times the production rate projected for the proposed aquafarm.

A water quality monitoring program measuring early morning surface and bottom dissolved oxygen levels, mid-day surface water transparency levels (secchi disc measurements), and bottom sediment conditions would be established, in line with existing industry monitoring standards, to insure that favorable water

quality is maintained in the excavation pit and that the pit's carrying capacity is never exceeded. It is in the applicants' best interest to take the measures necessary to insure the long-term maintenance of the pit's water quality, so as to insure the optimization of fish growth and fish health.

Should any indication of declining water quality ever occur, the applicants would take immediate corrective action. Declining water quality conditions would be reversed over the short-term by immediately reducing fish feeding rates. Over the long term, declining water quality conditions would be reversed and their recurrence prevented by installing aeration and/or water mixing devices, or by decreasing the stocking densities of fishes in the floating cages and above-ground nursery tanks. The DLNR Division of Aquatic Resources has used an air-lift water mixing device in Wahiawa Reservoir for many years with considerable success (Devick, 1990). With the above management approaches, negative environmental impacts in the excavation pit can be avoided.

VIII. DESCRIPTION OF THE EXISTING ENVIRONMENT

A. Location

The proposed project area is located at the former Dillingham quarry site in Kaena, on the extreme western portion of the island of Oahu approximately 35 miles from Honolulu. The proposed project area is approximately 900 feet mauka of Farrington Highway, abutting the western end of the Dillingham Airfield and extending eastward towards Camp Harold R. Erdman of the YMCA. It involves portions of two land parcels identified by Tax Map Key 6-9-1: 3 and 33. These parcels are part of approximately 2,830 acres of land included in the Kaena Point State Park Conceptual Plan, being at the proposed eastern border of the Park, on the Windward Coast (North Shore).

The proposed project focuses on the quarry's water-filled excavation pit, which covers an area of approximately seven acres, and on approximately two acres of old gravel roadbeds and other relatively level lands to the east and north of the excavation pit. Total area, including the rocky slopes bordering the excavation pit and level lands, totals approximately 18 acres.

B. Access

Access to the proposed project area is from Farrington Highway along the west end of the Dillingham Airfield and the east end of parcel 36; and from Dillingham Airfield via Gate No. 4 and the paved water tower access road which transits the eastern ends of parcels 33 and 3, and passes the proposed container, hatchery, and office areas (Figure 20).

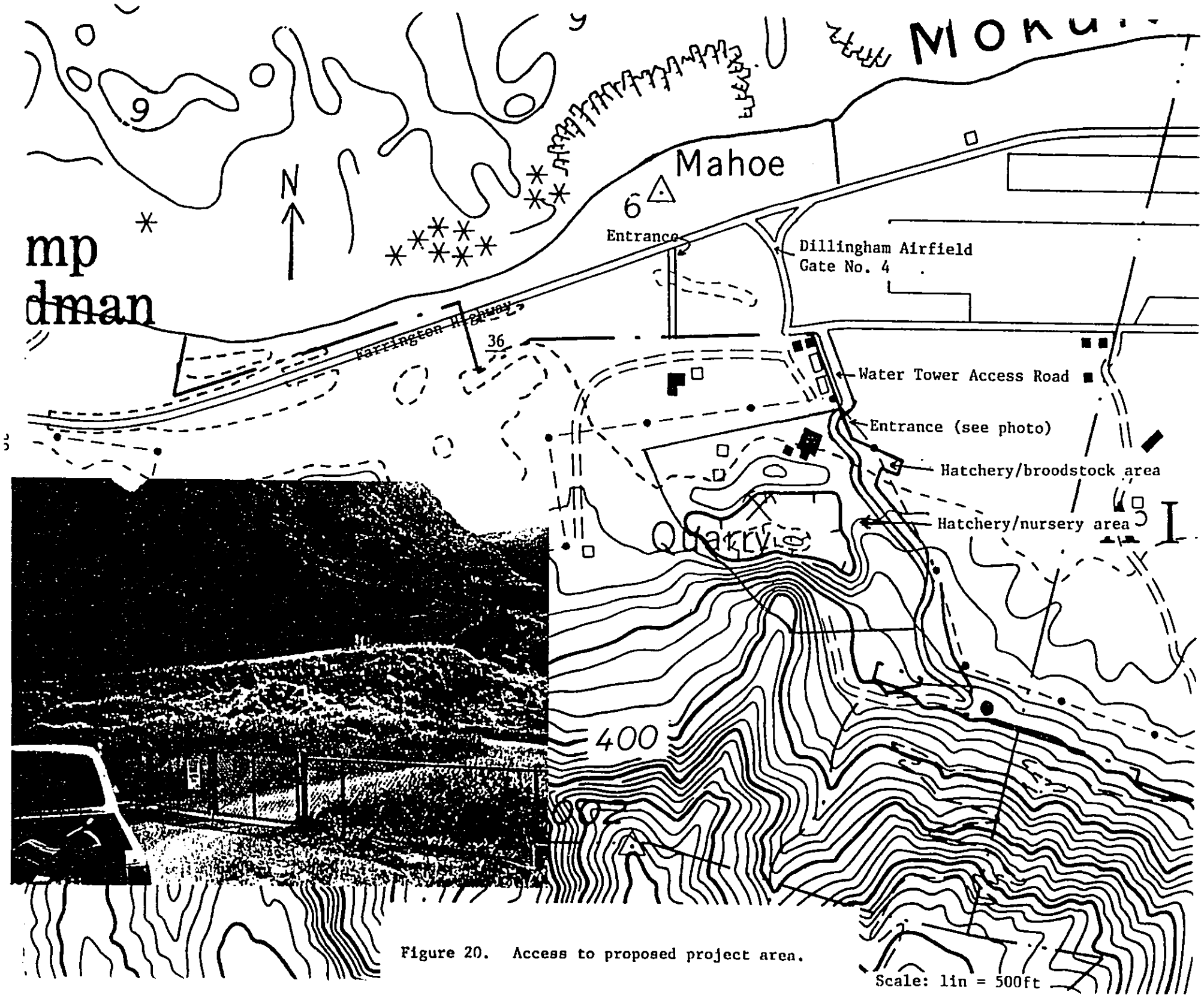


Figure 20. Access to proposed project area.

C. Surrounding Properties

The surrounding properties, in addition to the remaining portions of the quarry site, are: (1) Dillingham Airfield (to the north and east), (2) Mokuleia Army Beach (to the north), (3) a large tract of presently unused agriculture land and Camp Harold R. Erdman (to the west), and (4) the Kuaokala Forest Reserve and the Kuaokala Game Management Area (to the south) (Figure 21).

The Dillingham Airfield is presently leased to the DOT, by the U.S. Army, for general aviation. A Dillingham Airfield Master Plan is presently being prepared by Edward K. Noda and Associates to recommend future airport purposes and uses.

The Mokuleia Army Beach is presently open to the general public for swimming, fishing, picnicking, and camping.

Camp Erdman is operated by the Young Men's Christian Association of Honolulu and provides educational and recreational activities.

The Kuaokala Forest Reserve and the Kuaokala Game Management Area are managed by the DLNR and provide public hiking, camping, and hunting opportunities.

D. Population

The population around the proposed project area is rather limited, consisting of staff, tenants, and users of the Dillingham Airfield and Camp Erdman, a single residence located approximately one mile west of the quarry site and a short distance beyond Camp Erdman, and about ten beach-front residences located approximately one mile east of the quarry site between the Mokuleia Army Beach and the Mokuleia Beach Park. In addition, to the east of the Mokuleia Beach Park and extending to the Mokuleia Polo Field, approximately two miles east of the quarry site, are the Mokuleia Camp and Conference Center of the Episcopal Church, and another small residential community.

The Dillingham Airfield resident manager and his wife live in a house near the airfield UNICOM tower, approximately 1200 feet east of the proposed project area. Six barracks-style cabins are also present at the airfield, to the south of the UNICOM, for use by the Civil Air Patrol, the U.S. Army, the Hawaii National Guard, and other authorized users. The applicants presently have two of these cabins rented as temporary office/storage/caretaker cottage space in support of authorized research activities at the quarry site.

The tenants of the airfield include several small commercial operations, such as North Shore Aviation (Fightertown), Glider Rides, Honolulu Soaring Club, Soar Hawaii, Jump Hawaii,

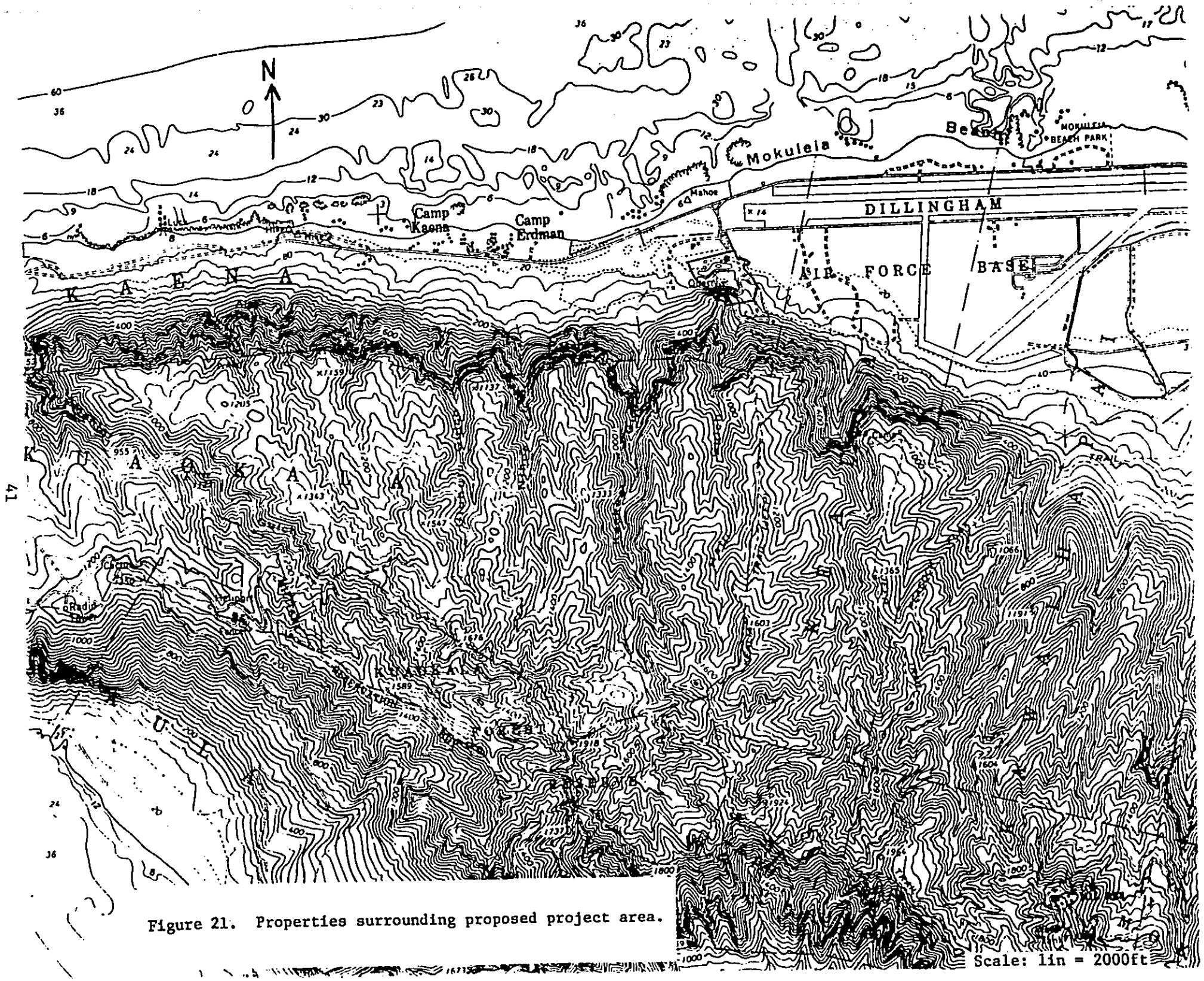


Figure 21. Properties surrounding proposed project area.

and Skydive Hawaii, and also several private general aviation tenants.

Camp Erdman has four staff cottages which house a total of eight persons. In addition, 23 rental cabins are present at the camp, for use by organized groups and the general public.

E. Landforms

The landforms in Hawaii are the result of construction by volcanoes, living organisms, and sedimentary processes, and of destruction by erosion (UH Dept. of Geography, 1983).

The proposed project area is on the north side of the Waianae Mountain Range, at the convergence of two physiographic divisions: the Mokuleia Deeply Dissected Upland, and the Waialua Plain, which is fronted by an uncliffed sedimentary coast (Figure 22).

The excavation pit and old gravel roadways are within the Mokuleia Deeply Dissected Upland, while the level lands makai of the excavation pit are within the Waialua Plain. To the east and west of the excavation pit are two deep gulches - the Haili Gulch and the Keekee Gulch.

F. Geology

The Waianae Range is the older of the two mountain ranges forming the island of Oahu, dating back approximately ten million years (State of Hawaii, 1977). Lava flows of the upper member of the Waianae Volcanic Series formed the large basaltic outcrop which was the focus of the site's former quarrying activities (Figures 23 and 24). This "former" outcrop is part of a geological formation classified Twb (Tertiary-Waianae-basalt). It is an extremely hard, dense, impermeable basalt, which is the reason the quarry excavation pit has served so effectively as a water catchment basin since the cessation of quarry activities.

To the east and west of this former basaltic outcrop and present-day excavation pit are deposits of recent, unconsolidated, non-calcareous sedimentary material (Ra), which give rise to the talus slopes to the east and west of the site. Makai of the basalt outcrop and non-calcareous formations, along the northern border of the proposed project area, are deposits of recent, unconsolidated, calcareous sediments (BM).

G. Hydrology

1. Groundwater

The proposed project area is located within Hydrographic Area VI., which includes part of the Schofield Plateau and the

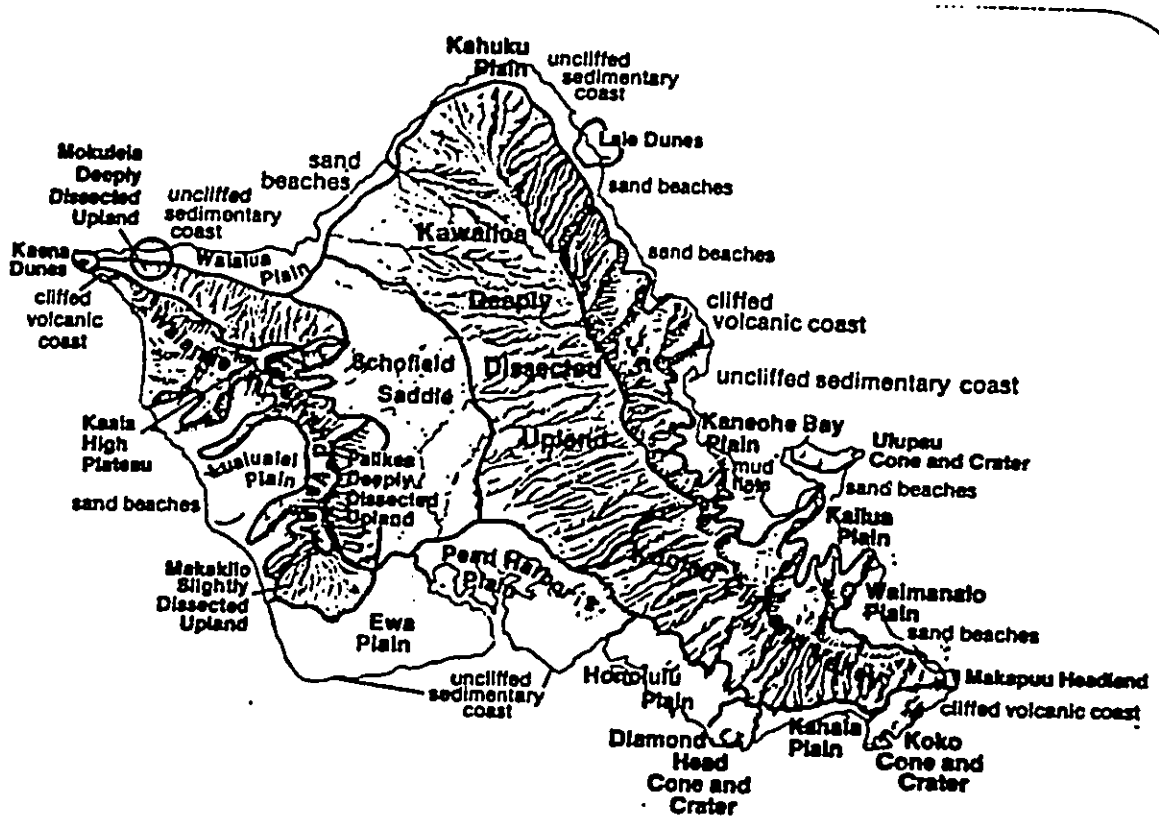


Figure 22. Map of physiographic divisions (UH Dept. of Geog., 1983).

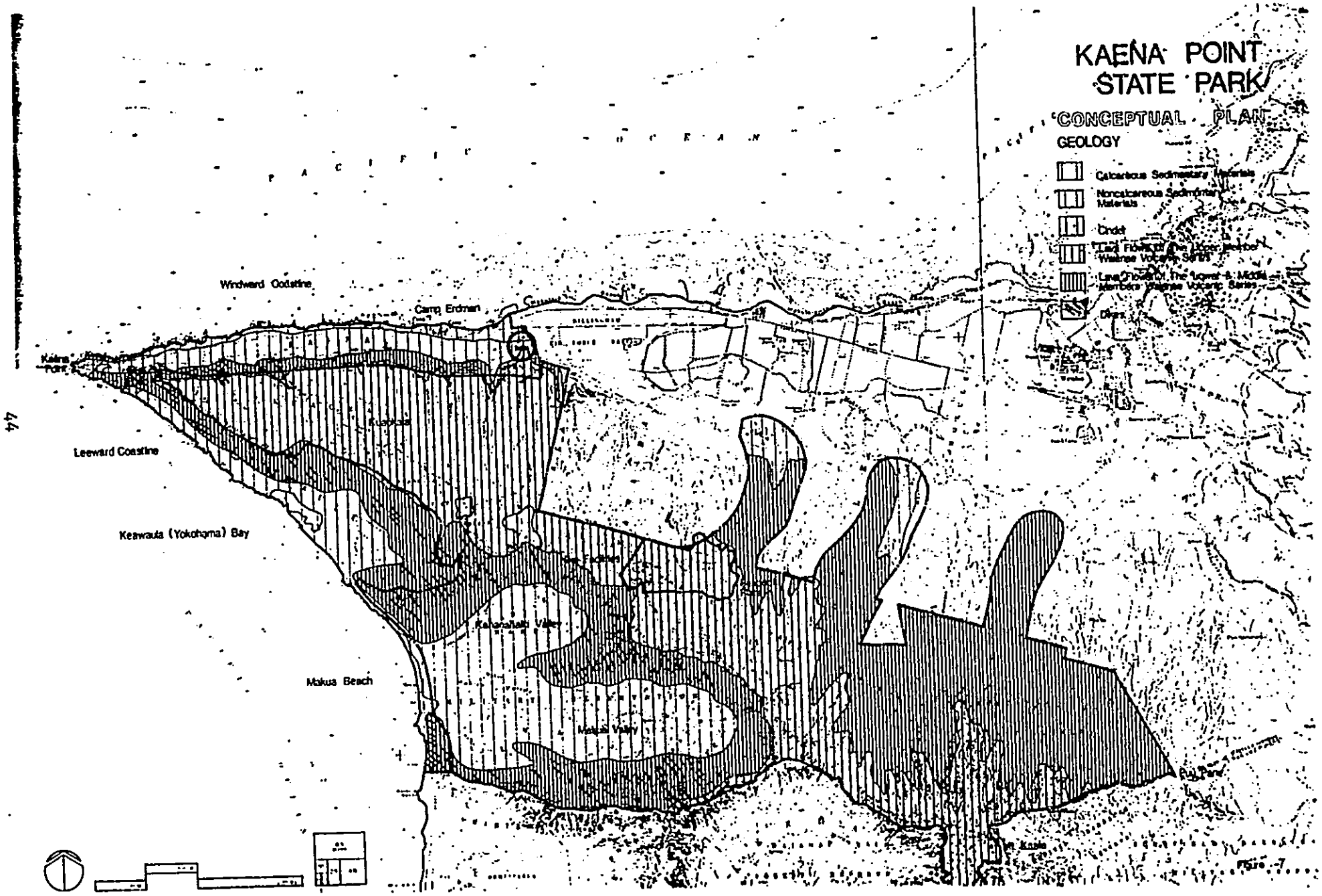


Figure 23. Geology of northwest Oahu (State of Hawaii, 1978).

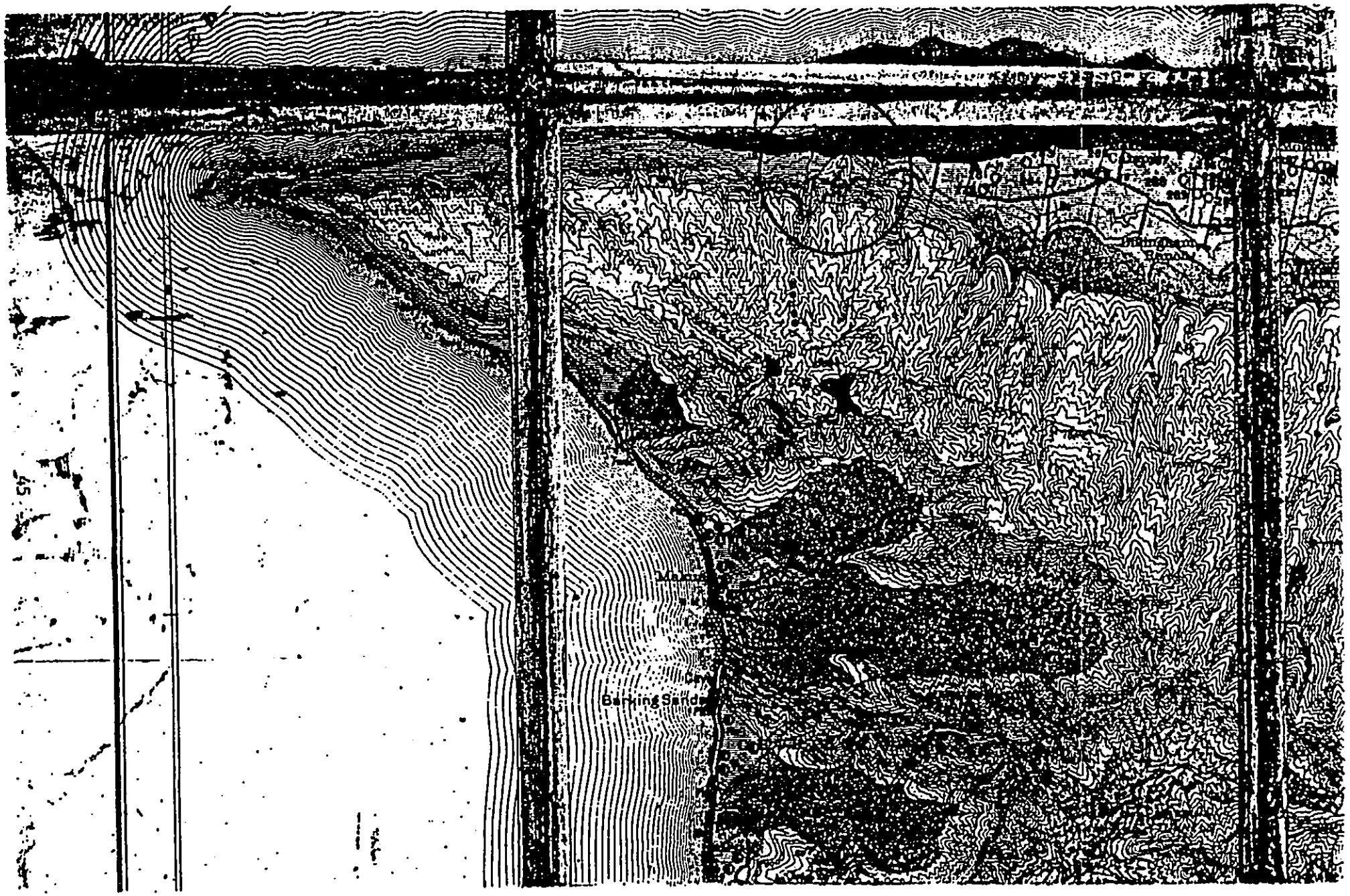


Figure 24. Geologic formations around proposed project area (USGS Map, 1938).

mountainous parts of the Waianae and Koolau Ranges (Figure 25). The associated aquifer is the Waianae Volcanics, described as follows: "Basalt, breccia, and intercalated soils; sediments consist of coralline limestone; terrestrial material is alluvium; partly confined" (USGS, 1986). Fresh groundwater in this aquifer is confined near sea level and at higher levels in dike complexes. Withdrawal of groundwater in Area VI. is managed under the Ground-Water Use Act; and designated as the Waialua Water Management Area. The principal uses of groundwater from Area VI. are for irrigation, public supply, and industrial activities.

U.S. Geologic Survey well records indicate that three wells exist, or have existed, near the proposed project site in recent times. Two of these wells are located near the west end of the Dillingham Airfield - one operational and one capped. The third well was near the northeast corner of the quarry site, but this well is no longer in existence. All of these wells are included in Isopiestic Area 12., Mokuleia.

The operational well at the Dillingham airfield is Well 34-12-01 (#278 B), known also as the U.S. Army well, which draws water from a depth of 63 feet. The chloride content of the water from this well has measured 134-170 milligrams per liter during various tests over the years, which is below the 250 milligrams per liter chloride standard for secondary drinking water. Specific conductance, dissolved solids, hardness, and alkalinity have been recorded at 633, 374, 115, and 66 milligrams per liter, respectively, and pH at 7.4 to 7.7.

The chloride content of the water from the former quarry well (depth 20 feet) was recorded at 189 milligrams per liter.

A small amount of groundwater may possibly enter the excavation pit through seepage.

2. Surface Water

Flowing surface waters in the Kaena/Mokuleia area are present only on an intermittent basis. The primary source of flowing surface water at the proposed project site is the Haili Gulch, which discharges directly into the excavation pit during and after occasional heavy rains (Figure 26). Surface runoff from the mauka cliffs and from the water tower access road and culvert also flow into the pit.

An estimated seven million gallons of water accumulate in the excavation pit annually from watershed runoff and direct rainfall. There is no outlet or discharge from the pit. Water losses which occur are due primarily to evaporation and, possibly, to seepage. Seasonal water level variation in the excavation pit, over an 18-month observation period, was

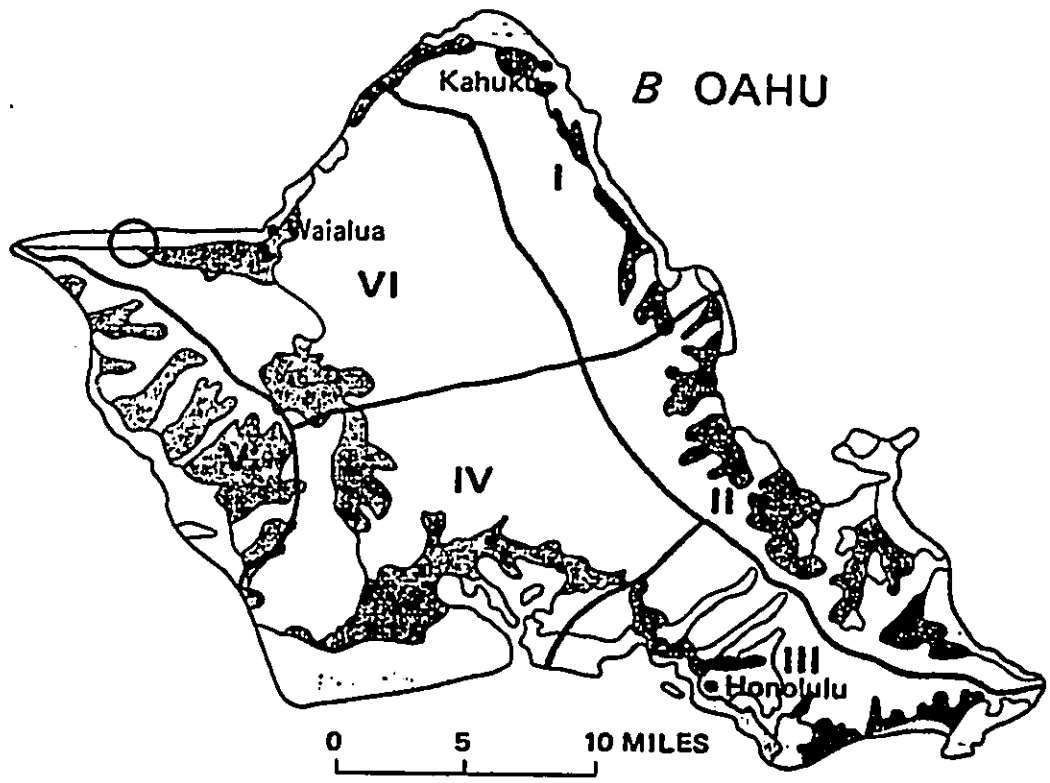


Figure 25. Principal aquifers of Oahu (USGS National Water Summary-Groundwater Resources).

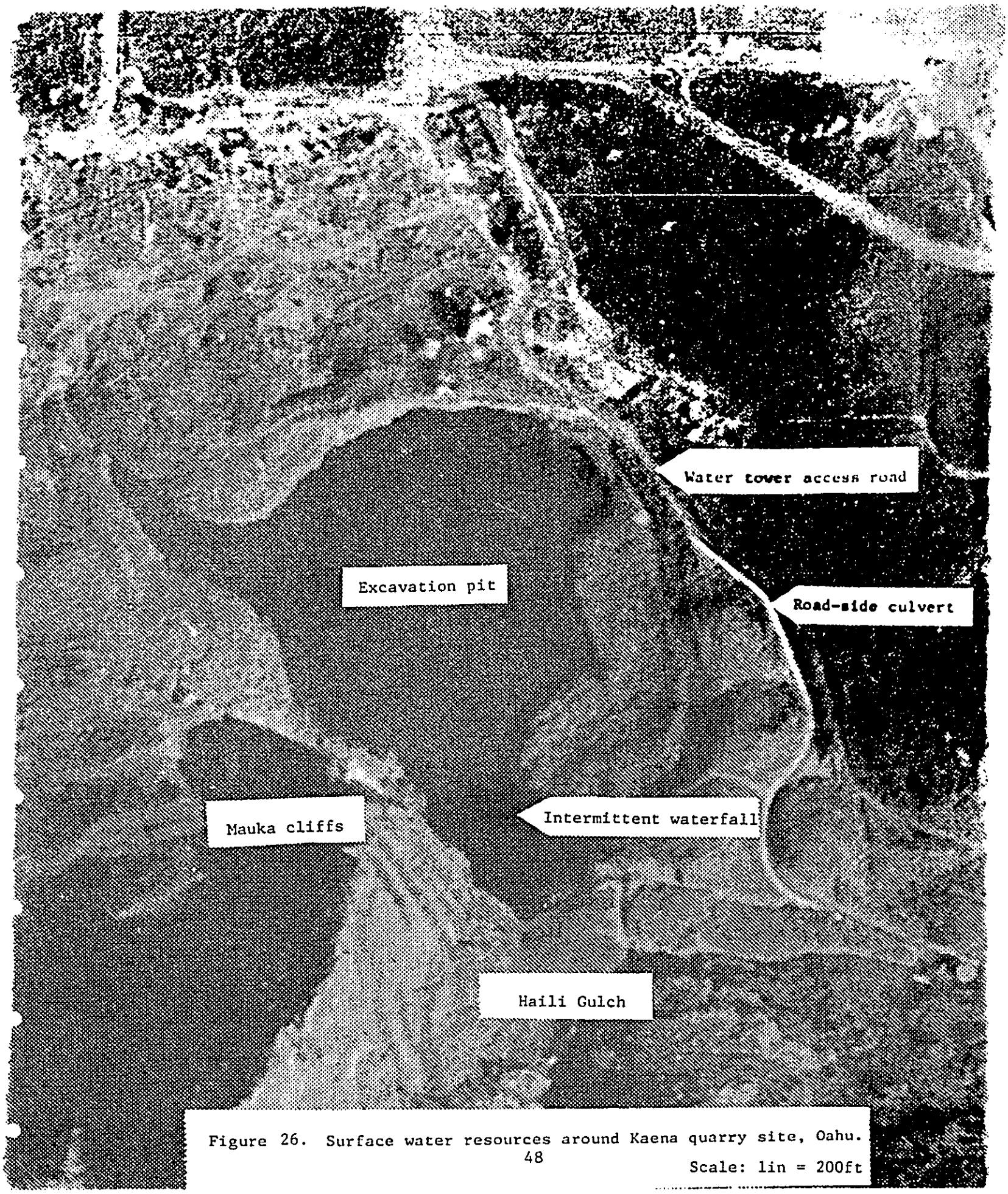


Figure 26. Surface water resources around Kaena quarry site, Oahu.
Scale: 1in = 200ft

approximately two feet. Water levels were highest during the winter months and lowest in late summer. Average annual excavation pit water volume is estimated to be approximately 100 million gallons; apparently being quite stable from year to year.

Turbidity of the pit water increases dramatically during and immediately after major rainstorms, due to the sudden influx of silt with the incoming surface runoff water. This suspended silt load settles out within a week or two, however, and no resulting problems have been observed for the resident or experimental fish populations in the pit.

Thermal stratification in the excavation pit was noted at three depths in July 1990, by a UH Aquaculture Extension Assistant scuba diving in the pit as part of this assessment. He reported thermoclines at depths of approximately 30 feet, 51 feet, and 72 feet, with the most pronounced temperature drop occurring at the first thermocline. Mid-day water temperatures in July were 83 degrees F (28.3 degrees C) at the surface and 72 degrees F (22.2 degrees C) at the bottom (depth 109 feet). Mid-day dissolved oxygen levels were 8 milligrams per liter at the surface and 3 milligrams per liter three feet above the bottom.

The mid-day surface water temperature in January was 71 degrees F (21.7 degrees C). The bottom water temperature was not measured in January but was likely to have been similar to the surface temperature. A seasonal overturn may occur if the winter surface water temperature ever falls below that of the bottom, at which time, in the presence of sufficient winds, the warmer bottom waters could rise to the surface.

The chloride content of the accumulated water was measured at 360 milligrams per liter, indicating the possible existence of a limited amount of brackish water seepage from the basal brackish water aquifer and/or an accumulation of sea salts from Kaena's ever-present salt mist. Hardness and alkalinity were measured at 205 and 187 milligrams per liter, respectively, and pH has been measured at 8.2 to 8.5. Little variation in these parameters has been observed between surface and bottom water measurements.

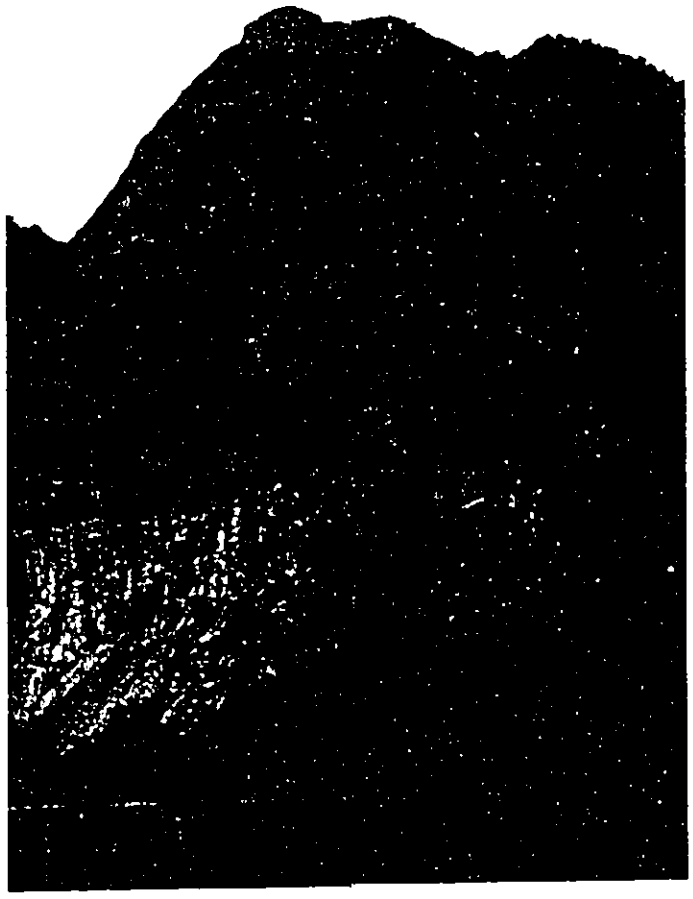
H. Topography

The present topography of the quarry area is highly variable, reflecting a history of approximately 35 years of active quarrying activities (Figure 27). There is little if any natural topography remaining at the proposed project site.

The north side of the quarry excavation pit consists of nearly vertical cliffs rising to an elevation of approximately 90 feet above sea level (Figure 28a). Shear cliffs on the south side of the pit rise to an elevation of approximately 400 feet (Figure 28b). The east and west sides of the pit are more gently sloped

Figure 27. Photo of excavation pit and surrounding lands (scanning from northwest to north).

(a) Cliffs to the north of the pit rise approximately 90ft.



(b) Cliffs to the south rise approximately 400ft

Figure 28. Sheer cliffs bordering quarry excavation pit.

and are the locations of former graded gravel roadways which led in and out of the quarry pit during operational times (Figures 29a and 29b). The slopes of these two sides range from 0 to 40 percent, and elevations vary from 30 to 60 feet above sea level.

The topography of the submerged portions of the excavation pit mirrors the portions above water, being steeply to vertically sloped along the north and south sides, and more gently sloped along the east and west sides. The pit's water depth averages approximately 50 feet, based on 20 randomly distributed soundings. The maximum water depth recorded to date is approximately 110 feet.

The northerly and easterly portions of the site, on the Waialua Plain, are generally level, except for localized areas where large boulders and mounds of crusher fines have been stockpiled (Figure 29c). The elevations of these level areas are approximately 20 feet above sea level.

I. Soils

The proposed project site is located at the juncture of two soil associations, the rock land-stony steep land association and the Kaena-Waialua association (Figure 30). The former is described as steep to precipitous well-drained to excessively drained, rocky and stony land; the latter as deep, mainly nearly level and gently sloping, poorly drained to excessively drained soils that have a fine-texture to coarse-textured subsoil or underlying material.

The SCS classified the proposed project area simply as a quarry in their 1972 survey of Oahu's soils, and provided no further soil analyses on the site (Figure 31). Three soil classifications are indicated, however, for the adjacent land areas, and these classifications are in agreement with our soil observations.

The steeply sloped lands to the south of the quarry site are solid basalt, classified by the SCS as rock land (rRK). The same classification should be indicated for the excavation pit and the steeply sloped land immediately to the north and south of the pit. Rock land is made up of areas where exposed rock covers 25 to 90 percent of the surface. The rock outcrops and very shallow soils are the main characteristics of rock land. This land type is typically used for pasture, wildlife habitat, and water supply.

The lands to the west of the quarry site are classified as stony steep lands (rSY) by the SCS. The same type of soil is present at the quarry site, to the west of the excavation pit, and immediately to the east. Soils of this classification consist of masses of boulders and stones deposited by water and gravity on

(a) Former graded gravel roadway proposed for placement of hatchery/ nursery tanks.

(b) Former gravel roadway provides access to west shore of excavation pit.

(c) Generally level area proposed for placement of ocean-shipping containers and hatchery/ broodstock tanks.

Figure 29. Level to gently sloped portions of the proposed project area.

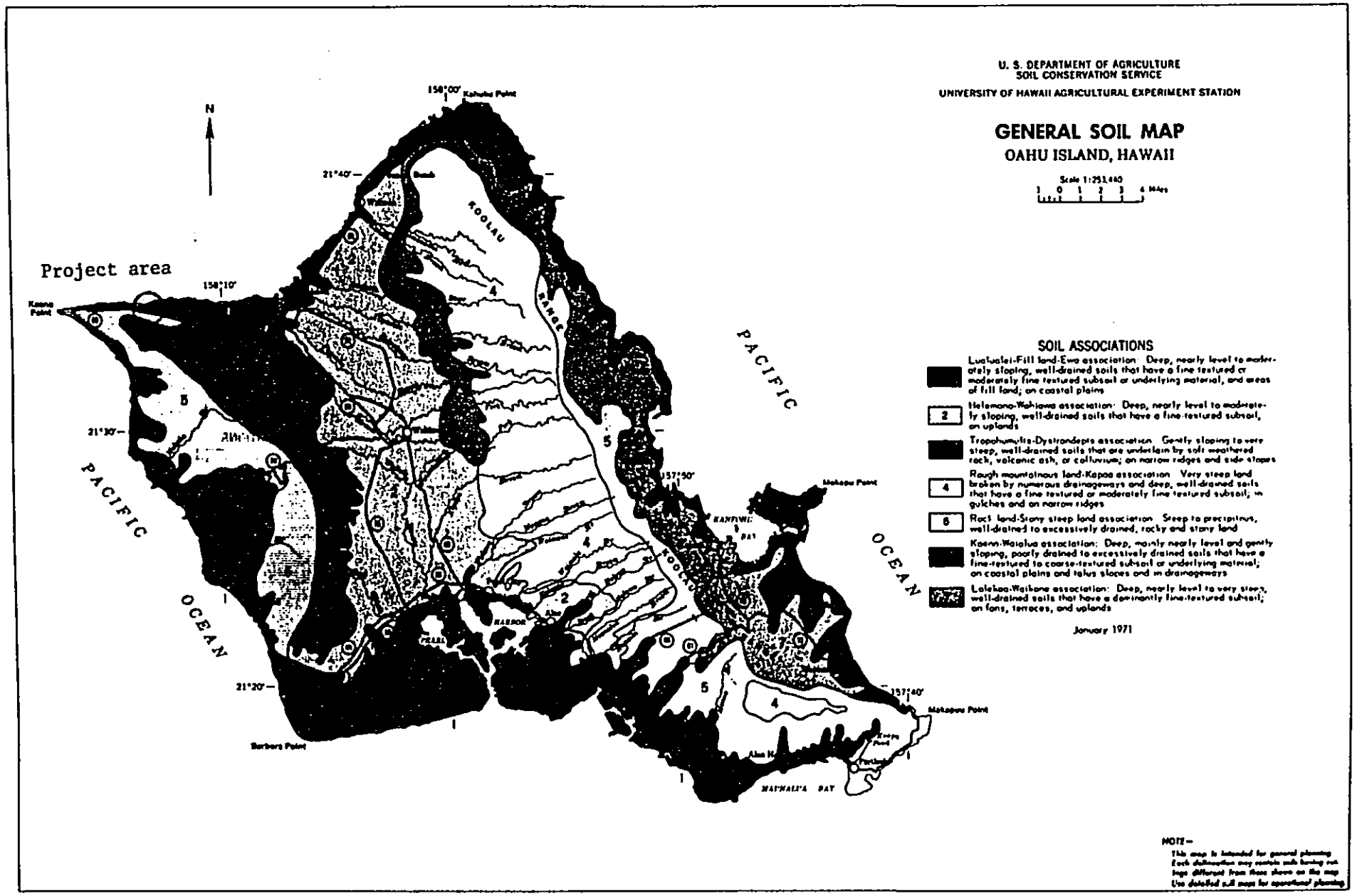


Figure 30. General soil map of Oahu.

Figure 31. Soil classification map of Mokuleia/Kaena area (USSCS, 1972).

the side slopes of drainageways (Haili and Keekee gulches). Stones and boulders cover 50 to 90 percent of the surface. There is a small amount of soil among the stones that provides a foothold for plants. Rock outcrops occur in many places. This land type is typically used for wildlife habitat and recreation.

The level lands to the north and northeast of the quarry site are classified as Jaucus sand (JaC). The same type of soil is present at the quarry site, on the level lands to the north and northeast of the excavation pit. This is a sandy brown soil with rapid permeability. Runoff is very slow to slow. The hazard of water erosion is slight, but wind erosion is a severe hazard where vegetation has been removed. Workability is slightly difficult because the soil is loose and lacks stability for use of heavy equipment. This soil type is used for pasture, sugarcane, truck crops, and urban development.

The level lands to the north and east of the excavation pit, and also portions of the sloped lands immediately to the east and west of the pit, are, in many places, overlain with an accumulation of one to several feet of silt-like crusher fines which apparently settled out from the crusher wash water during approximately 35 years of rock crushing and washing activities at the quarry.

J. Climate

The climate of the proposed project area is semi-arid, similar in many respects to the climate found along the Waianae coast. Annual rainfall at the site is less than 20 inches (Figure 32). Most of this falls from October to April, often during occasional winter storms (Figure 33).

Estimated annual solar radiation at the site is 400 to 450 calories per square centimeter (Figure 34). The days are generally warm, while the nights are typically cool. Summer temperatures are somewhat warmer than winter temperatures, but the seasonal range is less pronounced than the diurnal range. Daily mean August temperatures at the Waianae weather station ranged from 71.1 degrees F to 89.5 degrees F, while daily mean January temperatures ranged from 62.5 degrees F to 81.1 degrees F (State of Hawaii, 1977). The temperature extremes have ranged from a high of 96 degrees F to a low of 50 degrees F. (Note: Long-term climatic data for the Kaena area itself is quite limited.)

The site is directly exposed to the northeasterly trade winds which blow most of the year (Figure 35). During the winter months, however, the trades periodically give way to synoptic scale weather systems, such as cold fronts, Kona storms, and upper level low pressure systems. These are the times when most of the precipitation falls.

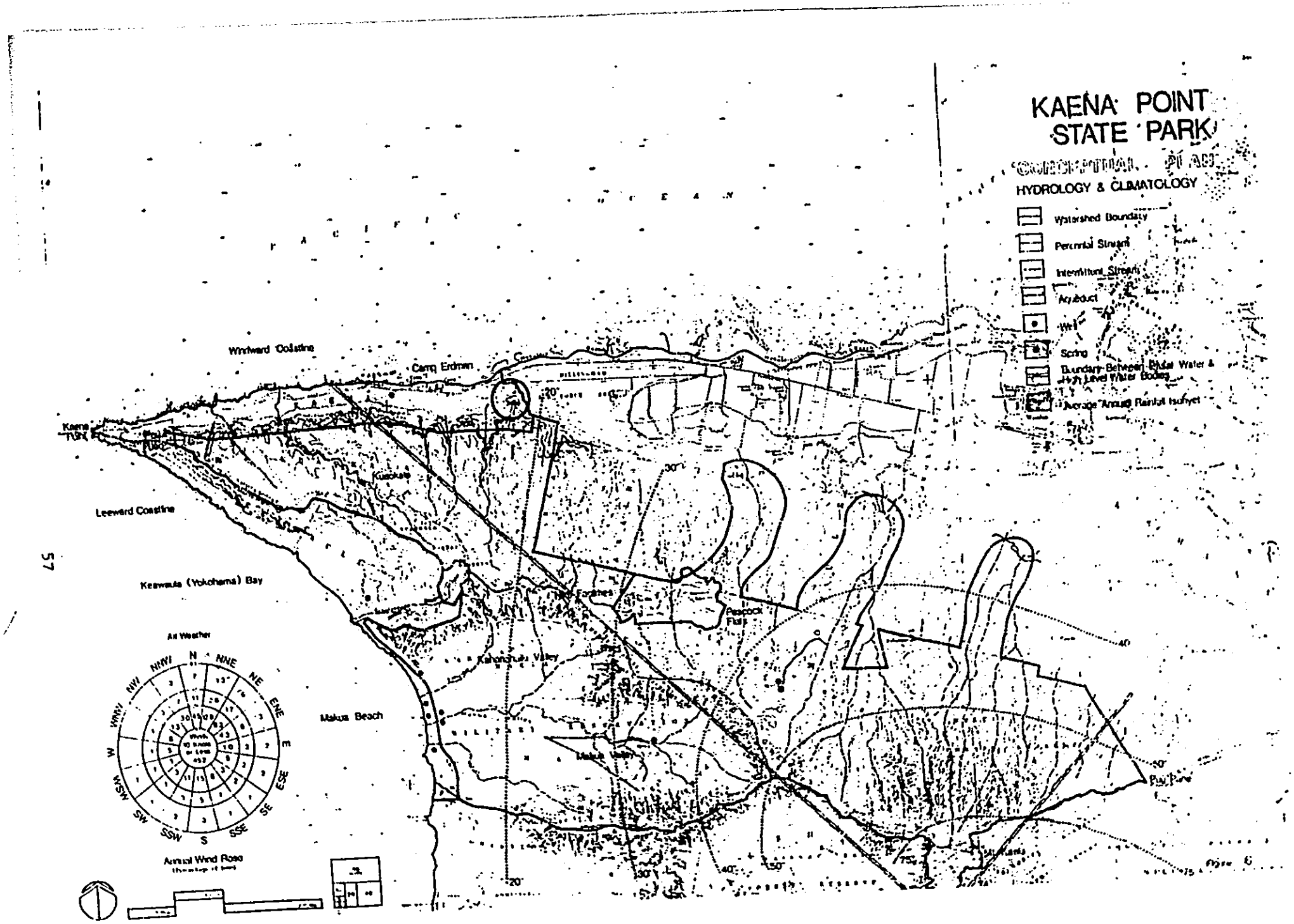
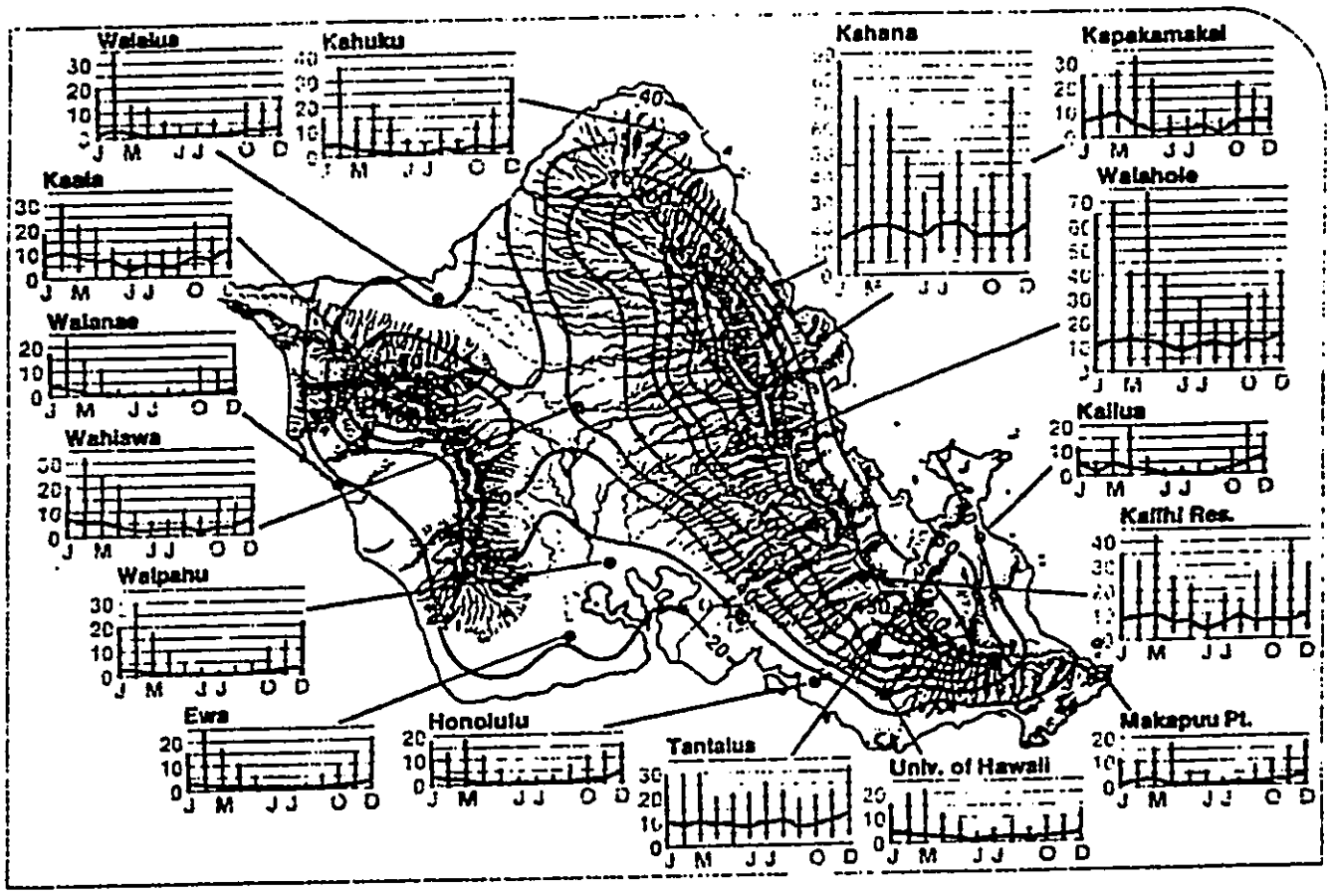


Figure 32. Hydrology and climatology of northwest Oahu (State of Hawaii, 1978).



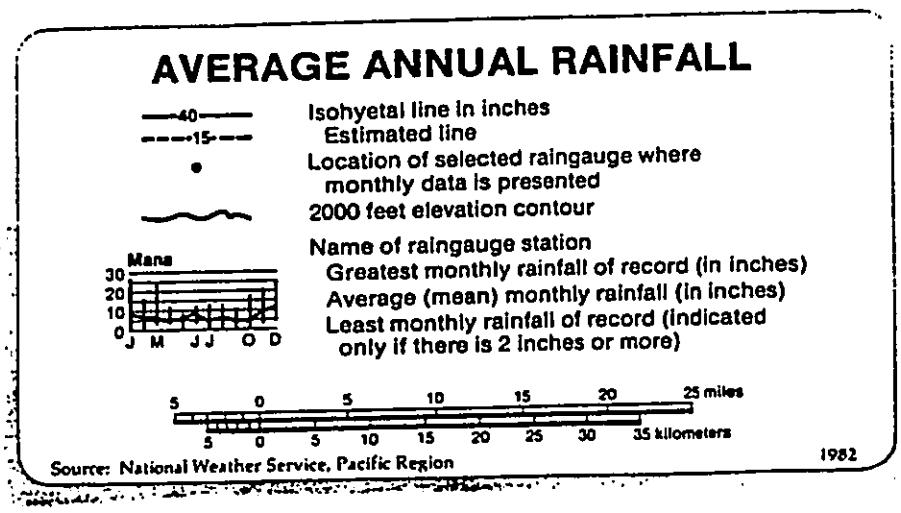


Figure 33. Map of average annual rainfall (UH Dept. of Geog., 1983).

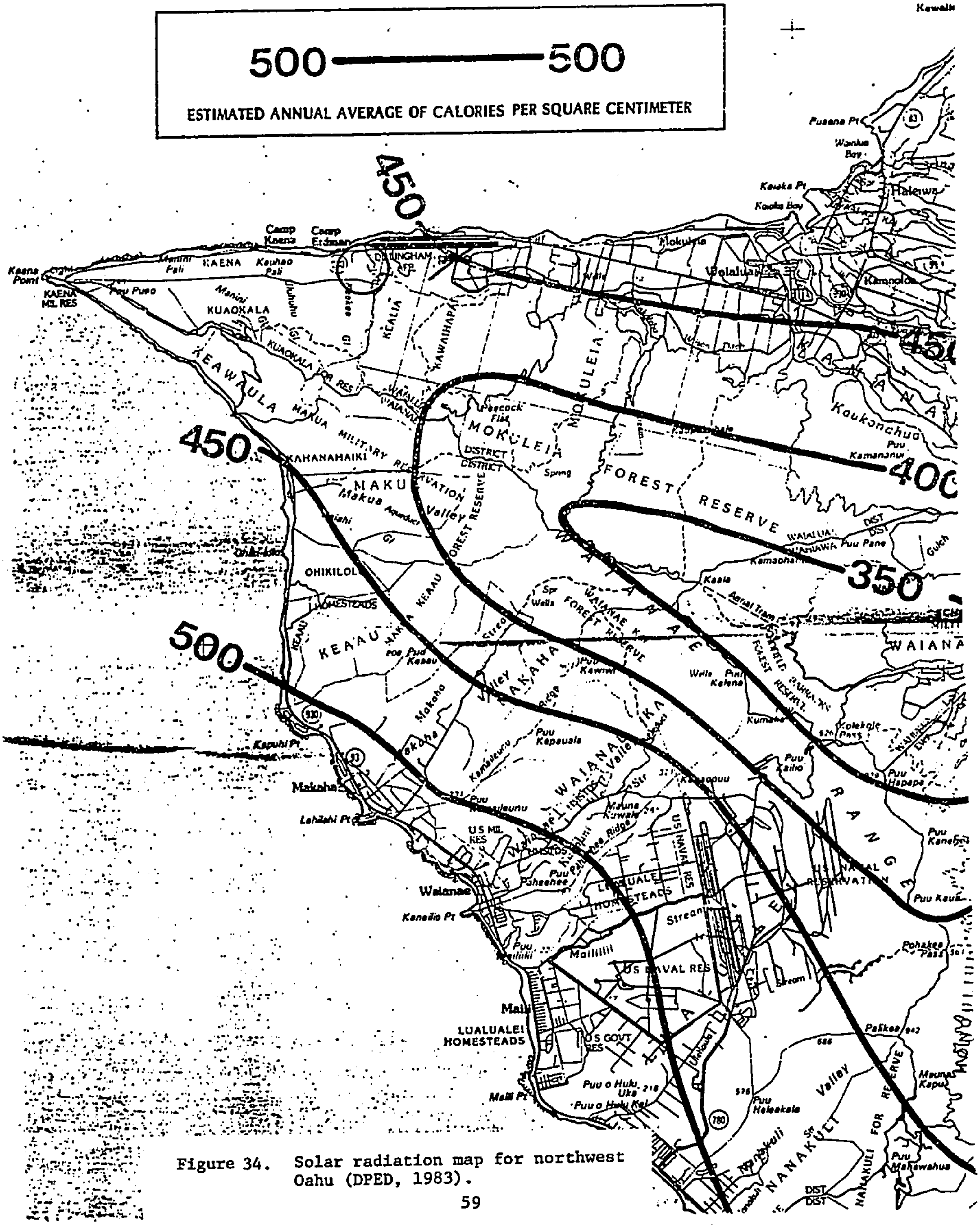


Figure 34. Solar radiation map for northwest Oahu (DPED, 1983).

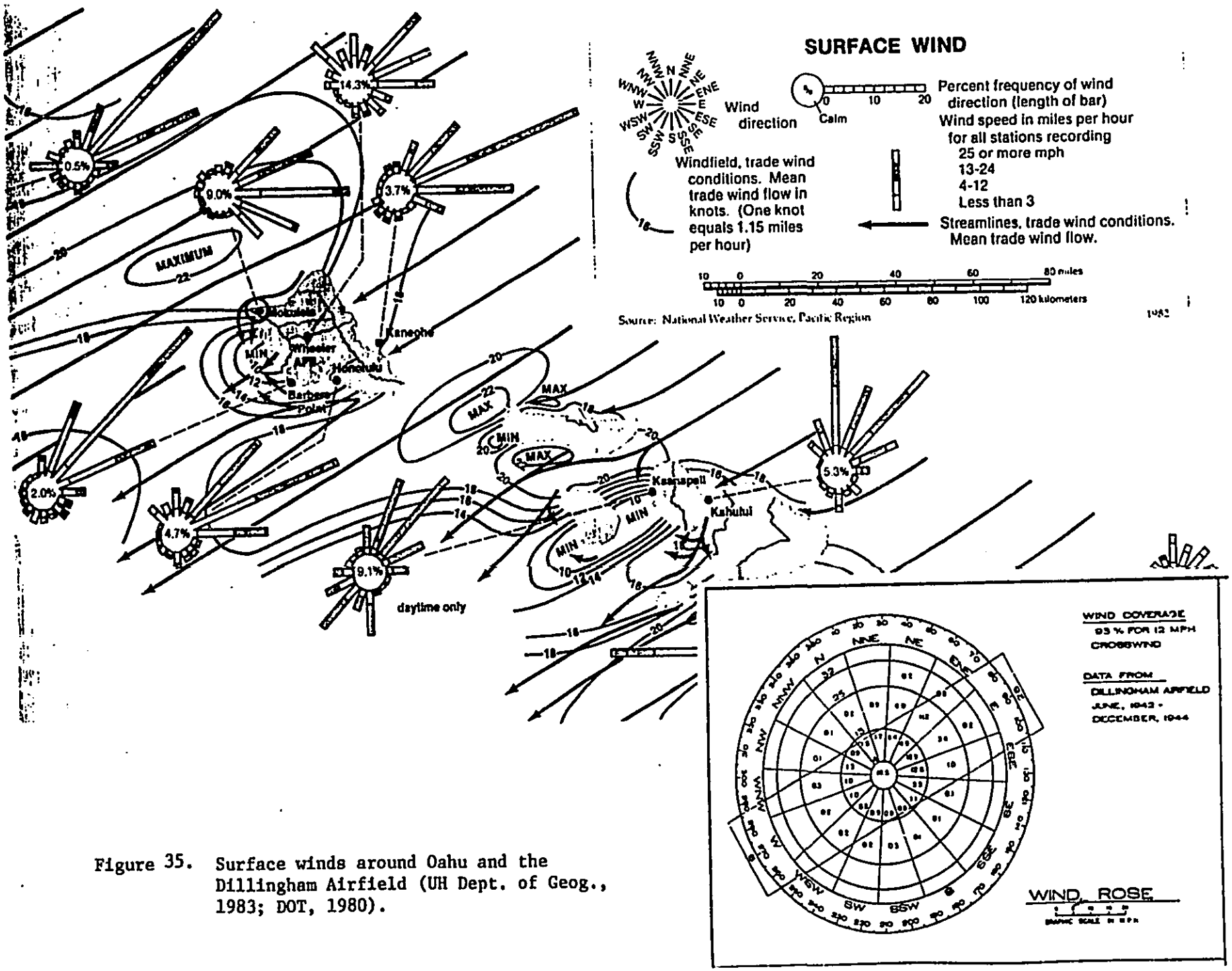


Figure 35. Surface winds around Oahu and the Dillingham Airfield (UH Dept. of Geog., 1983; DOT, 1980).

Wind measurements taken at Kaena Point over an 18-month period during the mid-1970s, by the UH Department of Meteorology, averaged 12.5 miles per hour at the 30 foot elevation and 13.7 miles per hour at the 90 foot elevation (Ramage, 1977). Minimum wind speeds were recorded during early morning hours. Recorded wind speeds picked up during the day and averaged 16 to 17 miles per hour in the early afternoon, gradually decreasing in the late evening and nighttime hours.

Wind speeds across the water surface of the excavation pit are quite variable, both in direction and speed, due to the funneling effect of the trade winds passing along and deflecting off of the shear cliffs on the south and north sides of the pit.

K. Natural Hazards

1. Earthquakes

All of Oahu is classified as Seismic Zone 1 (low seismicity) by the Uniform Building Code (Applied Analysis, 1989). The largest earthquakes on record in the vicinity of Oahu have registered between 4 and 5 on the Richter Scale. The highest earthquake intensities on Oahu have been caused by large earthquakes on the island of Hawaii; Modified Mercalli intensities of IV to V (minor damage) have been estimated for Oahu.

2. Tsunamis

The projected tsunami inundation zone for the Kaena/Mokuleia area extends to the 50 foot contour line, according to the Civil Defense tsunami evacuation map (Figure 36). The level makai lands to the north, east, and west of the excavation pit, and the lower portions of the sloped lands bordering the pit are approximately 20 feet in elevation, and the rocky rises proposed for the hatchery and farm offices are approximately 30 feet and 40 feet in elevation. However, the highest actual recorded height of tsunami run-up in recent times was 16 feet above sea level, in 1946, and this apparently did not adversely affect operations at the quarry site (Figure 37). Subsequent tsunamis have recorded run-up heights of 9 to 12 feet.

3. Hurricanes and Tropical Storms

Hurricanes and tropical storms are very rare in Hawaii. Only five hurricanes have affected the islands during the past 90 years. Tropical storms, with winds below 74 miles per hour, are more frequent. Hurricanes and tropical storms are most likely to occur between July and November. These storms and "winter storms" are the source of occasional heavy rainfall in the project area.

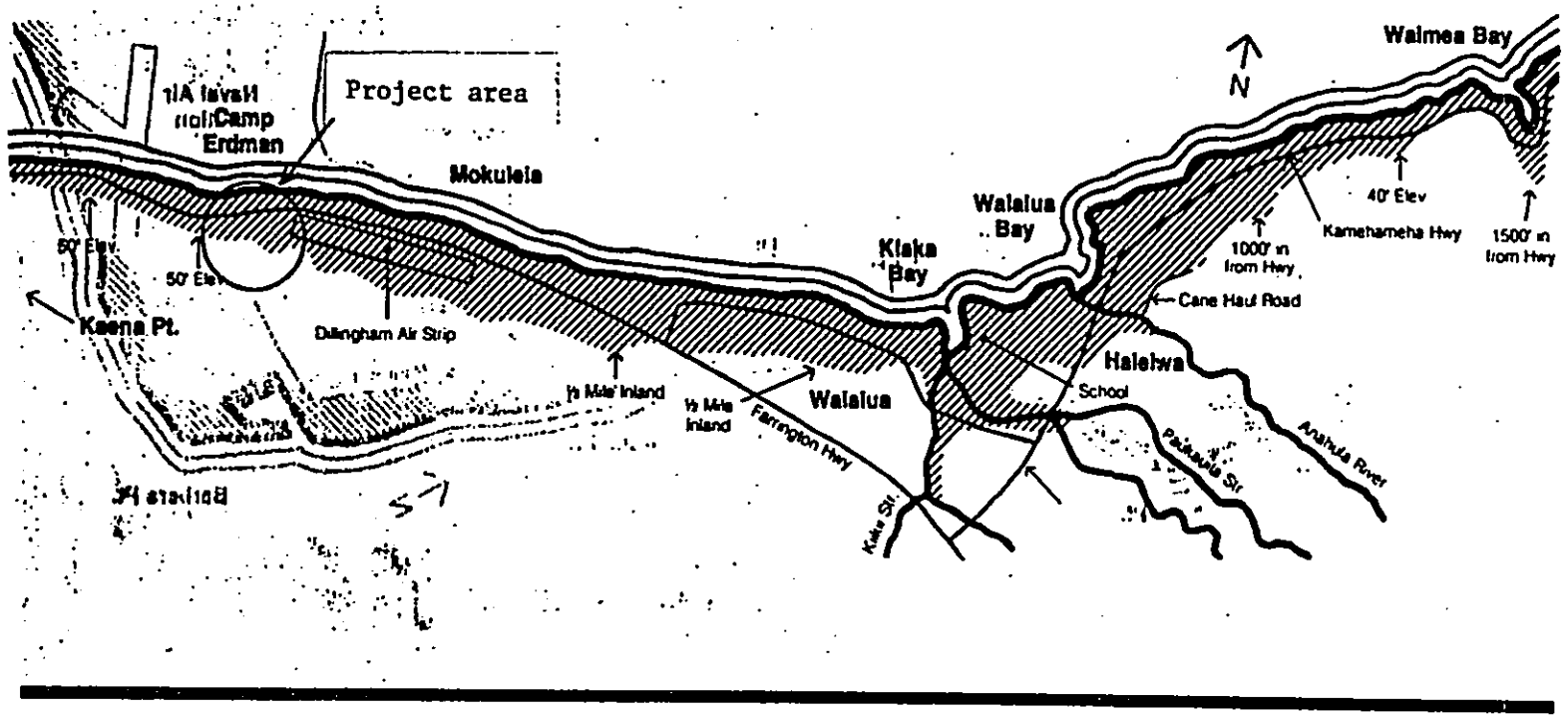


Figure 36. Civil Defense tsunami evacuation map 6.

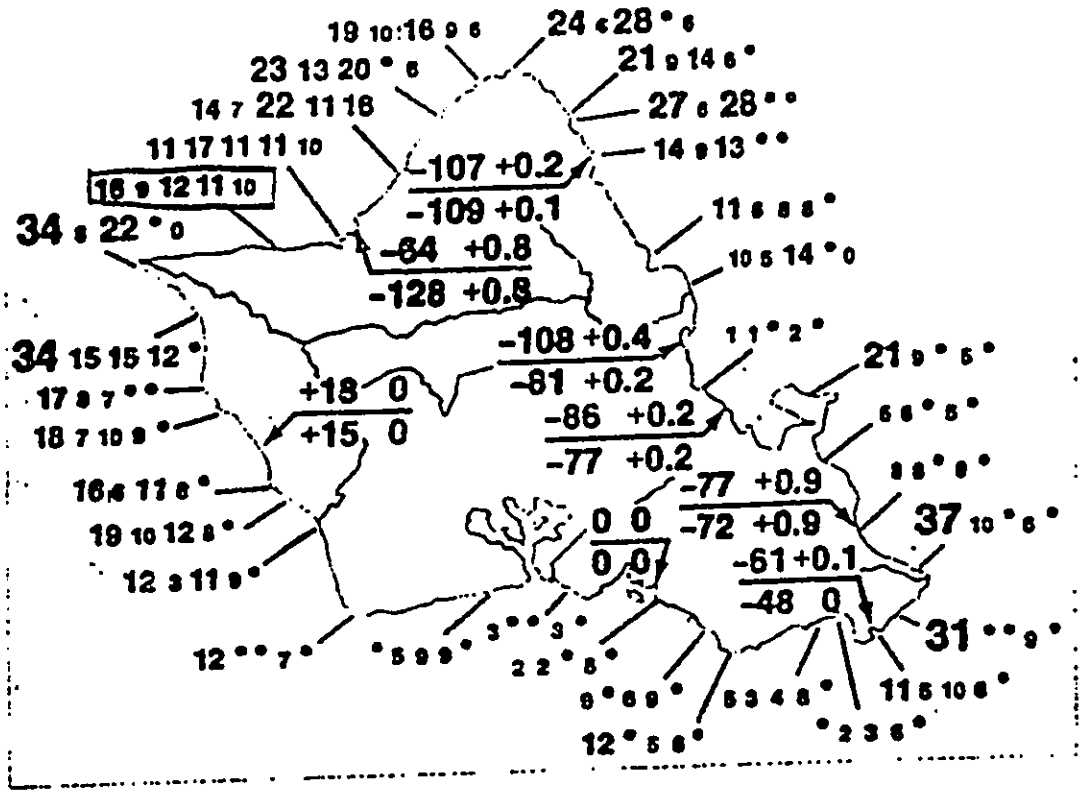


Figure 37. Map of tsunamis and tides (UH Dept. of Geog., 1983).

4. Flooding

The proposed project area is located within Flood Zone D. - flood risk undetermined, according to the National Flood Insurance Program Rate Map (Figure 38). Major flooding, however, is not expected at the site. Runoff from Heili Gulch, the mauka cliffs, and the water tower access road and culvert flow directly into the excavation pit, thereby protecting the adjacent lands. The water level in the pit was observed to rise several inches in 24 hours during and after storms occurring in the winters of 1989-90 and 1990-91, due to the inflow of rain generated runoff, but this rise in water level posed no risk to the adjacent lands. The remaining freeboard along the west side of the pit, the lowest side, was approximately 10 feet above last winter's high water level. Water stains on the side-walls of the pit indicate that last winter's high water level was roughly equal to the long-term high water level for the pit.

The flat areas to the north and east of the excavation pit exhibit localized short-term ponding following heavy rains, but such standing waters soon dissipate, percolating down through the sandy soil. Maximum ponding depth observed in the winters of 1989 and 1990 was two to three inches, in a few areas, and this disappeared within one to two days.

5. Rock Slides

Several substantial rock slides have occurred along the sheer cliffs mauka of the excavation pit; and falling rocks are commonly heard and seen in this area during and after winter rains. No facilities or activities will be located in this area.

6. Fires

Brush and forest fires are quite common in Kaena and in the nearby Mokuleia/Makua/Waianae areas, particularly during the very dry summer months. Many of these fires, if not most, are caused by civilian and military activities in these areas.

L. Archaeological and Historic Sites

No archaeological or historic sites were observed within the boundaries of the proposed project area and none are listed on the Hawaii or Federal Register's of Historic Places. McAllister (1933) also indicated no places of interest at the site but did identify two fishing shrines (Ka'a) nearby (Figure 39). Site 189 is named Hauone; site 190 is named Puu o Hekiki.

M. Past and Recent Land Use

The quarry site has been unused for approximately 15 years, since the Hawaiian Bitumuls and Paving Company, a subsidiary of the

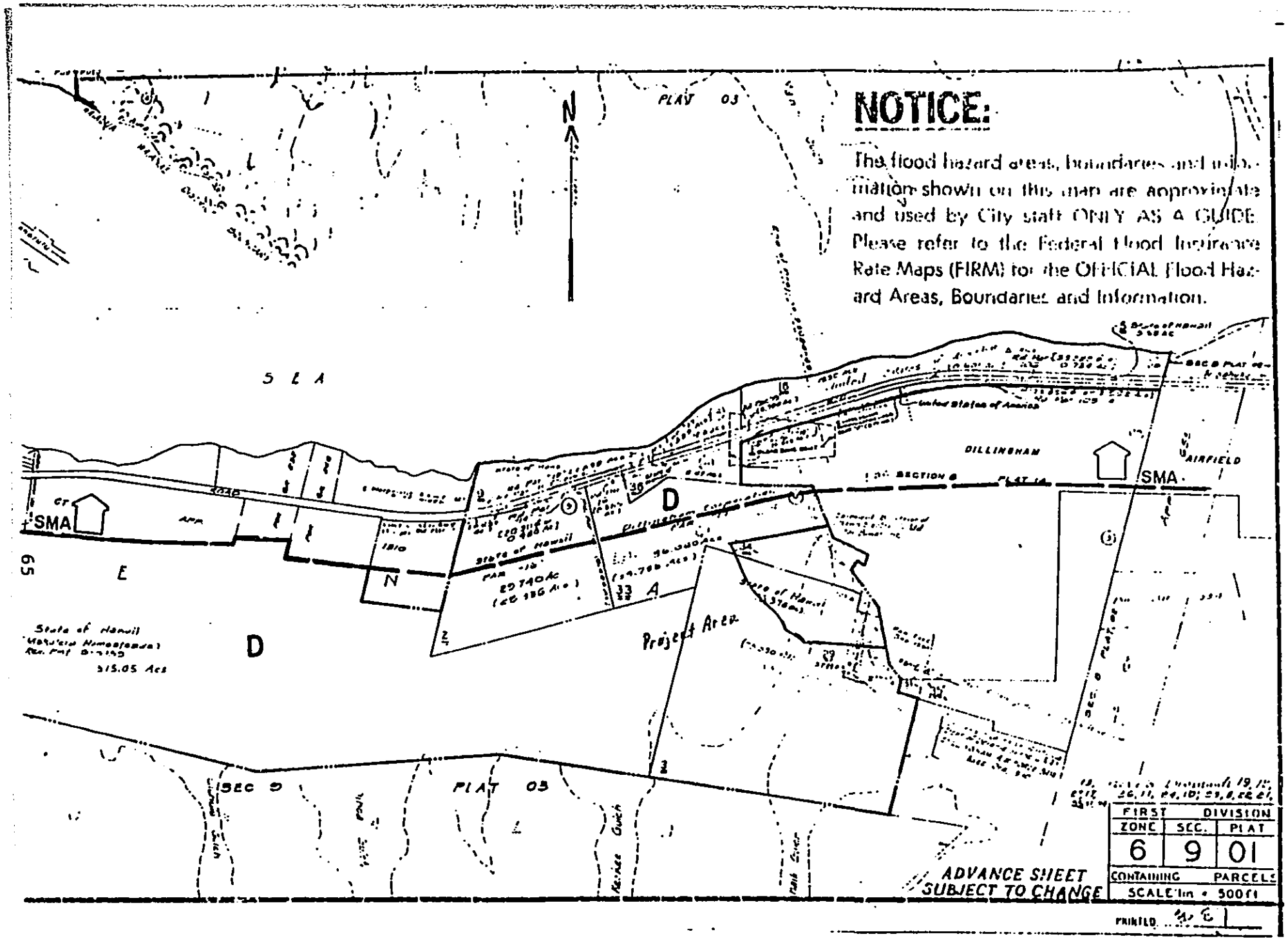


Figure 38. Map of flood hazard areas and SMA boundary.

Scale: 1in = 1000ft

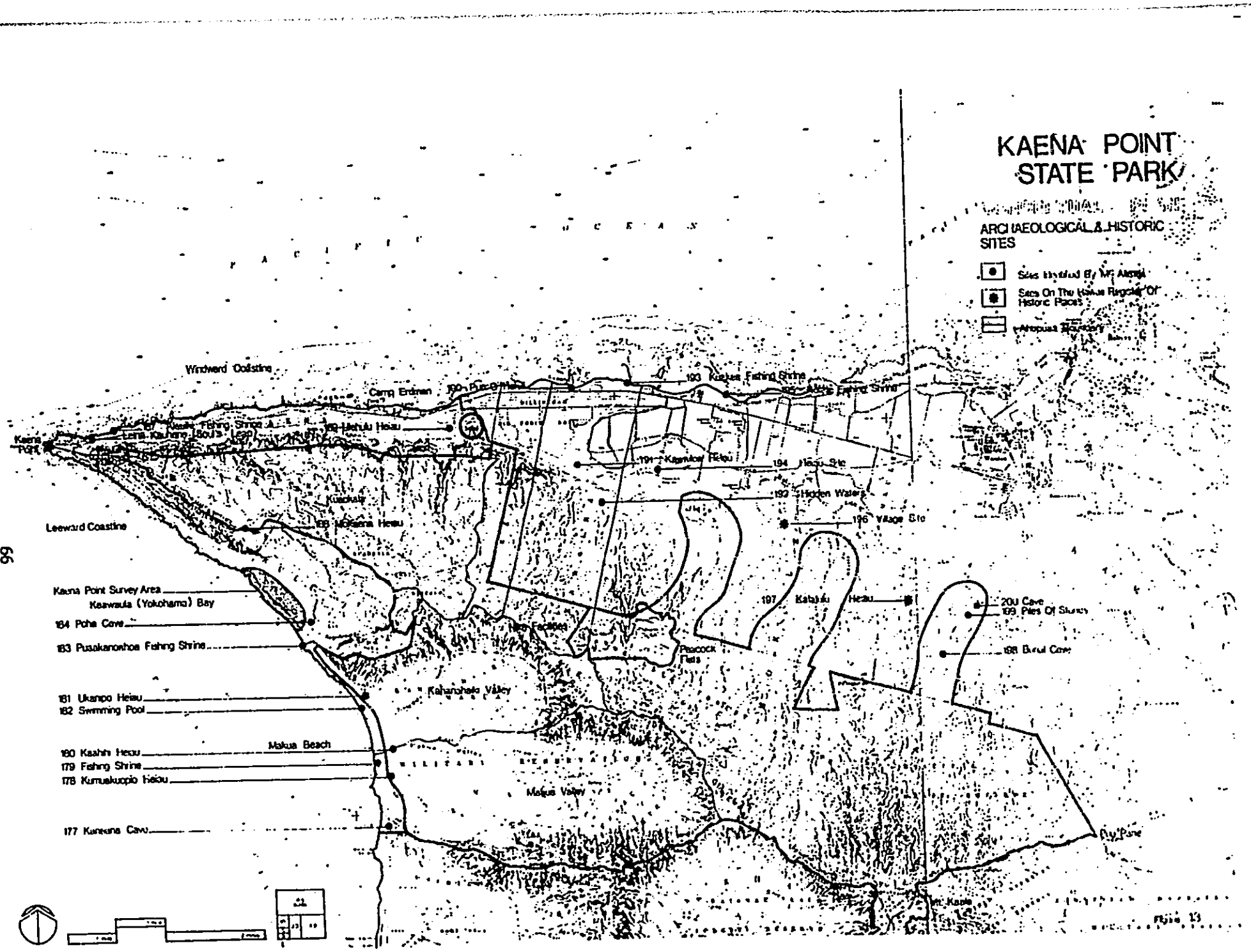


Figure 39. Map of nearby fishing shrines (State of Hawaii, 1978).

Dillingham Corporation, ceased its operations at the site in the mid-1970s.

The first recorded use of the quarry area and the eastern portion of the Dillingham Airfield area, to the best of our knowledge, was for farming by the Look Hop Sing Company. U.S. Geologic Survey well records indicate the Company drilled its first well in 1894 and a second well in 1920, both near the west end of the present day airfield, close to the quarry.

A 1922 War Department map indicates that during the period 1908 to 1913, most of the proposed project area was used for grazing by the Dillingham Ranch (Figure 40). Extensive rock wall development in the general area was also depicted on this map, indicating an earlier use of this area. Many of these walls are omitted from a 1936 War Department map, covering the period 1928 to 1929, indicating their apparent destruction during the intervening years (Figure 41). Also indicated on this map is a flume system apparently used for crop irrigation by the Look Hop Sing Company.

The U.S. Army took over the two Look Hop Sing Company wells in 1941 when they established the Dillingham Airfield. A former quarry employee recounted to us that the quarry was developed by the U.S. Army Corps of Engineers to obtain rock for construction of the airfield runway.

In 1942, the Army constructed a 100,000 gallon concrete water tank located above and immediately to the east of the proposed project area, as a head tank for the wells. The tank remains in use at present by the DOT.

State tax records indicate that the mauka quarry property (TMK 6-9-1: 3) was leased to the Mokuleia Ranch and Land Co., Ltd in 1944, by the Territory of Hawaii; granted to the Hawaiian Rock and Supply Co., Ltd in 1953; and transferred to the Hawaiian Bitumuls and Paving Co., Ltd in 1962. State tax records indicate that the makai quarry property (TMK 6-9-1: 33) was likewise leased to Hawaiian Bitumuls and Paving Co., Ltd, in 1961, by the Mokuleia Ranch and Land Co., Ltd. Extensive quarrying activities apparently occurred during this period.

In 1975, the State of Hawaii initiated condemnation proceedings against the Mokuleia Ranch and Land Co., Ltd and the Dillingham Corporation to acquire the makai parcel, for the establishment, development, and construction of Kaena Point State Park (State of Hawaii, 1ST Circuit Court, 1976). Judgement was rendered in favor of the State of Hawaii, in 1977 (State of Hawaii, 1ST Circuit Court, 1977).

TERRITORY OF HAWA
ISLAND OF OAHU
KAENA QUADRANGL

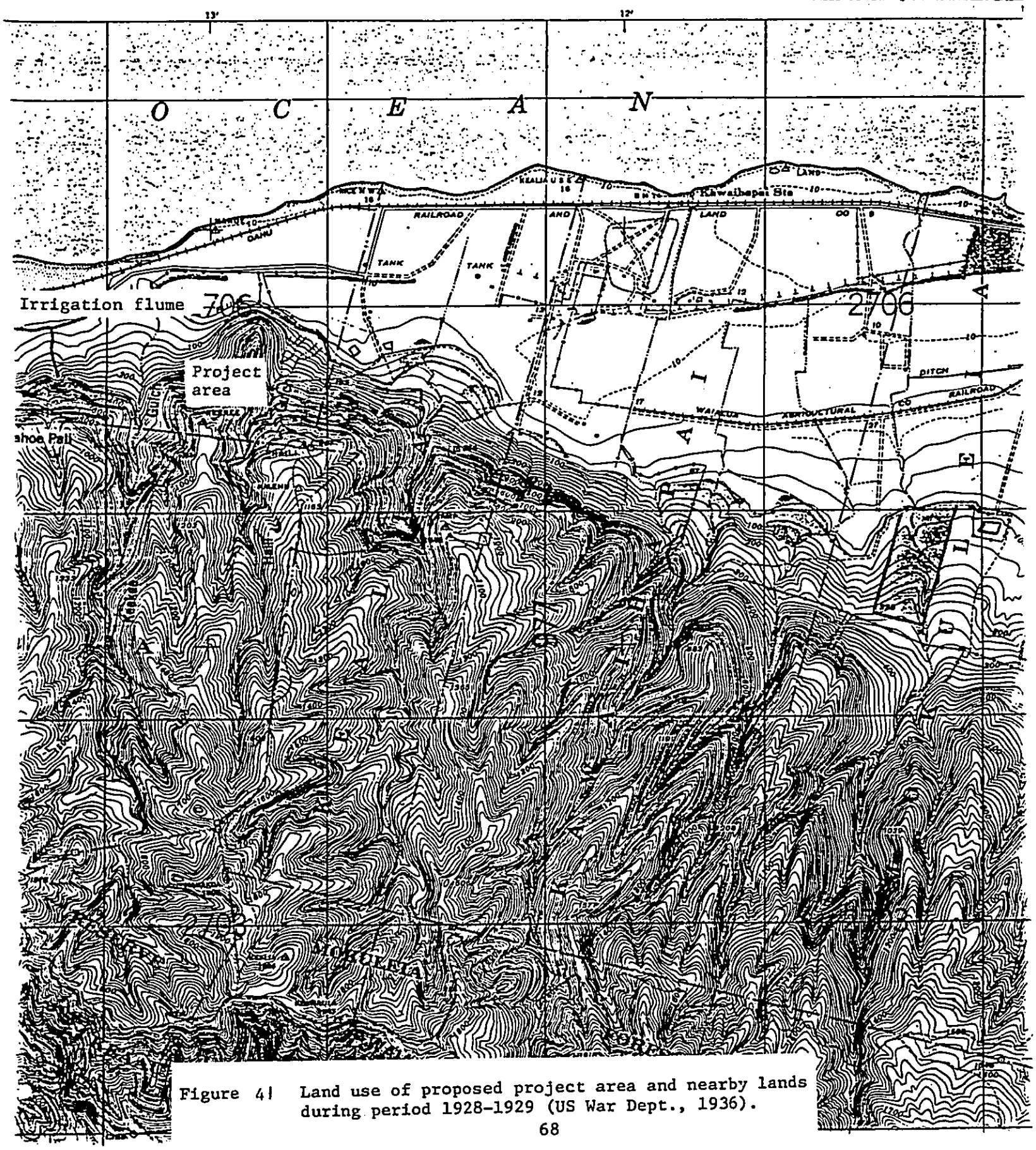


Figure 41 Land use of proposed project area and nearby lands during period 1928-1929 (US War Dept., 1936).

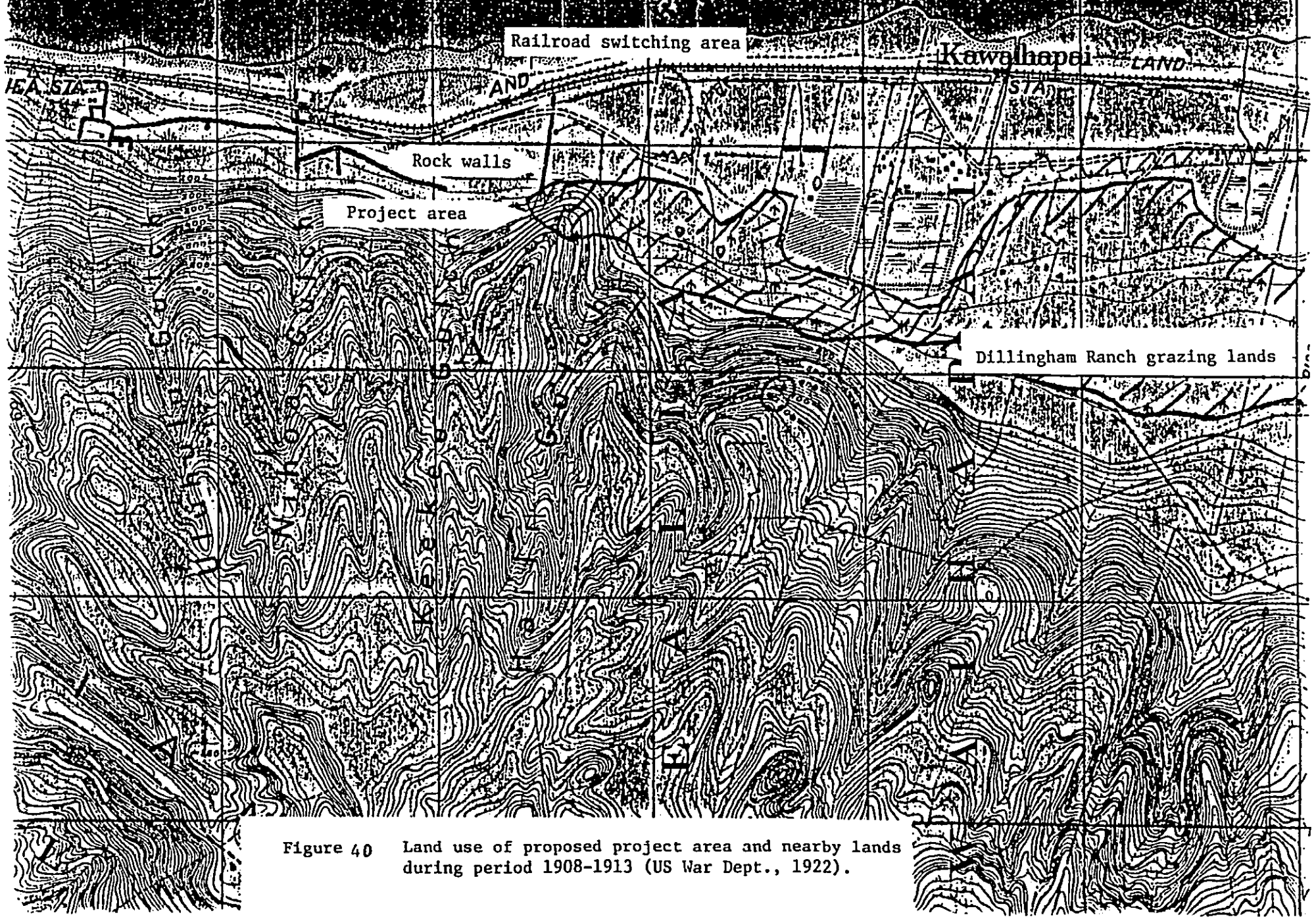


Figure 40 Land use of proposed project area and nearby lands during period 1908-1913 (US War Dept., 1922).

N. Derelict Structures and Discarded Materials

Numerous buildings and other structures from the quarry operation remained on the proposed project area and elsewhere on the quarry site after Hawaii Bitumuls and Paving Co., Ltd ceased operations in the mid-1970s (Figure 42).

Two of the largest buildings were two- and three-story wooden structures, constructed of massive timbers, located just makai of the excavation pit, near the northeast corner of the proposed project site (Figure 43a). These buildings were involved in the rock crushing operations at the quarry, and were apparently connected by a conveyor belt system to a large concrete structure located on the cliff bordering the excavation pit (Figure 43b). The remnants of a massive steel I-beam structure are located approximately 300 feet west of these three structures, near the northwest corner of the proposed project site, and appear to have been portions of a large loading ramp or dock for the quarry (Figure 43c). Several smaller buildings were located at the makai border of the quarry site, adjacent to the airfield. These were apparently the quarry office and weigh-station. Two well preserved small stone buildings exist just to the west of the proposed site. One is padlocked shut and has been reported to have been a dynamite storage building.

The Hawaii Army National Guard, 227th Engineering Company began demolition and clean-up operations on the eastern portion of the quarry site in July 1990, as a summer training exercise. The two large wooden buildings and most of the smaller buildings and structures were demolished and then buried and/or pushed against the base of the hillside, makai of the excavation pit, during the July-August exercises (Figure 44a and 44b). No plans exist, to our knowledge, to demolish the concrete structure on the cliff adjacent to the excavation pit (Figure 44c). Plans do exist, however, to demolish and bury the large I-beam structure. The 227th may complete the clean-up of the eastern portion of the quarry site in the summer of 1991.

The majority of the smaller discarded materials are located in the Koa-haole brush in the western portion quarry site, beyond the boundary of the proposed project area and beyond the scheduled 227th clean-up area. Brush fires in August 1990 burned much of this area, exposing several of the large tanks and numerous 55-gallon drums labeled as having contained potentially hazardous or toxic materials. Industrial Technologies completed a clean-up operation of the largest stockpile of drums in October 1990. Their analysis of the leaking material from the drums, provided to the DOH Hazard Evaluation and Emergency Response Branch, indicated that it was roofing tar.

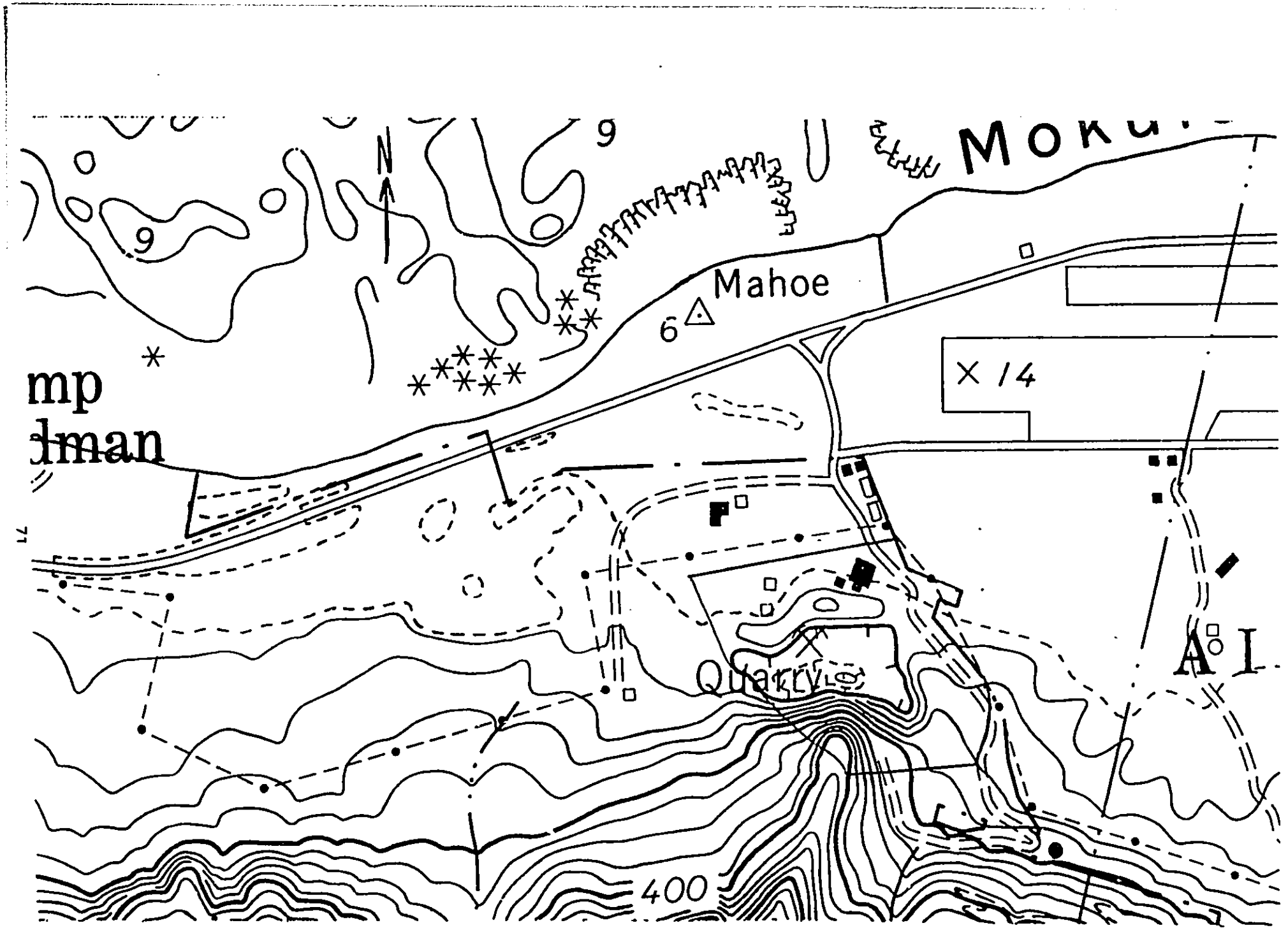
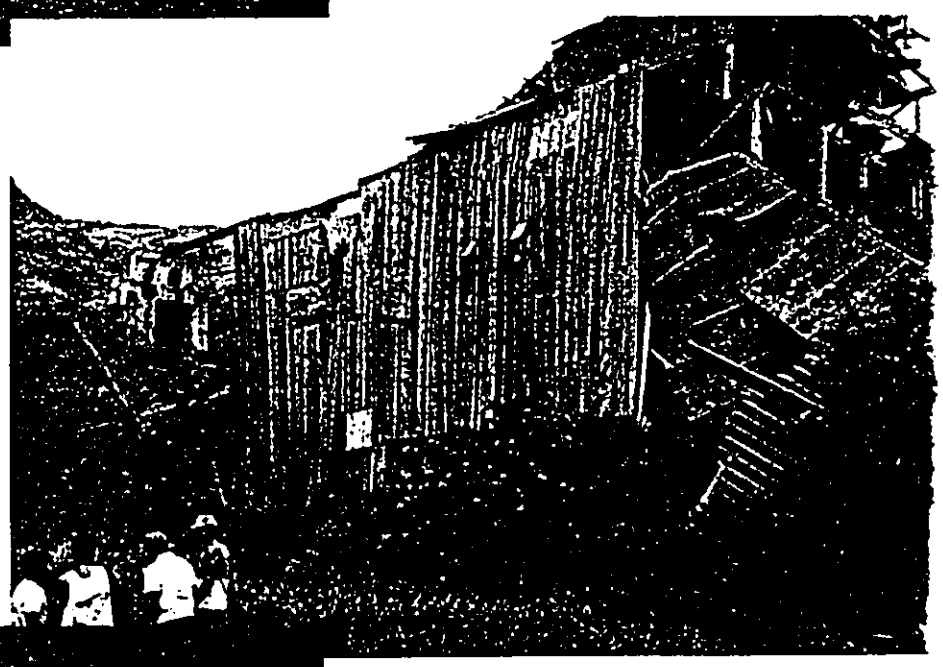


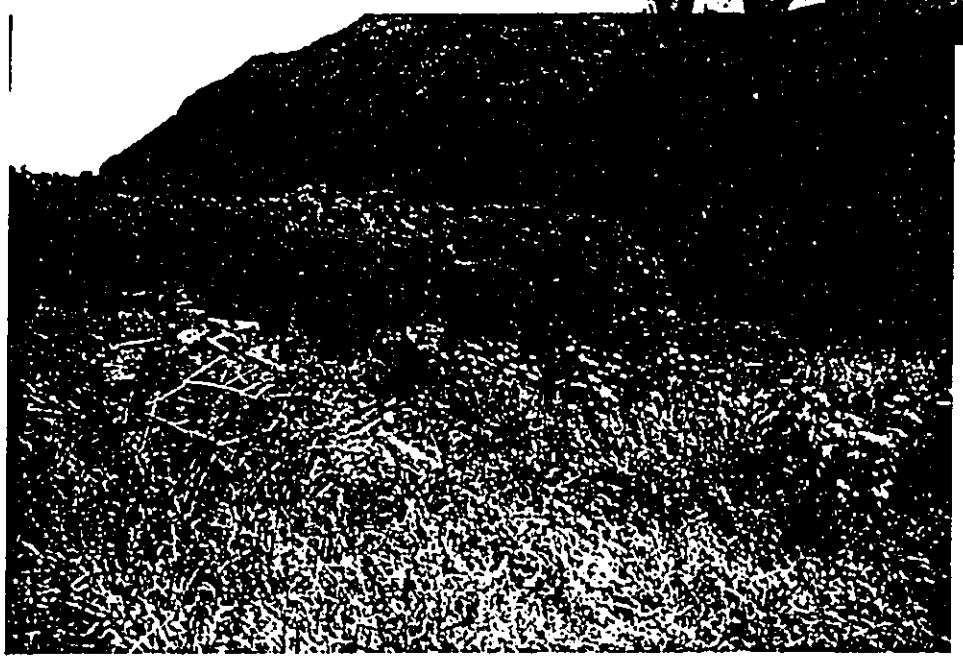
Figure 42. Numerous buildings and structures were constructed on the quarry site.

Scale: 1in = 500ft

(a) The two largest quarry buildings.



(b) Concrete structure mauka of large buildings.



(c) Steel I-beam structure.

Figure 43. Examples of quarry structures.

(a) Two large wooden buildings being demolished.

(b) Large and small buildings are buried against base of hillside.

(c) The large concrete structure remains on the bluff makai of the excavation pit.

Figure 44. Quarry site during and after the demolition of the quarry buildings by the Hawaii National Guard, 1990.

D. Flora

1. Introduction

The proposed project area is in the dry zone at the foot of the Waianae Range and extends from an elevation of approximately 20 feet to an elevation of approximately 160 feet. The site has been extensively disturbed in the past, and it is very doubtful that any native vegetation remains.

Several walk-through surveys were conducted by the applicants and Mr. Dan McConnell during the summer of 1990, to inventory the flora of the area, determine major vegetation zones, to search for rare and endangered plants, and to identify any areas of potential environmental problems or concerns. As this was a very dry period, many of the annual species which may be present during the wetter winter months were absent.

Samples were collected of the plants which could not be positively identified in the field, for later identification at the DOA Plant Pest Control Branch by Mr. Wayne Kobayashi and Mr. Nilton Matayoshi, and the Bishop Museum, Botany Department by Dr. George Staples and Mr. Clyde Imada, with the assistance of Mr. Darral Herbst of the U.S. Fish and Wildlife Service (FWS), Environmental Services Division. A checklist of observed species and of species which may possibly be present, based on literature reviews and the expert opinions of the above specialists, is presented in Appendix III.B.

Five "vegetation zones" characterize the proposed project area: (1) Aquatic and emergent vegetation, growing in the water-filled excavation pit, (2) shoreline vegetation, growing around the edge of the pit, (3) scrub vegetation, growing on the old gravel roadways and rocky slopes around the pit, (4) wasteland vegetation, growing on the level lands makai of the pit where the quarry's crushing and washing operations occurred, and (5) roadside vegetation, growing along the recently paved water tower access road and culvert (Figure 45).

2. Aquatic and Emergent Vegetation

Aquatic vegetation in the excavation pit appears to be limited to beds of stonewart Chara sp., occurring mostly below a depth of approximately 10 feet. Emergent vegetation is limited to a few scattered water lilies Nymphaea sp.

3. Shoreline Vegetation

A narrow band of shoreline vegetation occurs around the pit where existing soils are kept wet or moist much of the year by standing water in the pit. This area is characterized by honohono Commelina diffusa, primrose willow Ludwigia octovalis, pluchea

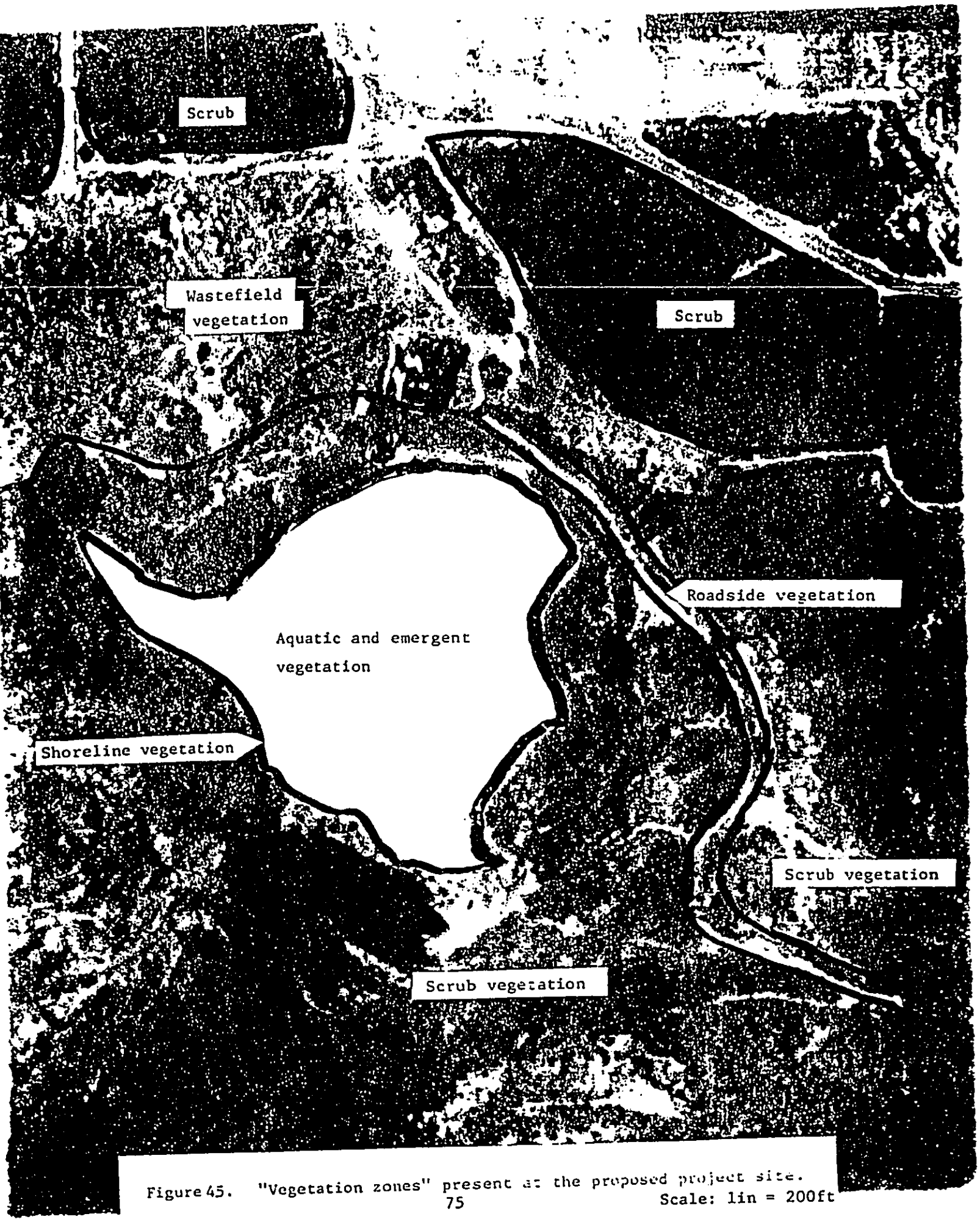


Figure 45. "Vegetation zones" present at the proposed project site. Scale: 1in = 200ft

Pluchea carolinensis, and Indian pluchea P. indicus, by scattered Christmas berry Schinus terebinthifolius and Java plum Syzygium cuminii, and, until a recent wind storm, by a large common ironwood Casuarina equisetifolia.

4. Scrub Vegetation

Scrub vegetation covers most of the proposed project site. Dense stands of koa-haole Leucaena leucocephala and scattered patches of castor bean Ricinus communis occurs immediately behind the narrow band of shoreline vegetation. Largely monotypic stands of koa-haole predominate overall in this zone. Koa-haole measuring an estimated 15 to 20 feet tall are common on several of the sloped areas. Elsewhere, particularly on the old gravel roadways, the koa-haole are smaller, apparently indicating stands of more recent occurrence and areas of less favorable growing conditions.

Widely scattered among the koa-haole are kukui Aleurites moluccana, kiawe Prosopis pallida, Java plum, and Christmas berry. Five-fingered morning glory Ipomoea cairica, Indian morning glory I. indica, hairy merremia Merremia aegyptia, Glycine wightii, Macroptilium atropurpureum, yellow liliko'i Passiflora edulis, and balsam pear Momordica charantia grow on or entwine the koa-haole in many areas; quite heavily so in a few areas.

The understory of the scrub vegetation zone, both immediately behind the shoreline vegetation zone and on the old gravel roadways, consists of dense growths of tall Guinea grass Panicum maximum. The Guinea grass gives way to a shorter introduced panicgrass Panicum spp. on the more steeply sloped areas, and also to buffelgrass Cenchrus ciliaris and sourgrass Digitaria insularis. Also found on occasion in the understory are dwarf koa Desmanthus virgatus and Mexican sunflower Tithonia diversifolia.

5. Wastefield Vegetation

Wastefield vegetation consists primarily of Guinea grass, panicgrass, swollen fingergrass Chloris barbata, buffelgrass, sourgrass, natal redtop Rhynchelytrum repens, widely scattered common ironwood, small stands of koa-haole, and several large patches of pluchea. Also observed on occassion in this vegetation zone are Christmas berry, Java plum, heliotrope Heliotropium procumbens var. depressum, an endemic sedge Cyperus trachysanthos, and common purslane Portulaca oleracea.

6. Roadside Vegetation

Roadside vegetation consists primarily of Guinea grass, sourgrass, natal redtop, buffelgrass, swollen fingergrass,

panicgrass, spiny amaranth Amaranthus spinosus, coat buttons Tridax procumbens, salvia Salvia spp., balsam pear, castor bean, and koa-haole. Also present along the water tower access road are asystasia Asystasia gangetica, Christmas berry, pua-lele Emilia fosbergii, Mexican sunflower, papaya Carica papaya, five-fingered morning glory, Indian morning glory, hairy merremia, kukui, garden spurge Chamaesyce hirta, dwarf koa, Glycine eightii, Macroptilium atropurpureum, cow pea Macroptilium lathyroides, hibuscus Abutilon incanum, 'ilima Sida fallax, yellow liliko'i, currant tomato Lycopersicon pimpinellifolium, and Jamaica vervain Stachytarpheta jamaicensis.

7. Status

Overall, the flora of the proposed project area is almost entirely exotic, typifying a highly disturbed dryland habitat. Only one endemic plant, the sedge Cyperus trachysanthos, and two indigenous plants, Indian morning glory and 'ilima, were observed on the proposed project area; and these are not considered endangered. A single clump of the endemic sedge was found in a low depression near the west side of the site in an area which experiences occasional ponding. A small portion of this plant was provided to the Bishop Museum for the herbarium collection. The Indian morning glory is quite common at the site, growing on the ubiquitous koa-haole. A single 'ilima plant was found along the roadside near the water tower.

No additional endemic or indigenous plants were observed during the walk-through surveys of the site. Most, if not all, of the native plants remaining in this general area are likely to exist in sheltered areas along the cliff face of the Waianae Range and below, at the base of the cliffs and on the talus slopes, mauka of the proposed project area.

The rare native tree 'ohe makai or 'ohe 'ohe makai Reynoldsia sandwicensis is reported to be scattered among the koa-haole on the steep slopes and among the boulders and rock outcroppings mauka of the Dillingham Airfield, according to the unpublished Environmental Assessment of the Dillingham Airfield (Figure 46). The rare native kawelu or ma 'oli 'oli Schiedea kealiae is also reported above the airfield, on or at the foot of the cliff faces. This species is listed on the Federal Register (Category 1). Additional possible native species are listed for Windward talus slopes, cliffs, gulches, and coastal zone in the Makua-Kaena State Park Environmental Impact Statement. The most plausible of these are listed among the "possible" species in the plant checklist (Appendix III.B.), although if any of these are present in the general area, they would most likely occur mauka of the proposed project area.

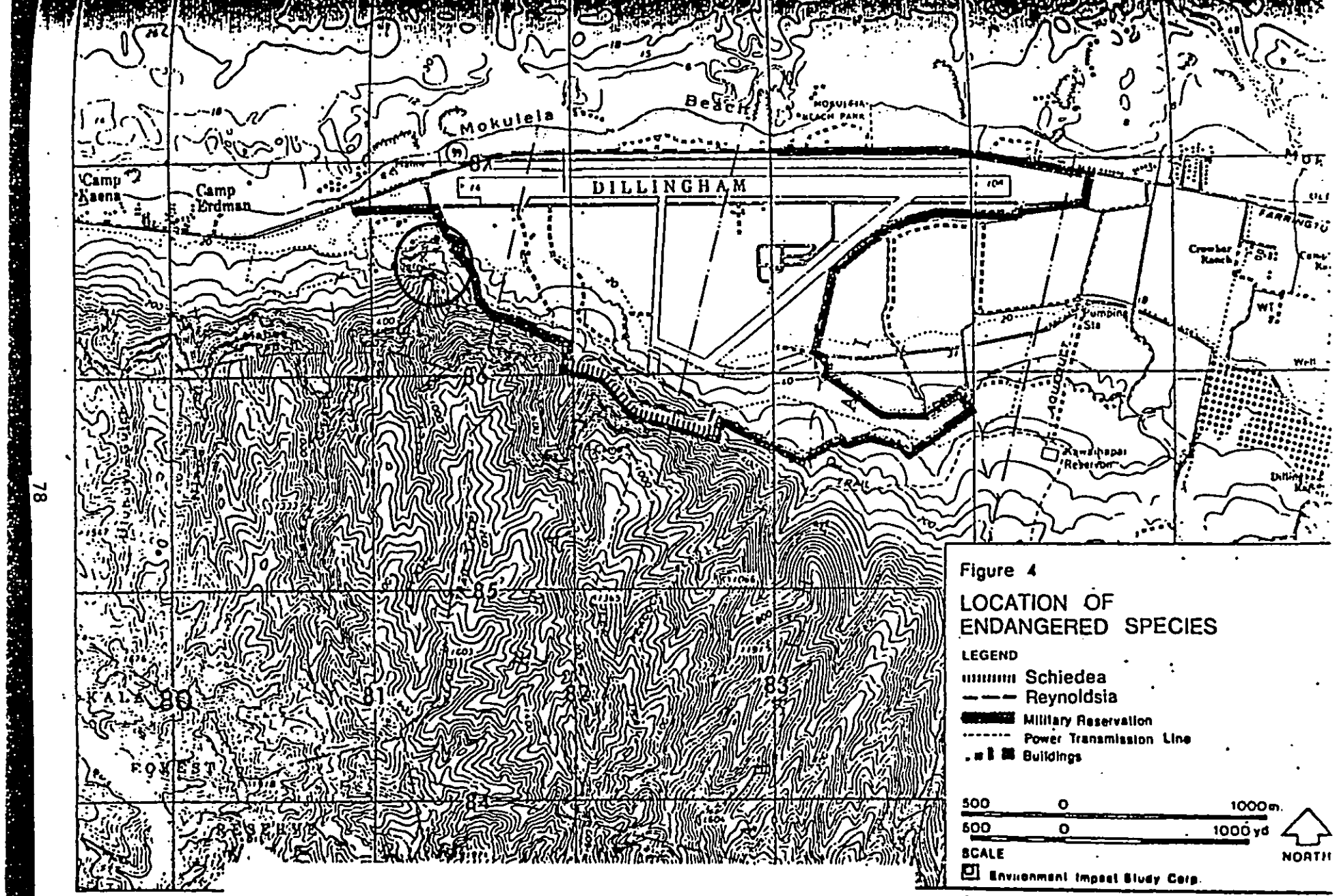


Figure 46. Location of endangered plant species (US Army).

F. Fauna

1. Introduction

Observations were made of both the aquatic and terrestrial fauna of the proposed project area during most of the 18-month study period by the applicants and Mr. McConnell. Ms. Carla Kishinami of the Bishop Museum, Zoology Department, assisted with two walk-through surveys of the terrestrial fauna, looking particularly for birds and reptiles. Field notes for several bird identifications were verified by Dr. Robert Pyle of the Bishop Museum. Mr. Ralph Saito of the DLNR Division of Forestry and Wildlife provided additional information on bird counts at the site. Samples were collected of terrestrial and aquatic snails for later identification by Dr. Michael Hadfield of the Pacific Biomedical Research Center and by Dr. Richard Brock of the UH Hawaii Institute of Marine Biology, respectively. The majority of the animal species observed or reported at the site are exotic, but some are indigenous or endemic. Checklists for the major faunal groups, excluding insects, of observed species and of species which may possibly be present, based on literature reviews and the expert opinions of the above specialists, are presented in Appendix III., C. to F.

2. Aquatic Macro-invertebrates

The aquatic macro-invertebrate fauna of the excavation pit appears rather impoverished. Bryozoans were observed attached to firm shaded substrates and appear to be Hyalinella viahiriae, a cosmopolitan species.

Louisiana red crayfish Procambarus clarkii were observed in the shallows on a few instances but do not appear to be common, at least not in shallow waters.

Aquatic nymphs of the blue damselfly Enallagma civile and the forktail damselfly Ishnura posita were among the more common of the macro-invertebrates observed. The nymphs of these exotic damselflies were often observed under rocks in the shallows, and adults were commonly seen flying around the pit. Dragonfly adults were only infrequently observed flying around the pit, and no dragonfly nymphs were found in the pit water.

Two aquatic snails were observed, Melania sp. and Planorbarius corneus, with the former being a euryhaline, pan-Pacific, and probably indigenous species and the more abundant of the two, and the latter being a common North American aquarium species. The Melania sp. were most often found browsing on algae-covered rocks and dead tree branches in the shallows, and on the beds of stonewart.

3. Terrestrial Snails

Two terrestrial snails were also observed, the African snail Achatina fulica and the relatively recently introduced cannibal snail Euglandina rosea. Few African snails were observed alive, but their empty shells were very abundant beneath the koa-haole. No endemic tree snails were observed on or near the site, and none are expected due to the presence of the cannibal snail.

4. Fish

The blackchin tilapia Sarotherodon melanotheron, a recent and unplanned introduction in Hawaii, is the predominant fish species in the excavation pit (Appendix III.C.). They are present in large numbers near the surface, from the shoreline to the center of pit. "Tilapia-shaped" fish, assumed to be blackchin tilapia, were observed in large schools around the 31-foot thermocline and in decreasing numbers in deeper waters, down to the bottom at a depth of 110 feet, by a UH Aquaculture Extension Assistant scuba diving in the pit during July 1990.

Exotic mosquitofish Gambusia affinis, guppies Poecillia reticulata, and green swordtails Xiphophorus helleri are very abundant in the shallower waters around much of the perimeter of the pit and have been observed near the surface to the center of the pit. Showy-tailed goldfish Carassius auratus and several smaller unidentified aquarium fish species, including what appeared to be white cloud mountain tetra Tanichtys albonubes, are also present. Chinese catfish Clarias fuscus and pongee Ophicephalus striata were observed on a few occasions in the shallow waters of the cove on the west side of the pit, and one Hawaiian sunfish (red hybrid Mossambique tilapia) Oreochromis mossambicus was commonly observed near the surface towards the center of the pit and in the cove.

Schools of endemic aholehole Kuhlia sandvicensis and exotic neon tetra Hyphessobrycon innesi were reported as being present in the pit by persons who have visited the site over many years, and also exotic koi Cyprinus carpio, channel catfish Ictalurus punctatus, and oscar Astronotus ocellatus.

5. Amphibians and Reptiles

The common bullfrog Rana catesbeina is present in small numbers around the edges of the pit (Appendix III.D.). Several red-eared pond sliders Chrysemys scripta and painted turtles C. picta were also observed in the pit, sunning themselves in the shallows on exposed boulders and fallen tree branches (Grogen, 1990). All are exotic.

More than one gecko species was observed around the site but only the most recently introduced species, the house gecko

Hemidactylus frenatus, has been positively identified. A skink was also observed, but not positively identified. The introduced giant neotropical toad Bufo marinus and green anole lizard Anolis carolinensis porcatus are considered likely to be present but were not observed.

6. Birds

A diverse assortment of bird species were observed or reported at or near the proposed project area (Appendix III.E.). These include marine birds, water birds, shore birds, lowland birds, upland birds, and forest birds. Most of these are exotic.

Great frigatebirds Fregata minor palmerstoni were occasionally observed flying over the site, particularly just before storms, but did not land. A fairly sizable population of Laysan albatross Diomedea immutabilis is seasonally present at the nearby Dillingham Airfield, but none were observed at the proposed project area. Other marine birds may infrequently fly past the site; one white-tailed tropicbird Phaethon lepturus dorotheae was observed flying past the Dillingham Airfield during a 1977 bird survey.

American coots (Hawaiian coot) Fulica americana alai were often observed around the excavation pit during the study period, although in widely varying numbers. The local subspecies is considered endemic and is listed as endangered on the Federal Register. Mr.Ralph Saito, DLNR Division of Forestry and Wildlife, has been observing the coot population at the excavation pit for many years and reported to us in February 1990 that the number of coots at the site had been steadily decreasing for several years. The winter count in 1990 was 5. The number of coots increased markedly in the summer of 1990, however, with 10 to 15 birds being commonly present, and increasing on a few occasions to as high as 20. In the winter of 1990-91, the numbers were again very low. Mr. Saito has stated that he considers the excavation pit to be a secondary feeding area for the coots and, also, for occasional visiting ducks Anas sp. (Saito, 1990).

Indigenous black-crowned night-herons Nycticorax nycticorax hoactli were frequently observed around the pit, and the exotic Cattle egret Bubulcus ibis seems a likely visitor, although none were observed.

Lesser golden plovers Pluvialis dominica (fulva) were frequently observed on the level wastefields makai of the excavation pit. Several other indigenous shore birds may possibly visit the site: the wandering tattler Heteroscelus incanus, the bristle-thighed curlew Numenius tahitiensis, the ruddy turnstone Arenaria arenaria, and the sanderling Calidris alba.

The spotted dove Streptopelia chinensis and the zebra dove Geopelia striata were two of the most commonly observed lowland birds at the site, frequenting open areas and roadways. Also commonly observed were the red-vented bulbul Pycnonotus cafer, the common myna Acridotheres tristis which roost in the sheer mauka cliffs, the northern cardinal Cardinalis cardinalis, the red-crested cardinal (Brazilian cardinal) Paroaria coronata, the black-rumped waxbill Estrilda troglodytes, and the nutmeg mannikin (ricebird) Lonchura punctulata. The northern mockingbird Mimus polyglottos and the house finch Carpodacus mexicanus were observed at the Dillingham Airfield during 1976/77 bird surveys, and they may occur at the site. All of the above are exotic. Other exotic lowland species are likely or possible visitors to the site.

One common barn-owl Tyto alba was observed at the site during the present study, and the endemic short-eared owl (Hawaiian owl) Asio flammeus sandwichensis may possibly be present.

One Erckel francolin Francolinus erckelii was observed at the site, and one pea fowl Pavo cristata and one ring-necked pheasant Phasianus colchicus were observed nearby, at the Dillingham Airfield; they are almost certainly present at the site. Other upland gamebirds may also be present at the site as a variety of species have been introduced over the years in the nearby Waianae Mountains. Various large upland gamebirds are frequently heard around sunset, mauka of the excavation pit but they are difficult to observe due to the heavy scrub forest and underbrush.

The only two forest birds observed at the site were the exotic white-rumped shama Copsychus malabaricus and the Japanese white-eye Zosterops japonicus. Also possibly occurring are the Japanese bush-warbler Cettia diphone, which was observed at the Dillingham Airfield during the 1976/77 bird surveys; the endemic Oahu 'elepaio Chasiempsis sandwichensis gayi, which has been reported at higher elevations above the area; and the exotic red-billed leiothrix Leiothrix lutea, which was formerly common in the area but is now scarce on Oahu.

7. Mammals

Feral cats Felis catus and mongoose Herpestes auropunctatus are the two most commonly observed mammals at the site (Appendix III.F.) Dogs Canis familiaris have also been observed, but it is uncertain whether these were feral dogs or recently lost or abandoned hunting and domestic dogs.

Muricidae are likely to be quite common at the site, particularly the roof rat Rattus rattus, the Polynesian rat R. exulans, and the house mouse Mus musculus, although none have been directly observed. Feral pigs Sus scrofa have been observed, nearby, at the Dillingham Airfield, and are likely to be present on occasion

at the quarry site (Murphy, 1989). Feral goats Capra hircus are present in the Waianae Range, mauka of the site, and may possibly venture down to the site (Riper, 1982).

8. Status

Overall, the fauna of the proposed project area is largely exotic. Only one endemic species, the American coot, and four indigenous species, the Laysan albatross, the great frigatebird, the black-crowned night-heron, and the lesser golden plover, were observed on or near the proposed project area; and of these, only the American coot is considered endangered. Additional endemic, indigenous, and Polynesian species may occasionally visit the site, based on observations and published reports on nearby or similar areas. None, however, were observed by the applicants or Mr. McConnell during the 18-month study period.

The excavation pit is considered to be a secondary feeding area for the endangered American coot by Mr. Saito of DLNR. No nests or recently hatched young have been observed around the pit, and suitable nesting areas do not appear to be available due to the depth of the water and the extremely steep sides. The numbers of coots observed in the pit by Mr. Saito have been decreasing for several years, and the numbers observed during the study period have been highly variable.

Coots have not apparently been disturbed by past aquaculture activities in Hawaii. In fact, the numbers present at several aquafarms have increased substantially over the years. At the applicants' Punaluu aquafarm, coots and also the common morehen (Hawaiian gallinule) Gallinula chloropus sandvicensis, another endangered species, have frequently nested and successfully hatched young. No conflict is anticipated, therefore, between the proposed action and the intermittent presence of the coot. Mr. William Kramer of the FSW Pacific Islands Office concurs with this assessment of no conflict (Kramer, 1991, see Appendix IV).

Q. Infrastructure

1. Roads

Farrington Highway is the only major public roadway servicing the Kaena area. Traffic on this road is generally very light, except on major summer holiday weekends when the traffic is somewhat heavier. The Dillingham Airfield perimeter road is open to the public during daylight hours, but traffic on this road is almost always very light. The water tower access road is a paved road transiting the eastern ends of Parcels 3 and 33, but is not open to the general public. Access to this road is through a locked airfield perimeter fence gate. Numerous gravel roadbeds also exist at the quarry site from the former quarry operations, but most of these are overgrown with scrub vegetation and grasses.

2. Electricity

The Hawaiian Electric Company overhead electric line around Kaena Point, connecting the Waialua and Makaha substations, passes within 100 feet of the eastern and northern boundaries of the proposed project area. The overhead line along the eastern boundary is a 11.5kv solidly grounded three-phase line. The overhead line along the northern boundary is an 11.5kv ungrounded line. Several disconnected power poles are also present at the site, some standing and some down, which serviced the former buildings and processing installations at the quarry.

3. Telephone

The Hawaiian Telephone Company provides telephone service to the Dillingham Airfield and Camp Erdman, to the east and west of the proposed project area, and service was apparently previously provided to the quarry site.

4. Potable Water

The quarry site is not presently connected to water service. Previously, the Hawaiian Rock and Supply Company and the Hawaiian Bitumuls and Paving Company were serviced by the 10-inch U.S. Army well (well 34-12-01) at the Dillingham Airfield. The water line to the site was apparently severed during recent construction activities while rerouting and paving the water tower access road. The quarry site's one and one-half-inch water meter is still in place and the four-inch water line from the water tower, which is located on the quarry site, passes within 25 feet of the proposed property line, near the proposed locations of the container area and hatchery/broodstock area.

The U.S. Army well is presently operated by the DOT. Water service from this well is presently provided to the airfield and to various public and private customers along Farrington Highway, from Mokuleia Beach Park west to Camp Erdman (a total of 10 service connections, at present).

The U.S. Geologic Survey tested the well's actual yield in 1965 at 500 gallons per minute; and the Honolulu Board of Water Supply (BWS) estimated average well production in 1975 at 480,000 gallons per day (333 gallons per minute), based on an average well operation time of 16 hours per day. Past water service to the quarry site from the well was approximately 2,500 gallons per day, according to U.S. Geologic Survey well records.

5. Sewage

The Waialua/Mokuleia/Kaena area presently depends on cesspools and septic tanks to accommodate sewage disposal. A sewage treatment plant is planned for Waialua, pending availability of

construction funds. When this occurs, the City and County Sewers Division master plan shows the extent of service to terminate at Camp Erdman.

No cess pools are registered for the quarry site. At least two cess pools did exist, however, approximately 200-300ft makai of the proposed project area and approximately 300-400ft makai of the excavation pit, as indicated by the presence of toilets in two of the quarry office buildings prior to the demolition of the buildings by the Hawaii National Guard.

No contamination of the excavation pit by the previous cess pools or by any future approved individual wastewater disposal system is anticipated. All sewage treatment has been and would be kept a safe distance (50ft or more) makai (downslope) of the excavation pit.

6. Public Services

Law enforcement in the area is provided by the Wahiawa Police Station. The Dillingham Airfield UNICOM tower personnel also provide security surveillance around the western portion of the airfield, during the UNICOM operating hours of 8am to 5pm; the airfield's resident manager is a deputized law enforcement officer who handles after-hour problems at the airfield.

Fire and rescue service for the area is provided by the Waialua Fire Station. Back-up help comes from the Sunset Beach and Wahiawa Fire Stations. The fire department also receives assistance from the military and the Waialua Sugar Company in the event of large uncontrollable brush fires.

R. Noise

The primary natural sounds present at the proposed project area are those of insects and birds. On occasion, when the winds are suitable, the sounds of heavy surf can also be heard from the shoreline which is approximately 1,300ft makai of the project area.

These sounds are often covered, however, by various man-made sounds which include: (1) general aviation traffic from the adjacent Dillingham Airfield, (2) road traffic from Farrington Highway, (3) recreational sounds from the Mokuleia Army Beach, and (4) various military-related noises including helicopter practice approaches and landings at the airfield which continue under the lease agreement with the DOT, and small-arms, machine gun, and mortar fire during routine training exercises in the area mauka of the airfield and east of the project area.

IX. RELATIONSHIP OF THE PROPOSED ACTION TO THE LAND USE PLANS, POLICIES, AND CONTROLS FOR THE AFFECTED AREA

A. Land Ownership and Existing Land Use

The proposed project area, which includes portions of two land parcels, is owned by the State of Hawaii. State tax records indicate that government ownership of the mauka parcel, TMK 6-9-1: 3, on which the majority of the proposed action would occur, goes back prior to 1944. The makai parcel, TMK 6-9-1: 33, was acquired by the State in 1977 through condemnation proceedings against the Mokuleia Ranch and Land Co., Ltd. and the Dillingham Corporation for the establishment, development, and construction of Kaena Point State Park. Neither parcel has been used for any public or private purpose since the cessation of quarrying activities in the mid-1970s.

B. Adjacent Land Use

The lands to the east and north of the proposed project site are military lands comprising the Dillingham Airfield and the Mokuleia Army Beach. The airfield lands are presently leased to the DOT for general aviation uses; the beach lands are presently used for public recreation. Military uses of the airfield continue under the DOT lease agreement, on a reduced scale.

The lands to the west are State lands which are not presently in use. Until recently, however, they were used for the grazing of cattle and horses under Revocable Permit S-5759 to Mokuleia Homesteads.

The lands to the south are State lands comprising the Kuaokala Forest Reserve and the Kuaokala Game Management Area. These lands are used for various State purposes and public recreation.

C. Proposed Park Land Use

The proposed park land uses of the quarry site are as a maintenance yard, secured parking for upland area, a moto-cross course, and a rifle range (Figure 47). These are activities which would not appear to be particularly well suited for the more pristine portions of the Kaena Point State Park.

The water-filled excavation pit and small areas of level land around the pit, which the applicants have proposed for above-ground tank culture and farm support infrastructure, would also not appear to be areas which would lend themselves to these proposed park activities. However, there are large areas of level or gently sloping land present at the quarry site, makai and west of the proposed project area, which would appear to have the physical characteristics suitable for some or all of these proposed activities.

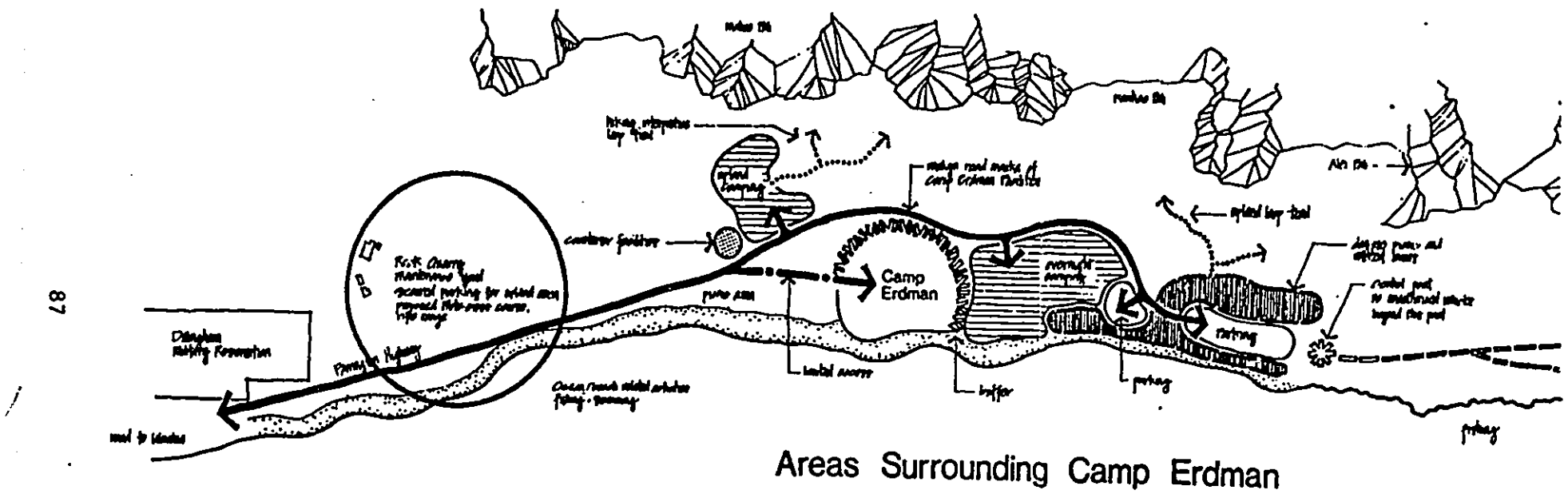


Figure 47. Proposed Kaena Point State Park land use of the quarry site (State of Hawaii, 1978).

D. Federal Land Use Regulations/Controls/Permits

There are no federal land use regulations, controls, or permits that affect this project. The proposed action would not involve any navigable or tidally influenced waters, require the alteration of any wetlands, or impact any endangered species or sanctuaries.

Furthermore, the proposed action would not conflict with or infringe upon present or future Army or DOT airfield activities. In fact, airfield planners stated in a recent public hearing that they would like to see the lands adjacent to the airfield kept or placed in agricultural activities so as to avoid potential future conflicts due to airfield activities and noises, which might arise if adjacent lands were used for "higher activities" (Noda and Associates, 1990).

E. State Land Use Regulations/Controls/Permits

1. State Land Use Designation

The proposed project site is classified as Conservation (C) district by the State Land Use Commission (Figure 48). The adjacent properties are classified as Agriculture (A) district.

Policy IA(3) of the 1990 draft State Conservation Lands Functional Plan, prepared in coordination with the Department of Land and Natural Resources, would appear to encourage the use of Conservation district lands for commercial aquaculture. In the 1990 draft, the DLNR Aquaculture Development Program was designated as the lead organization to "identify public and privately owned sites (in the Conservation district) suitable for commercial aquaculture".

The majority of the site, including the excavation pit, is within the General (G) subzone of the Conservation district, as defined by the Department of Land and Natural Resources (Figure 49). The objective of the General subzone is to designate open space where specific conservation uses may not be defined, but where urban use would be premature (Brewer, 1980). Aquaculture is specifically identified as a permitted use within this subzone.

The makai edge of the site extends slightly into the Limited (L) subzone. The objective of the Limited subzone is to designate areas where natural conditions (floods, tsunamis, erosion, etc.) suggest constraint on human activities. It should be noted, however, that all of the former quarry structures were located within this subzone, and these operated for more than 35 years without incident due to tsunamis, flooding, or other natural conditions. Furthermore, as the DLNR Aquaculture Development Program has noted, many of the natural lowland and coastal areas

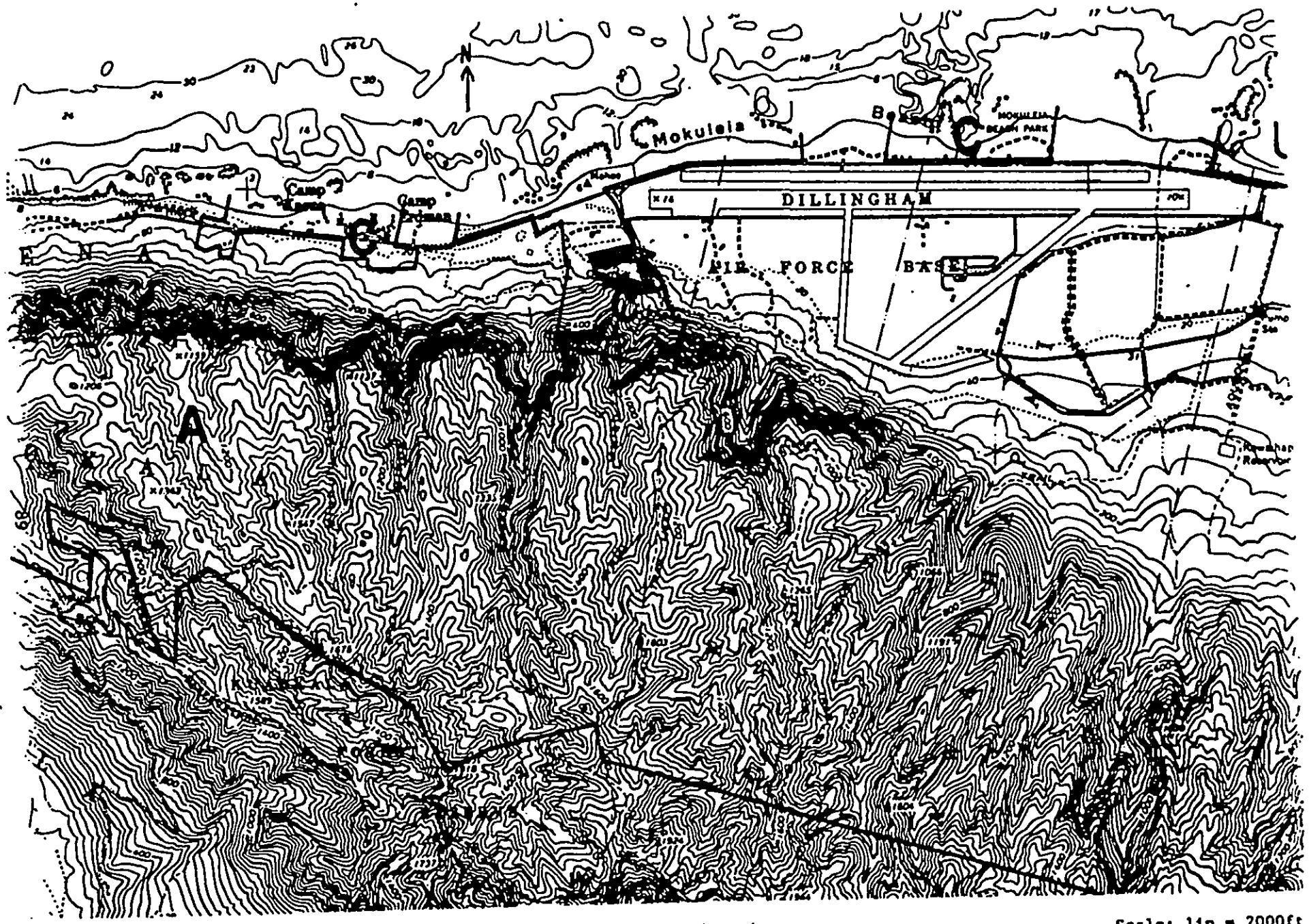


Figure 48. State land use designation.

Scale: 1in = 2000ft

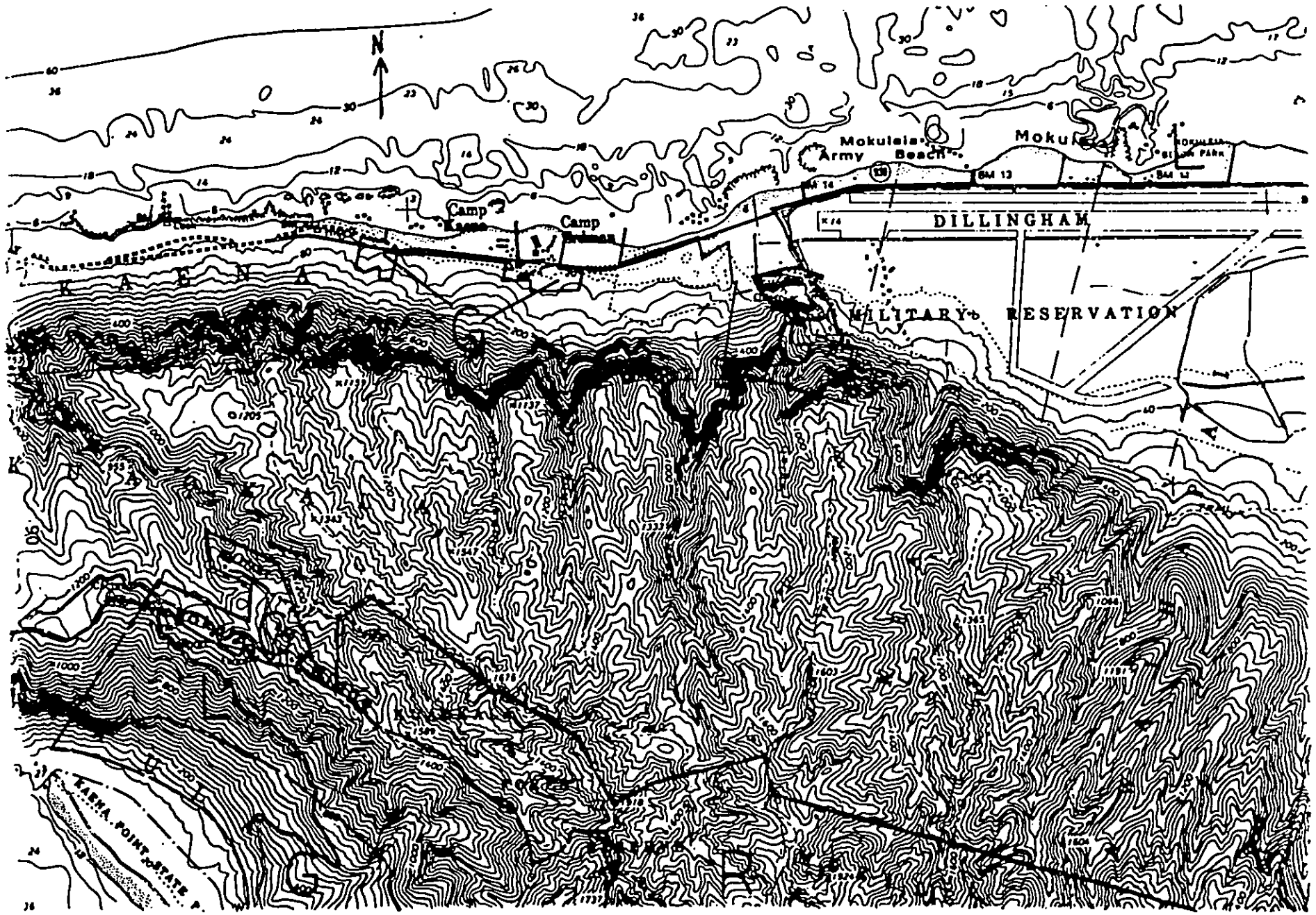


Figure 49. Conservation district subzones.

Scale: 1in = 2000f·

within the Limited subzone represent potentially ideal aquaculture sites (Brewer, 1980).

The proposed location of the aquafarm's container area would be just over the boundary of the Limited subzone, and the proposed location of the farm operations office and hatchery/broodstock area would appear to touch or straddle the boundary of this subzone (Figure 50). The areas in question are all more than 1,200 feet inland from the coast and at an elevation of several feet or more above the maximum tsunami inundation level recorded in recent times of 16 feet. In fact, the proposed farm operations office would be located near or above the 50-foot contour line which is the maximum inundation level projected for the north shore of Oahu by UH Joint Institute for Marine and Atmospheric Research in cooperation with the State Civil Defense System. It is hoped, therefore, that the applicant's proposed aquaculture activities would be allowed to extend somewhat into the Limited subzone, where the quarry structures safely operated for so many years.

2. National Pollutant Discharge Elimination System Permit

The applicants would not require a NPDES permit from the DOH and the U.S. Environmental Protection Agency, since the proposed action would not involve the discharge of any wastewaters from fixed point sources into surface waters, would produce less than 100,000 pounds of aquatic animals per year, and would involve the culture of aquatic animals non-indigenous to the United States.

3. Historic Site Review

The proposed action would not involve any designated historic properties listed in the Hawaii Register of Historic Places and in the Federal Register of Historic Places. The site is already a highly disturbed area, owing to nearly a century of past quarrying, ranching, and farming activities. It is highly unlikely that any historic materials would have survived such past activities, if any had ever previously existed at the site. The proposed action would involve areas which were created largely if not entirely by post-war quarrying activities at the site, and which existed in historic times only as the interior of a former large rock outcrop.

4. Introduction of Non-Indigenous Species

The applicants would obtain all necessary import permits from the DOA Plant Quarantine Branch, before importing any non-indigenous plant or animal species.

CORRECTION

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

within the Limited subzone represent potentially ideal aquaculture sites (Brewer, 1980).

The proposed location of the aquafarm's container area would be just over the boundary of the Limited subzone, and the proposed location of the farm operations office and hatchery/broodstock area would appear to touch or straddle the boundary of this subzone (Figure 50). The areas in question are all more than 1,200 feet inland from the coast and at an elevation of several feet or more above the maximum tsunami inundation level recorded in recent times of 16 feet. In fact, the proposed farm operations office would be located near or above the 50-foot contour line which is the maximum inundation level projected for the north shore of Oahu by UH Joint Institute for Marine and Atmospheric Research in cooperation with the State Civil Defense System. It is hoped, therefore, that the applicant's proposed aquaculture activities would be allowed to extend somewhat into the Limited subzone, where the quarry structures safely operated for so many years.

2. National Pollutant Discharge Elimination System Permit

The applicants would not require a NPDES permit from the DOH and the U.S. Environmental Protection Agency, since the proposed action would not involve the discharge of any wastewaters from fixed point sources into surface waters, would produce less than 100,000 pounds of aquatic animals per year, and would involve the culture of aquatic animals non-indigenous to the United States.

3. Historic Site Review

The proposed action would not involve any designated historic properties listed in the Hawaii Register of Historic Places and in the Federal Register of Historic Places. The site is already a highly disturbed area, owing to nearly a century of past quarrying, ranching, and farming activities. It is highly unlikely that any historic materials would have survived such past activities, if any had ever previously existed at the site. The proposed action would involve areas which were created largely if not entirely by post-war quarrying activities at the site, and which existed in historic times only as the interior of a former large rock outcrop.

4. Introduction of Non-Indigenous Species

The applicants would obtain all necessary import permits from the DOA Plant Quarantine Branch, before importing any non-indigenous plant or animal species.

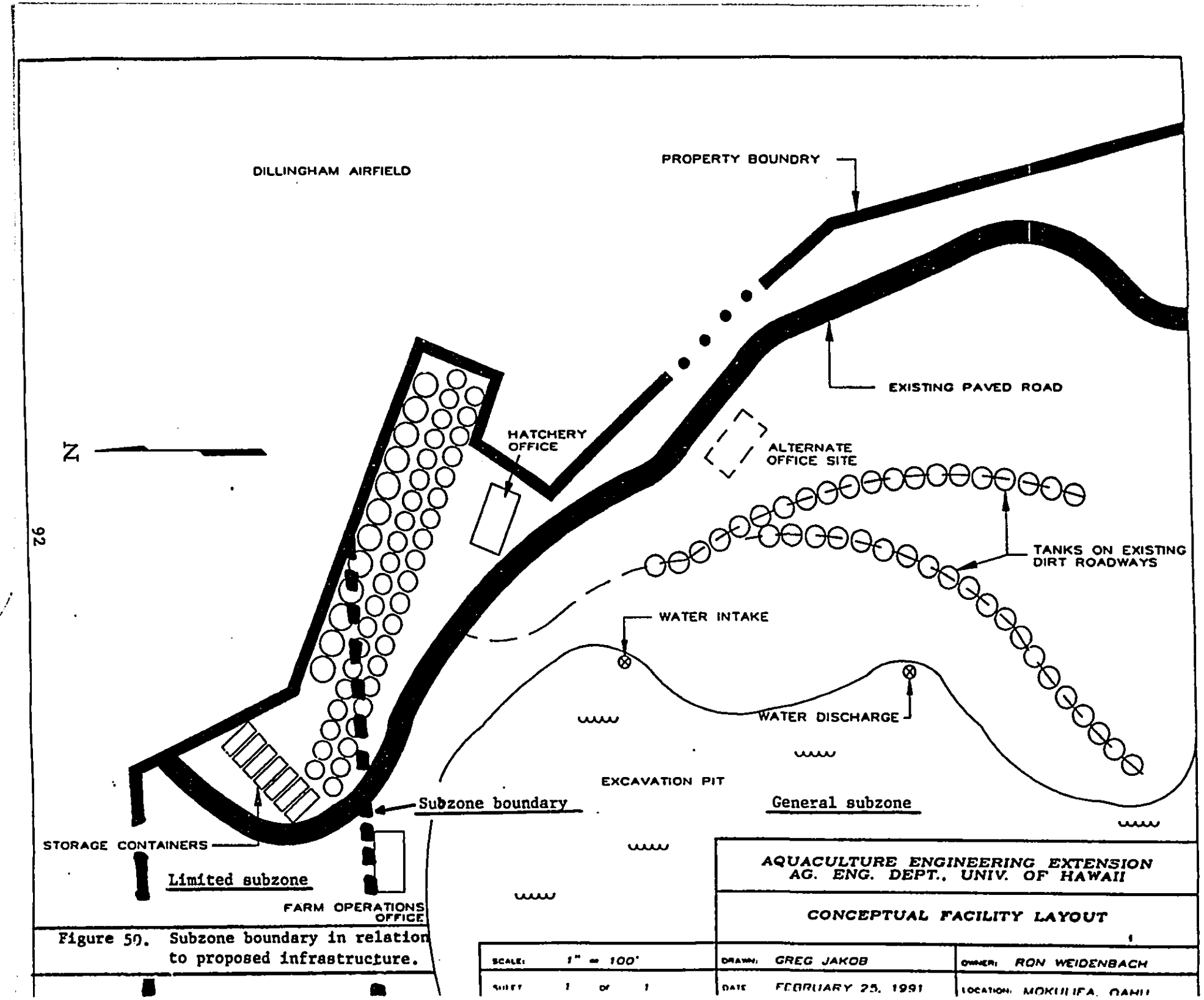


Figure 59. Subzone boundary in relation to proposed infrastructure.

5. Designated Groundwater Control Area Use Permit

The proposed site is within the Waialua Water Management Area. However, the applicants have made no plans to initiate the use of groundwaters at the proposed project site.

6. Underground Injection Control Line

The proposed action is mauka of the DOH Underground Injection Control (UIC) line, which follows Farrington Highway in the vicinity of the proposed project area. However, the proposed action does not involve such activities as the use of underground injection wells or cess pools, which are regulated mauka of the UIC line.

7. No-Pass Zone

The proposed action is within the DOH No-Pass Zone which regulates wastewater disposal. As such, the applicants would need to submit plans to the DOH Wastewater Branch for approval prior to construction of an individual wastewater disposal system for the proposed facility.

F. County Land Use Regulations/Controls/Permits

1. General Plan/County Zoning

The proposed project site is classified as Preservation (P-1) district by the City and County of Honolulu (Figure 51). The DLNR has jurisdiction over all P-1 lands, and regulates their uses.

The adjacent lands are zoned General Preservation (P-2) district and General Agricultural (AG-2) district. Aquaculture is listed as a principal permitted use in both of these zoning districts.

2. Special Management Area

The proposed project site is located mauka of the Special Management Area (SMA) boundary (Figure 52). In any case, aquaculture is listed as an exempted activity in the SMA (City and County of Honolulu, 1984).

3. County Grading, Grubbing, and Stockpiling Permits

The applicants are presently registered with the SCS as cooperating farmers of the Windward Oahu Soil Management District. The applicants would register again as cooperating farmers for the proposed project, and the limited amount of earthwork planned for the proposed project would be carried out in cooperation with SCS engineers. A standing cooperative agreement exists between the SCS and the County Public Works

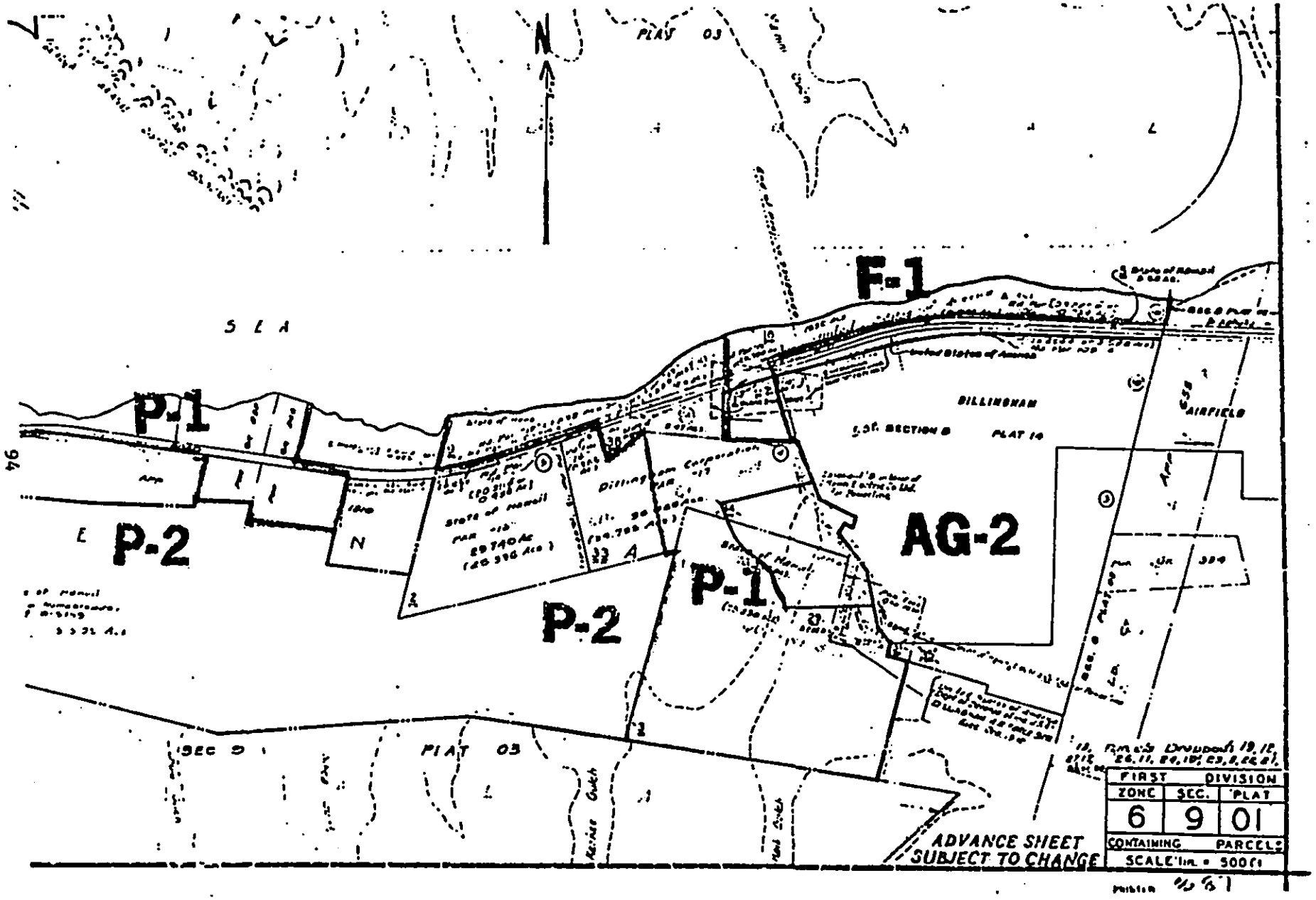


Figure 51. General plan/County zoning classification.

Scale: 1in = 1000ft

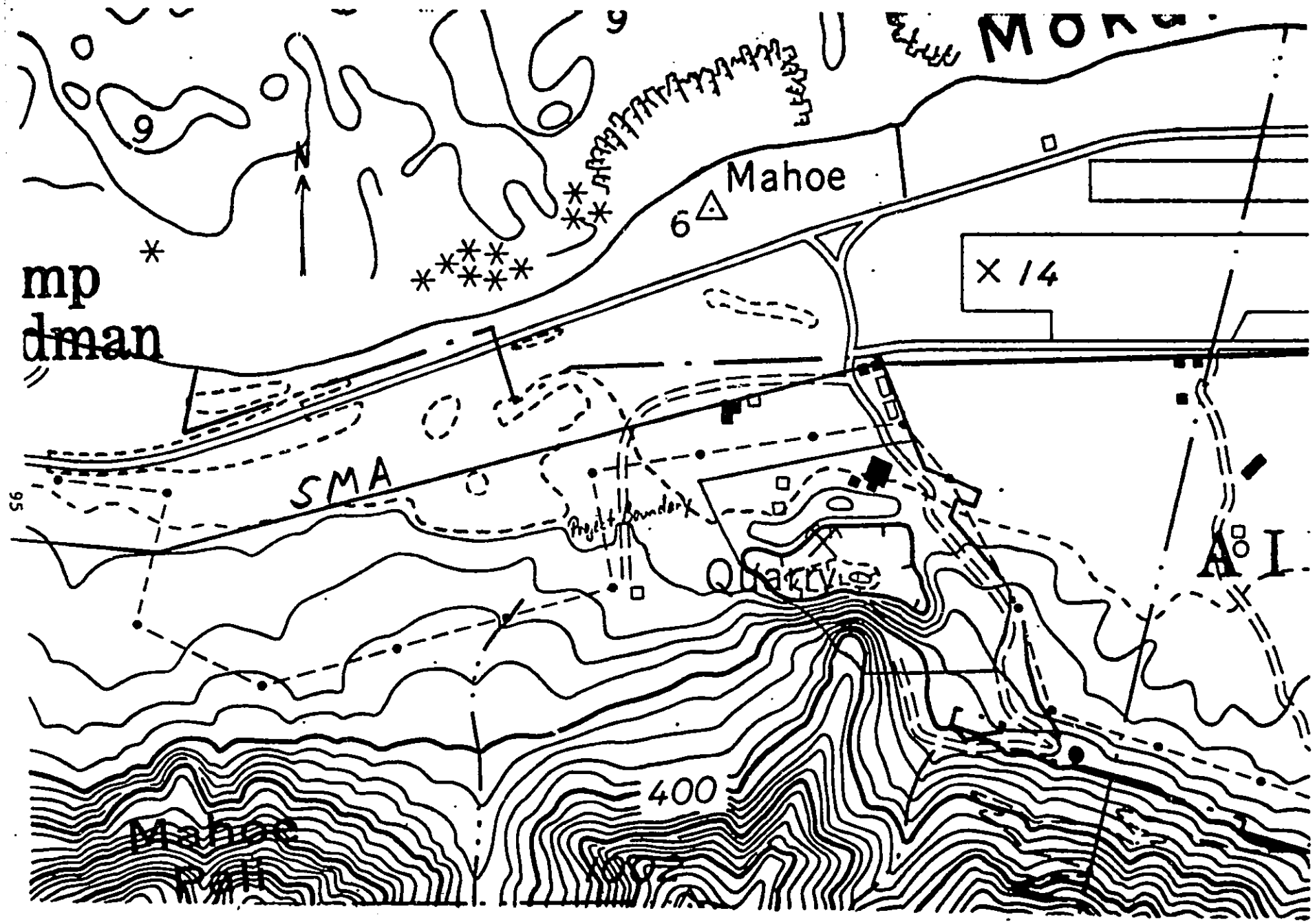


Figure 52. Special Management Area boundary.

Scale: 1in = 500ft

Department (PWD) whereby the SCS assumes administrative responsibility for cooperating farmers and the PWD waives all grading, grubbing, and stockpiling permit requirements and fees.

4. Construction Permits

The applicants would obtain all necessary building permits from the County Building Department as required to construct the proposed aquafarm infrastructure.

X. ANTICIPATED ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATIVE MEASURES

A. Introduction

A discussion of the anticipated environmental impacts generated by the proposed aquafarm follows, for the most part, the sequence of topics previously utilized in Section VIII. Description of the Existing Environment. No major negative environmental impacts have been identified in relation to the proposed action. However, several minor impacts, both positive and negative, would result. Where these minor impacts would be negative, proposed mitigative measures are discussed.

B. Access

The proposed project would have no negative impact on access to the affected land parcels (TMK 6-9-1: 3 and 33), or to the adjacent land parcels (TMK 6-9-1: 2, 4, and 36). Access to the proposed project area from Farrington Highway, via parcel 36, is presently blocked by large boulders placed by the State to deter illegal access to the quarry site. A large vandalized gate exists along this access point which eventually could be repaired by the applicants to allow controlled vehicle access, thereby providing a positive impact.

However, the applicants would at least initially enter the site via the airfield perimeter road and water tower access road, under an existing arrangement with the airfield's resident manager and maintenance supervisor.

C. Natural Beauty and Open Space

The proposed action would result in a positive impact on the natural beauty of the proposed project area by way of the clean-up and removal of quarry structures and discarded materials remaining at the project site. The concrete tower and other essentially immovable structures would be cleaned up to the extent possible, and then concealed with landscape plantings.

The water-filled excavation pit and the proposed hatchery/nursery area would not be visible from Farrington Highway or the Dillingham airfield, and the proposed container, hatchery/broodstock, and office areas would only be slightly visible. No significant change in viewshed is therefore anticipated. In any case, the proposed floating cages, above-ground tanks, and farm infrastructure would all be constructed, placed, and maintained in an aesthetic and orderly fashion, and would be an attractive point of interest to those visiting the site, and to those flying over the site from the nearby airfield.

The natural beauty of the cliffs and talus slopes mauka of the site, and the feeling of open space overall, would not be diminished by the proposed aquafarm. The overall visual impact of the proposed project should be pleasant, attractive, and in keeping with the rural natural setting of the area.

D. Surrounding Properties

The proposed project would have no negative impact on the surrounding properties. A positive impact would result from the presence of staff at the site and from the overall clean-up of the site, which would decrease the incidence of trespass across surrounding properties by persons seeking access to the excavation pit and the remaining derelict quarry structures.

E. Population

The proposed action would have no negative impact on the very limited population living near the quarry site.

The proposed project could have a positive impact on the students of Waialua High School who are studying aquaculture as part of a new school curriculum, if they wish to visit a neighborhood aquafarm. Similarly, camp groups from Camp Erdman and Camp Mokuleia could arrange visits to the site to observe an operating aquafarm. Other schools and community interest groups would also be encouraged to visit the farm, once the project is operational.

A limited number of employment opportunities should result from the project, which would provide an additional benefit to the community and another positive impact.

A positive impact would also result from the applicants' control of access to the excavation pit. The excavation pit, in its present unsupervised condition, is a community safety hazard which has already been the cause of one drowning and has resulted in numerous lesser injuries. The applicants' presence would deter trespass at the site and hazardous activities such as cliff diving.

F. Landforms

No negative impacts would occur to the landforms of the area, which were significantly altered by past quarrying operations.

G. Geology

No impacts would occur to the geology of the area, which was substantially impacted by previous quarrying operations.

H. Hydrology

1. Groundwater

The proposed action would have no impact on groundwater resources. Domestic wastewater disposal would be by an approved individual wastewater disposal system, installed in accordance with DOH and County regulations. Water draining from the fish tanks would be recycled to the excavation pit or used for landscape irrigation.

2. Surface Waters

There are no perennial streams on or within several miles of the proposed project site, and no discharge would occur from the excavation pit to the ocean or surrounding land areas. Effluent from the above-ground tanks would be recycled to the excavation pit where it would be assimilated by natural physical and biological pond processes, or used for landscape irrigation.

The proposed project would have a positive impact on the runoff of surface water from Haili Gulch, which flows intermittently into the excavation pit primarily down the water tower access road. Routine maintenance of the drainage culvert along the west side of the road would insure the unobstructed flow of winter storm runoff into the pit. It would thereby prevent or reduce the incidence of roadside erosion which presently occurs when the drainageway fills with weeds and forest litter, and then overflows.

No significant negative impact is anticipated with the water-filled excavation pit, since no significant degradation in water quality should occur as a result of the proposed action. The projected fish production rate of 500 pounds per million gallons of standing water would be substantially below the production rates of other Hawaii or mainland aquaculture operations.

To insure the maintenance of favorable water quality in the pit and to prevent any possible negative impact, the applicants would conduct a routine water quality monitoring program. In addition, the applicants would be prepared to install a water mixing or aeration device in the pit to promptly reverse any detected

decline in water quality and to substantially increase the pit's carrying capacity, should the need ever arise.

I. Topography

The proposed project would have no significant negative impact on the site's existing topography since the proposed action would utilize the existing water-filled excavation pit, gravel road beds, and level work areas of the former quarry operation, thereby eliminating the need for large-scale excavation and grading.

A positive impact would result from the leveling of a few scattered mounds of gravel and fines remaining from the quarry operation, and from the filling-in of existing erosion channels.

J. Soils

The proposed action would have no significant negative impact on the existing soils, for the same reasons as above. The limited amount of grading envisioned for the proposed aquafarm would be planned and overseen by engineers of the SCS. Soil erosion would be controlled by immediately revegetating graded areas.

K. Climate

No impacts are expected to the climate of the area.

L. Natural Hazards

No impacts are expected to such natural hazards as earthquakes, tsunamis, hurricanes, tropical storms, and rock slides.

A positive impact should result from the limited grading of the proposed container and hatchery/broodstock areas, whereby existing depressions, now subject to occasional shallow ponding, would be eliminated. The incidence of ponding should also be reduced by the routine maintenance of the water tower access road culvert, as discussed previously. The overflow of this culvert is the primary source of ponding water in the container and hatchery/broodstock areas.

A positive impact on the incidence and control of fires in the area should also result from the proposed project. Most of the fires in the Kaena/Mokuleia area are the result of civilian and military activities. Many recent fires have been the result of arson. The presence of staff at the site would help deter such actions. In addition, on-site staff would be able to assist in the prompt reporting of fires and suspicious activities to the Fire Department and help provide fire fighting units prompt access to the overall quarry area, as the applicants did this past summer.

M. Archaeological and Historic Sites

No archaeological or historic sites were observed or reported for the proposed project area and none are anticipated to be found, given the extensive disturbance of the area in recent times by the quarry operation. No significant negative impact should therefore occur. Nevertheless, if archaeological remains are uncovered during construction, then construction activities would be immediately halted and the State Historic Preservation Officer would be summoned.

N. Land Use

The proposed project would have a positive impact on existing land use. The area has been unused since the mid-1970s, and over this time, has been subject to such illegal activities as trespass, theft, vandalism, arson, dumping, and littering. The proposed action would put this land to productive use with an activity, aquaculture development, which is widely supported as being "an environmentally-clean, socially-acceptable, economic development alternative (which would) create new jobs, broaden the State tax base and fulfill long-term State goals" (State of Hawaii, 1991).

The proposed site, including the excavation pit, is almost entirely within the General subzone of the State Conservation district. Aquaculture is specifically listed as a permitted use in this subzone. The makai edge of the site extends slightly into the Limited subzone, in the vicinity of the former quarry structures. The proposed container area and portions of the proposed hatchery/broodstock area and farm operations office would border or extend into this subzone. However, no significant negative impact on land use should result from the applicants' placement of these temporary, modular, or modularly constructed structures partially or entirely into this subzone.

O. Derelict Structures and Discarded Materials

The proposed action would have a positive impact on the derelict structures and discarded materials located within the proposed project area, as described above in Section X.C. of this EA, Natural Beauty and Open Space, i.e., the applicants would clean-up the project area to the extent possible, and then conceal remaining immovable structures with landscape plantings.

P. Flora

The proposed project would result in a positive impact on the vegetation of the area through the control of particularly noxious exotic plant species, such as the castor bean, through the control of brush fires and through selected landscaping efforts.

The proposed action would have a minor negative impact on the koa-haole scrub and the understory of exotic weeds and grasses which are present in the areas proposed for the placement of above-ground tanks and support infrastructure. However, the applicants would regrass or landscape such areas to ameliorate this minor negative impact.

Q. Fauna

A positive impact would result from the limited and gradual enrichment of the excavation pit's water, by way of an increase in the abundance of the aquatic macrofauna in the pit. The increased natural productivity would result in no significant negative impact to the existing environment. A routine water quality monitoring program would be conducted by the applicants to insure that water quality conditions remain favorable. Should any indication of any water quality deterioration ever occur, the applicants would undertake immediate corrective action by way of the installation of a water mixing or aeration device, or by the reduction of fish stocking densities.

Another positive impact would result from the presence of staff at the site which would help insure the safety of visiting waterfowl, such as the endangered American coot, that might otherwise be subject to periodic harassment and possible "target practice" by trespassers. Local experience over the past 15 to 20 years has repeatedly indicated that aquaculture activities benefit coot and other waterfowl populations. All of the proposed cages and tanks would be covered with solid lids or netting to prevent bird predation, fish escape, and deter theft and vandalism.

R. Infrastructure

The proposed project would not result in a significant increase in the use of roads, electricity, telephone service, potable water service, or public services in the area and, therefore, would not result in a significant negative impact. Sewage disposal would be by an approved individual wastewater disposal system and likewise would not result in a significant negative impact.

S. Noise

No significant negative impacts are anticipated on ambient noise levels in the area. The only noises to be generated by the proposed action would be the use of small 1/20-1hp aerators and water pumps which would be barely audible at a distance of 25ft and which would be silenced by the sounds of the adjacent airfield.

XI. ALTERNATIVES TO THE PROPOSED ACTION

A. No Action

Under this alternative, the proposed site, which has been unused for more than 15 years, would likely remain unused until such time as funds are available to implement one or more of the proposed park uses of the area. As such, none of the positive or minor negative environmental impacts discussed in Section X. of this EA, would occur.

The applicants believe that the positive environmental impacts of the proposed action far outweigh the minor negative impacts, and that therefore the no action alternative would not be to the public good. Certainly, the no action alternative would be contrary to the spirit of the 1990 State Conservation Lands Functional Plan draft, which identifies the DLNR Aquaculture Development Program as the lead agency to "locate, preserve and encourage the availability of sites (in the Conservation district) for commercial aquaculture by both private and public sector landowners".

B. Alternative Sites

Available alternative aquaculture sites, with comparable physical characteristics, are now virtually or entirely non-existent on Oahu. In recent years, competing land uses, particularly resort developments and golf courses, have essentially tied-up available agricultural lands on Oahu which would be suitable for aquaculture development. In addition, the existing reservoirs on the island are committed to domestic uses and large-scale agricultural irrigation projects, or have been condemned and drained as a result of hazards having been identified with their containment dams.

The applicants' need for a site with moderately hard to hard water is an additional limiting factor; most of Oahu's surface and ground water resources are soft to very soft and are therefore not particularly well suited for the culture of Chinese catfish, one of the applicants two primary culture species.

Alternative sites may exist on the outer islands, but the primary markets and the applicants' existing customers are on Oahu.

C. Modified Actions

Several modified actions have been considered. The physical characteristics of the site limit the possible aquaculture husbandry options to cage culture and tank culture. The high hardness, high chloride content, and warm water temperatures of the excavation pit water further limit the applicants' options by reducing the choices of possible species to those which could be

cultured under such environmental conditions, i.e., soft water and cool water species would not likely do well at this site.

Within the above constraints, the applicants have proposed the aquaculture project described in the preceding sections of this EA. The proposed action utilizes both cage culture and tank culture, providing the applicants with two environmentally compatible husbandry alternatives for each target species.

A reduction in the number of cages would place constraints on the applicants' grow-out options and, ultimately, on total farm production. By spreading out the cultured fishes among the proposed number of cages, the applicants expect to achieve maximum fish growth rates and survival. If the number of cages were to be reduced, then the applicants would have to either stock the remaining number of cages at higher stocking densities, sacrificing growth and survival rates, or accept a significant reduction in the total numbers of fishes stocked and total farm production.

A reduction in the number of tanks would reduce the opportunities for temperature and photoperiod control, and water treatment, thereby reducing broodstock maturation and spawning capabilities. In addition, such a modified action would reduce the options for quarantine, research, separation of genetic stocks, fry rearing, product diversification, and the option to culture species which may prove to be poorly suited for cage culture.

In either case, if a significant reduction in husbandry capacity were to occur, the proposed action would be economically impaired. As such, fixed labor and other support costs would become an increasingly burdensome proportion of total expenditures, at the same time that the ability of the project to generate revenue is decreased. No significant environmental benefit would be gained from either modified action.

An increase in the number of cages and/or tanks would likely result in a more productive and economically viable project, as long as favorable water quality conditions are maintained and sufficient market capacity continues to exist. The option for an increased number of cages seems quite possible; the excavation pit's water quality could be readily maintained with the use of a water mixing or aeration device. The limited availability of level land, however, would likely preclude any significant increase in tank culture capacity. In either case, no significant negative environmental impact would result.

A significant reduction in the extent of proposed aquafarm infrastructure would likely have similar results to the above. A reduction in container storage capacity would mean that fish feed and other essential supplies could not be ordered and stored in bulk, resulting in the loss of economies of scale. A reduction

in storage capacity would also result in the increased risk of theft and vandalism, and in a shortening of the life expectancy of farm equipment and supplies, due to constant exposure to the elements. A reduction in office space would result in reduced operating efficiency and reduced farm security. No significant environmental benefit would result from any of these modified actions.

An increase in aquafarm infrastructure would be constrained by the limited availability of additional level land within the proposed project area. The increased use of cold frames over the proposed hatchery tanks would result in increased hatchery production, by increasing tank water temperatures. The purchase of additional shipping containers would provide additional storage, workshop, and laboratory space, if ever needed. Such additions in proposed infrastructure would result in no significant negative environmental impact.

XII. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The proposed project has been conceived of with an awareness of the environmental attributes of the area, with an understanding of the potential minor environmental impacts which would result from the proposed action, and with the knowledge of public and private support for aquaculture as an environmentally-clean, socially-acceptable, development alternative to create new jobs, broaden the State tax base, and fulfill long-term State goals.

The proposed action would not involve trade-offs between short-term uses of the area and the maintenance and enhancement of long-term productivity. Also, it would not foreclose future recreational options for the area, narrow the range of future beneficial uses of the area, or pose any long-term risks to public health or safety.

Locally and internationally, catch fisheries are declining due to the effects of overfishing and environmental degradation. Aquaculture is widely seen as a major means to mitigate the losses of this nutritionally and economically valuable source of animal protein.

The proposed action would put an unused natural resource to productive use, provide additional locally grown seafood products for local consumption and for export sales, and develop new technologies for the use of cage culture and tank culture under local conditions. All of this could be accomplished with no significant negative impact to the existing environment or to the sites long-term productivity.

XIII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The proposed project would not deplete or diminish, in an irreversible or irretrievable manner, any important natural resource associated with the project site. The proposed action has been carefully designed to utilize existing physical features of the site, with no significant alterations.

Expendable resources to be used in the construction and operation of the proposed aquafarm would be brought to the site from outside sources. These would include labor, construction materials, fish feed, operating supplies, potable water, and utilities.

XIV. DETERMINATION AND REASONS SUPPORTING DETERMINATION

Upon evaluation of the technical characteristics of the proposed aquafarm relative to the existing environmental characteristics of the site, the applicants have determined that no significant negative environmental impact would occur as a consequence of the proposed action. Several minor environmental impacts have been identified, but most of these would be positive impacts. Where minor negative impacts have been identified, appropriate mitigative measures have been suggested. Possible alternative actions have also been considered but have not been found to offer any significant benefits relative to the minor negative impacts identified with the proposed action.

The proposed project would not result in trade-offs between short-term uses of the area and the maintenance and enhancement of long-term productivity of the area. In addition, the proposed action would not deplete or diminish any important natural resource of the area in an irreversible or irretrievable manner. It is the applicants' opinion, therefore, that the proposed aquafarm would be an environmentally compatible and socially beneficial use of the subject State Conservation Lands, and would not interfere with, and, in fact, would be complementary to proposed Kaena Point State Park uses of the quarry site. It would also be in keeping with stated public objectives of encouraging the availability of formerly developed State conservation lands for commercial aquaculture activities.

APPENDIX I. BACKGROUND OF APPLICANTS AND COMPANY

Mr. and Mrs. Weidenbach formed Hawaii Fish and Shellfish Company (HFS) in 1980 and have been producing freshwater aquaculture products on a commercial basis since 1982. HFS presently operates a six-acre multi-species aquafarm in Punaluu, Oahu, and until 1991, operated a small aquaculture research facility in Waimanalo. Chinese catfish is the primary crop grown by HFS. Secondary crops include Hawaiian sunfish, grass carp, bighead carp, silver carp, freshwater prawns, and top minnows.

Mr. Weidenbach has been active in Hawaii's aquaculture industry since 1975, has been a part-time consultant and research fellow at the East-West Center, Environment and Policy Institute, and the Resource Systems Institute, since 1977, and has served as a fisheries biologist and an aquaculture consultant on several United Nations and World Bank projects. Mr. Weidenbach holds B.S. and M.S. degrees in Natural Resource Management from the University of Michigan, School of Natural Resources, and prior to coming to Hawaii, held professional positions with the University of Michigan, Great Lakes Research Division; the University of Miami, School of Marine and Atmospheric Sciences; the National Audubon Society; and the National Park Service.

Mrs. Weidenbach has been involved in HFS business, research, hatchery, grow-out, and marketing activities from the company's inception. Mrs. Weidenbach is a former State social worker with B.S. and M.S.W. degrees from the University of Hawaii. She brought to the company a wealth of practical farm and business skills from her years of experience with her family's Big Island anthurium farm in Mountain View, and from employment in several other local small businesses.

Mr. McConnell, HFS fishery biologist, has been with the company since 1988. He has been active in Hawaii's aquaculture industry since 1978, being previously employed as farm manager at Folwerco Hawaiian Sunfish Farm and at Amorient Aquafarm, Inc., in Kahuku, and as assistant hatchery manager at Aquatic Farms, Ltd., in Waikane. Mr. McConnell holds a B.S. degree in fishery biology from Oregon State University and, for several years, was a Peace Corps volunteer and, later, a fishery biologist and aquaculture consultant in the Republic of Palau, Micronesia.

APPENDIX II. CONSULTED AGENCIES, GROUPS, AND INDIVIDUALS

A. City and County of Honolulu

Board of Water Supply
- Water Information Office
- Water Chemistry Laboratory
- Engineering Branch
  - Design Section

Building Department

Department of Finance
- Real Property Assessment Division

Fire Department
- Waialua Station

Department of General Planning

Department of Land Utilization
- Land Use Information
- Land Use Permits

Police Department
- Wahiawa Station

Department of Public Works
- Wastewater Management Division

B. Hawaii State Government

Department of Accounting and General Services
- State Archives

Department of Agriculture
- Plant Industry Division
  - Plant Pest Control Branch
  - Plant Quarantine Inspection Branch

Department of Business and Economic Development
- Information Office
  - Library
- Business Services Division
  - Business Action Center
- Land Use Commission

Department of Defense
- Hawaii Army National Guard
  - 227th Engineer Company

Department of Health
- Environmental Quality Control Office
- Hazard Evaluation and Emergency Response Branch
- Sanitation Branch
- Safe Drinking Water Branch
- Solid and Hazardous Waste Branch
- Wastewater Branch

Department of Labor and Industrial Relations
- Aloha State Specialized Employment Training

Department of Land and Natural Resources
- Office of Conservation and Environmental Affairs
- Aquaculture Development Program
- Division of Aquatic Resources
  - Recreational Fisheries Program
  - Anuenue Fisheries Research Center
- Division of Conservation and Resources Enforcement
- Division of Forestry and Wildlife
- Division of Historic Preservation
- Division of Land Management
  - Oahu District Land Agent
- Division of State Parks and Outdoor Recreation
- Division of Water Resource Management
  - Water Resources Information Center

Department of Transportation
- Airports Division
  - Administration Branch
  - Engineering Branch
  - Dillingham Airfield
    - Maintenance
    - Resident Manager
    - UNICOM

University of Hawaii
- Environmental Center
- Department of Geography
- Hawaii Cooperative Fishery Research Unit
- Hawaii Institute of Marine Biology
  - Coconut Island Branch
  - Mariculture Research and Training Center
- Hamilton Library - Reference Services
  - Government Documents
  - Hawaiian/Pacific Collections
  - Map Collection
  - Science/Technology
- Pacific Biomedical Research Center
  - Kewalo Marine Laboratory

Sea Grant College Program
Extension Service
Aquaculture
Fisheries
College of Tropical Agriculture and Human Resources
Department of Agricultural Engineering
Aquaculture Engineering Extension Project
County Extension Office
Tsunami Research JIMAR
Water Resources Research Center
William S. Richardson Law Library
Department of Zoology

C. United States Government

Department of Agriculture
Animal and Plant Health Inspection
Animal Damage Control
Soil Conservation Service
Hawaii Field Office
Tropical Aquaculture Research Unit

Department of Army
Corps of Engineers
Pacific Ocean Division
Environmental Resources Section
Schofield Army Base
Office of Community Relations

Commander in Chief of the Pacific
Office of Community Relations

Department of Interior
Fish and Wildlife Service
Environmental Services
Pacific Islands Office
Geological Survey
Water Resources Division

Department of Navy
Barbers Point Naval Air Station

D. Other Agencies and Groups

Air Survey Hawaii

Bishop Museum
Botany Department
Library
Geography and Maps Department
Zoology Department

East-West Center
Environment and Policy Institute

GTE Hawaiian Telephone Company

Hawaii Audubon Society

Hawaiian Electric Company
Engineering - Operations

Industrial Technologies

James Maragos

Edward K. Noda and Associates

Oceanic Institute
Center for Tropical and Subtropical Aquaculture
Aquaculture Effluent Discharge Project
Water Chemistry Laboratory

Margo Stahl

Young Men's Christian Association of Honolulu
Camp Harold R. Erdman

APPENDIX III. CHECKLISTS OF PLANTS AND ANIMALS

A. Introduction

Five checklists, prepared by the applicants, are presented in Appendix III.: (1) flowering plants, (2) fishes, (3) amphibians and reptiles, (4) birds, and (5) mammals. Taxonomy and nomenclature of the flowering plants follow Imada, et al., 1989, and Wagner, et al., 1990; amphibians and reptiles follow McKeown, circa 1977, and Tinker, 1980; fishes follow State of Hawaii, 1990, Rosen and Bailey, 1963, and Sterba, 1963; birds follow Pyle, 1988, and Shallenberger, 1986; and mammals follow Tinker, 1980, and S.G. van Riper and C. van Riper, 1982.

For each species listed on the checklists, the following information is provided:

1. Scientific name.

2. Vernacular name or names, or Hawaiian name, when commonly used.

3. Presence or likely presence, or possible presence of a particular species at or near the proposed project area.

   O Observed: Species observed on or near the project area during field surveys of the past year, or recently by other persons with reliable taxonomic knowledge.

   L Likely: Species likely to occur at the project area based on literature reviews and personal communications with persons familiar with the project area or with the species in question. However, not observed with certainty during field surveys of the past year, or recently by persons with reliable taxonomic knowledge.

   P Possible: Species possibly occurring at the project area on an infrequent basis, determined as above. Included here are reports of occurrence by persons of uncertain taxonomic knowledge. However, not observed during the past year's field surveys.

4. Distributional and endangerment status of species.

   E Endemic: Species occurring only in the Hawaiian Islands, i.e., occurring naturally nowhere else in the world.

   I Indigenous: Species occurring naturally in the Hawaiian Islands but also occurring naturally outside Hawaii.

   P Polynesian: Species introduced to Hawaii prior to the time of Captain Cook's discovery of the islands.

X Exotic: Species deliberately or accidentally introduced to Hawaii after the Western discovery of the islands.

* Endangered: Taxa which are in danger of extinction throughout all or a significant portion of their range unless threats jeopardizing their survival are alleviated; listed on the Federal Register, Updated September 11, 1990.

1 Category 1: Taxa for which the U.S. Fish and Wildlife Service has on file enough substantial information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species.

2 Category 2: Taxa for which there is some evidence of vulnerability, but for which there are not enough data to support proposals to list them as endangered or threatened species at this time.

3C Category 3C: Taxa that have proven to be more abundant or widespread than previously believed and/or those that are not subject to any identifiable threat.

B. Checklist of Flowering Plants (R.P. Weidenbach)

Scientific Name	Common Name	Presence	Status
Acanthaceae			
Asystasia gangetica	Asystasia	O	X
Agavaceae			
Agave sisalana	Sisal, malina	P	X
Cordyline fruticosa	Ti, ki	P	P
Pleomele halapepe		P	E(3C)
Aizoaceae			
Sesuvium portulacastrum	Sea purslane	P	I
Amaranthaceae			
Achyranthes indica		P	X
Amaranthus spinosus	Spiny amaranth	O	X
Anacardiaceae			
Schinus terebinthifolius	Christmas berry	O	X
Apiaceae			
Centella asiatica	Asiatic pennywort	P	X
Apocynaceae			
Rauvolfia sandwicensis	Hao	P	E
Araliaceae			
Reynoldsia sandwicensis	'Ohe makai	P	E
Asteraceaeae			
Ageratina adenophora	Maui pa makani	P	X
A. riparia	Hamakua pa makani	P	X
Ageratum conyzoides	Ageratum	P	X
Ambrosia artemisiifolia	Ragweed	P	X
Bidens pilosa	Spanish needle	P	X
B. torta	Ko'oko'olau	P	E
Cirsium vulgare	Bull thistle	P	X
Conyza bonariensis	Hairy horseweed	P	X
Emilia sonchifolia var. *javanica*	Red pua-lele	P	X
E. sonchifolia var. *sonchifolia*	Lilac pua-lele	P	X
E. fosbergii	Pua-lele	O	X
Erechtites valerianifolia		P	X
Lipochaeta integrifolia	Nehe	P	E
L. lobata var. *lobata*	Nehe	P	E(3C)
Pluchea indica	Indian pluchea	O	X
P. carolinensis	Pluchea	O	X

Reichardia picroides	Picridium	P	X
Sonchus oleraceus	Sow thistle	P	X
Tithonia diversifolia	Mexican sunflower	O	X
Tridax procumbens	Coat buttons	O	X
Verbesina encelioides	Golden crown-beard	P	X
Xanthium strumarium var. *canadense*	Kikania	P	X
Youngia japonica	Oriental hawksbeard	P	X
Bataceae			
Batis maritima	Pickleweed	P	X
Boraginaceae			
Heliotropium curassavicum	Seaside heliotrope	P	I
H. procumbens var. *depressum*	Heliotrope	O	X
Tournefortia argentea	Tree heliotrope	P	X
Brassicaceae			
Lepidium virginicum	Wild pepper grass	P	X
Cactaceae			
Opuntia ficus-indica	Prickly pear	P	X
Capparaceae			
Capparis sandwichiana	Native caper	P	E(2)
Caricaceae			
Carica papaya	Papaya	O	X
Caryophyllaceae			
Schiedea kealiae	Kawelu	P	E(1)
Casuarinaceae			
Casuarina equisetifolia	Common ironwood	O	X
Chenopodiaceae			
Atriplex suberecta	Australian saltbush	P	X
A. semibaccata	Australian saltbush	P	X
Chenopodium oahuense		P	E
Commelinaceae			
Commelina benghalensis	Hairy honohono	P	X
C. diffusa	Honohono	O	X
Convolvulaceae			
Cuscuta sandwichiana	Dodder	P	E
Ipomoea cairica	Five-fingered morning glory	O	X(?)
I. indica	Indian morning glory	O	I
I. pes-caprae subsp. *brasiliensis*	Beach morning glory	P	I

Jacquemontia ovalifolia subsp. sandwicensis	Pa'u-o-hi'i-aka	P	E
Merremia aegyptia	Hairy merremia	O	X
Cucurbitaceae			
Momordica charantia	Balsam pear, Bitter melon	O	X
Sicyos pachycarpus		P	E
Cyperaceae			
Cladium jamaicense	'Uki	P	I
Cyperus trachysanthos	Sedge	O	E
Kyllinga brevifolia	Kyllinga	P	X
Euphorbiaceae			
Aleurites moluccana	Kukui	O	P
Chamaesyce hypericifolia	Graceful spurge	P	X
C. hirta	Garden spurge	O	X
C. prostrata	Prostrate spurge	P	X
Ricinus communis	Castor bean	O	X
Fabaceae			
Acacia mearnsii	Black wattle	P	X
A. farnesiana	Kolu, klu	P	X
A. koa	Koa	P	E
Chamaecrista nictitans subsp. patellaria var. glabrata	Partridge pea	P	X
Crotalaria incana	Fuzzy rattle-pod	P	X
C. pallida	Smooth rattle-pod	P	X
Desmanthus virgatus	Dwarf koa	O	X
Desmodium sandwicense	Spanish clover	P	X
Erythrina sandwicensis	Wiliwili	P	E
Glycine wightii		O	X
Indigofera suffruticosa	Indigo	P	X
Leucaena leucocephala	Koa-haole	O	X
Macroptilium atropurpureum		O	X
M. lathyroides	Cow pea, Wild bean	O	X
Prosopis pallida	Kiawe	O	X
Senna pendula var. advena		P	E
Goodeniaceae			
Scaevola sericea	Naupaka-kahakai	P	I
Lamiaceae			
Plectranthus parviflorus	Spurflower	P	I
Salvia coccinea	Scarlet sage	P	X
S. spp.	Salvia	O	X
Lauraceae			
Cassytha filiformis	Kauna'oa	P	I
Persea americana	Avocado	O	X

Malvaceae			
Abutilon incanum	Hoary abutilon	P	I(?)
A. grandifolium	Hibiscus	O	X
Gossypium tomentosum	Ma'o, native cotton	P	E
Hibiscus tiliaceus	Hau	P	I(?)
Malvastrum coromandelianum	False mallow	P	X
Sida fallax	'Ilima	O	I
Sida rhombifolia	Cuba jute	P	X
Thespesia populnea	Milo	P	P
Menispermaceae			
Cocculus trilobus	Huehue	P	I
Myoporaceae			
Myoporum sandwicense	Naio, bastard sandalwood	P	I
Myrtaceae			
Psidium cattleianum	Strawberry guava	P	X
P. guajava	Guava	P	X
Syzygium cuminii	Java plum	O	X
Musaceae			
Musa x paradisiaca	Banana	P	P
Nyctaginaceae			
Boerhavia repens	Alena	P	I
Mirabilis jalapa	Commom four o'clock	P	X
Nymphaeaceae			
Nymphaea spp.	Water lily	O	X
Onagraceae			
Ludwigia octovalvis	Primrose willow, kamole	O	X
Oxalidaceae			
Oxalis corniculata	Lady's sorrel	P	X
Passifloraceae			
Passiflora edulis	Yellow liliko'i	O	X
P. foetida	Scarlet-fruited passion flower	P	X
P. suberosa	Huehue-haole	P	X
Piperaceae			
Peperomia leptostachya	'Ala'ala-wai-nui	P	I
Plantaginaceae			
Plantago lanceolata	Narrow-leaved plantain	P	X
P. major	Common plantain	P	X
Plumbaginaceae			
Plumbago zeylanica	'Ilie'e	P	I

Poaceae			
Andropogon virginicus	Broomsedge	P	X
Axonopus fissifolius	Broad-leaved carpetgrass	P	X
Brachiara mutica	California grass	P	X
Cenchrus ciliaris	Buffelgrass	O	X
C. echinatus	Common sandbur	P	X
Chloris barbata	Swollen fingergrass	O	X
C. radiata	Radiate fingergrass	P	X
Chrysopogon aciculatus	Golden beardgrass	P	X
Cynodon dactylon	Bermuda grass	P	X
Dactyloctenium aegyptium	Beach wiregrass	P	X
Digitaria ciliaris	Henry's crabgrass	P	X
D. insularis	Sourgrass	O	X
Eleusine indica	Goosegrass	P	X
Eragrostis pectinacea	Carolina lovegrass	P	X
E. variablis	'Emo-loa	P	E
Vulpia spp.		P	X
Heteropogon contortus	Pili	P	I
Leptochloa uninervia		P	X
Melinis minutiflora	Molasses grass	P	X
Oplismenus hirtellus	Basket grass	P	X
Panicum maximum	Guinea grass	O	X
P. torridum	Kakonakona	P	E
P. spp.	Panicgrass	O	X
Paspalum conjugatum	Hilo grass	P	X
P. scrobiculatum	Rice grass	P	I(?)
Pennisetum setosum	Feathery pennisetum	P	X
Rhynchelytrum repens	Natal redtop	O	X
Setaria gracilis	Perennial foxtail	P	X
S. verticillata	Bristly foxtail	P	X
Sporobolus africanus	African dropseed	P	X
S. virginicus	Beach dropseed	P	I
Portulacaceae			
Portulaca oleracea	Common purslane, pigweed	O	X
P. pilosa	'Ihi	P	X
Primulaceae			
Anagallis arvensis	Scarlet pimpernel	P	X
Proteaceae			
Grevillea robusta	Silk oak, silver oak	P	X
Rosaceae			
Osteomeles anthyllidifolia	'Ulei	P	I
Rubiaceae			
Psydrax odoratum	Alahe'e	P	I
Solanaceae			
Lycopersicon pimpinellifolium	Currant tomato	O	X
Solanum americanum	Popolo, black nightshade	P	I(?)

Sterculiaceae			
Waltheria indica	Hi'aloa	P	I(?)
Verbenaceae			
Lantana camara	Lantana	P	X
Stachytarpheta jamaicensis	Jamaica vervain	P	X
Verbena litoralis	Weed verbena	P	X
Zygophyllaceae			
Tribulus cistoides	Nohu	P	I

C. Checklist of Fishes (R.P. Weidenbach)

Scientific Name	Common Name	Presence	Status
Characidae			
Hyphessobrycon innesi	Neon tetra	P	X
Cyprinidae			
Cyprinus carpio	Common carp (Koi)	P	X
Carassius auratus	Goldfish	O	X
Ictaluridae			
Ictalurus punctatus	Channel catfish	P	X
Clariidae			
Clarias fuscus	Chinese catfish	O	X
Poeciliidae			
Gambusia affinis	Mosquitofish	O	X
Pocillia reticulata	Guppy	O	X
Xiphophorus helleri	Green swordtail	O	X
Kuhliidae			
Kuhlia sandvicensis	Aholehole	P	E
Cichlidae			
Astronotus ocellatus	Oscar	P	X
Sarotherodon melanotheron	Blackchin tilapia	O	X
Oreochromis mossambicus	Hawaiian sunfish (Red hybrid Mozambique tilapia)	O	X
Channidae			
Ophicephalus striata	Pongee	O	X
Miscellaneous unidentified aquarium fishes		O	X

D. Checklist of Amphibians and Reptiles (R.P. Weidenbach)

Scientific Name	Common Name	Presence	Status
Amphibians			
Ranidae			
Rana catesbeiana	Common bullfrog	O	X
Bufonidae			
Bufo marinus	Giant Neotropical toad	L	X
Reptiles			
Testudinidae			
Chrysemys scripta	Red-eared pond slider	O	X
C. picta	Painted turtle	O	X
Iguanidae			
Anolis carolinensis porcatus	Green anole lizard	L	X
Gekkonidae			
Lepidodactylus lugubris	Mourning gecko	L	P
Gehyra mutilata	Stump-toed gecko	L	P
Hemiphyllodactylus typus	Tree gecko	P	P
Hemidactylus garnoti	Indo-Pacific gecko	L	P
H. frenatus	House gecko	O	X
Scincidae			
Lampropholis delicata	Metallic skink	L	P

E. Checklist of Birds (R.P. Weidenbach)

Scientific Name	Common Name	Presence	Status
Diomedeidae			
Diomedea immutabilis	Laysan albatross	O	I
Procellariidae			
Puffinus pacificus chlororhynchus	Wedge-tailed shearwater	P	I
Phaethontidae			
Phaethon lepturus dorotheae	White-tailed tropicbird	P	I
Fregatidae			
Fregata minor palmerstoni	Great frigatebird	O	I
Ardeidae			
Bubulcus ibis	Cattle egret	L	X
Nycticorax nycticorax hoactli	Black-crowned night-heron	O	I
Anatidae			
Anas sp.	Unidentified ducks	O	?
Phasianidae			
Alectoris chukar	Chukar	P	X
Coturnix japonica	Japanese quail	P	X
Francolinus erckelii	Erckel francolin	O	X
Pavo cristata	Pea fowl	L	X
Phasianus colchicus	Ring-necked pheasant	L	X
Meleagris gallopavo	Wild turkey	P	X
Rallidae			
Fulica americana alai	American coot (Hawaiian coot)	O	E *
Charadriidae			
Pluvialis dominica (fulva)	Lesser golden plover	O	I
Scolopacidae			
Heteroscelus incanus	Wandering tattler	P	I
Numenius tahitiensis	Bristle-thighed curlew	P	I
Arenaria arenaria	Ruddy turnstone	P	I
Calidris alba	Sanderling	P	I
Columbidae			
Streptopelia chinensis	Spotted dove	O	X
Geopelia striata	Zebra dove	O	X
Columba livia	Pigeon	O	X

Tytonidae			
Tyto alba	Common barn-owl	O	X
Strigidae			
Asio flammeus sandwichensis	Short-eared owl (Hawaiian owl)	P	E
Pycnonotidae			
Pycnonotus cafer	Red-vented bulbul	O	X
Muscicapidae			
Cettia diphone	Japanese bush-warbler	L	X
Chasiempis sandwichensis gavi	Oahu 'elepaio	P	E
Copsychus malabaricus	White-rumped shama (Shama thrush)	O	X
Leiothrix lutea	Red-billed leiothrix	P	X
Mimidae			
Mimus polyglottos	Northern mockingbird	P	X
Sturnidae			
Acridotheres tristis	Common myna	O	X
Zosteropidae			
Zosterops japonicus	Japanese white-eye	O	X
Emberizidae			
Cardinalis cardinalis	Northern cardinal	O	X
Paroaria coronata	Red-crested cardinal (Brazilian cardinal)	O	X
Fringillidae			
Carpodacus mexicanus	House finch	L	X
Passeridae			
Passer domesticus	House sparrow	L	X
Estrildidae			
Estrilda astrild	Common waxbill	P	X
E. troglodytes	Black-rumped waxbill	O	X
Lonchura punctulata	Nutmeg mannikin (Ricebird)	O	X
L. malacca	Chestnut mannikin	P	X
Padda oryzivora	Java sparrow	L	X

F. Checklist of Mammals (R.P. Weidenbach)

Scientific Name	Common Name	Presence	Status
Muricidae			
Mus musculus	House mouse	L	X
Rattus exulans	Polynesian rat	L	P
R. norvegicus	Brown rat	P	X
R. rattus	Roof rat	L	X
Canidae			
Canis familiaris	Feral dog	O?	X
Viverridae			
Herpestes auropunctatus	Mongoose	O	X
Felidae			
Felis catus	Feral cat	O	X
Suidae			
Sus scrofa	Feral pig	L	P
Bovidae			
Capra hircus	Feral goat	P	X

APPENDIX IV. EXPERT COMMENTS REGARDING PROPOSED ACTION

A. Mr. William R. Kramer
United States Department of Interior
Fish and Wildlife Service
Pacific Islands Office
Fish and Wildlife Enhancement

B. Mr. Paul G. Olin
Aquaculture Specialist
University of Hawaii at Manoa
Sea Grant Extension Specialist

C. Mr. Greg S. Jakob
Aquaculture Engineer/Extension
University of Hawaii at Manoa
College of Tropical Agriculture and Human Resources
Department of Agricultural Engineering

United States Department of the Interior

FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

May 24, 1991

Mr. Ron Weidenbach
53-270 Kamehameha Highway
Hauula, Hawaii 96717

Dear Mr. Weidenbach:

This follows up on our telephone conversation of May 14 regarding your proposed development of an aquaculture facility at the Dillingham quarry site, Oahu, Hawaii. You are proposing to construct a series of floating cages for the production of catfish and talapia for commercial purposes. Specifically, you requested that we review the proposal and consider the possible impact of the construction and operation of the facility on the Hawaiian coot, an endangered waterbird. While you would lease the quarry from the State of Hawaii (the owner), no federal permit, funding, or authorization is required.

As you described, the cages to be constructed would be of two sizes: 4- by 8-feet and 8- by 12-feet. A series of these cages would float on the quarry pond surface. The cages and hatchery tanks would occupy a small fraction of the 7-acre pond.

Hawaiian coots have been observed on the pond. As many as 15 have been reported there at any one time (summer, 1990). It appears, however, that the birds become partially used to human activities and tolerate minor disturbances; they would be expected to continue to use the pond after initial construction disturbance. The quarry is deep and has extremely steep sides. As such, it does not have the gradually sloping wetland vegetation border that is found with many natural wetlands. This lack of vegetation greatly reduces its attractiveness as coot habitat. While the birds may land on the pond and feed, it is doubtful if they nest there.

The pond does not contribute to the coots' island-wide recovery to any significant degree. As such, and in consideration of the "low impact" types of activities you have described, we do not believe your project will have any appreciable impact on coots. We have reached this determination with the understanding that you will not be adversely affecting the water quality in the quarry through the addition of chemicals or other harmful compounds, and that you will not be harassing any birds which may land on the ponds in any overt way. To do so may be in violation of federal and state law.

Thank you for the opportunity to comment on your proposal.

Sincerely yours,

William R. Kramer

William R. Kramer
Fish and Wildlife Enhancement
Pacific Islands Office

University of Hawaii at Manoa

A Sea Grant College
Sea Grant Extension Service
1000 Pope Road, Room 226 • Honolulu, Hawaii 96822
Telephone: (808) 956-8191 • Facsimile: (808) 956-2858
Cable Address: UNIHAW

April 10, 1991

Mr. Ron Weidenbach
Hawaii Fish and Shellfish
53-270 Kamehameha Hwy.
Punaluu, HI 96717

Dear Ron,

I am happy to comment on your proposed aquaculture activities at the quarry site in Mokuleia, Oahu. Based on visits by myself and others working in my office, I feel the reservoir is a valuable resource with excellent potential for aquaculture development. Part of this potential is due to the quality and quantity of water which has been verified by on site testing and assessed by divers in the reservoir. I am optimistic, based on results of initial experiments we have conducted with Chinese catfish and tilapia and your level of experience with these species.

The depth of the water makes the cage and tank culture system you propose the optimum production technique, and the massive volume of 100 million gallons is such that a small percentage of the volume will be actively involved on growout. This will provide a good buffer volume to avoid any significant alteration in water quality. It is apparent that maintaining the water quality, primarily in terms of dissolved oxygen, is essential to promote the health and rapid growth of your crop.

I am also interested in conducting experiments on cage culture of ornamental fish. I feel these species may have very good production potential. Let me know if there are any aspects of this development in which I might assist you further.

Sincerely,

Paul G. Olin
Aquaculture Specialist

University of Hawaii at Manoa

College of Tropical Agriculture and Human Resources
Department of Agricultural Engineering
3050 Maile Way • Honolulu, Hawaii 96822
Cable Address: UNIHAW

April 5, 1991

Ron Weidenbach
53-270 Kamehameha Hwy.
Hauula, HI 96717

Dear Ron:

I wish you the best of luck at obtaining the potential aquaculture site in Mokuliea, Oahu. Upon reviewing your site plans and facility design, I can see no production or operational problems from an engineering standpoint. Both cage culture and tank culture of tilapia and catfish has proven itself worldwide. The use of plywood and liner tanks is an excellent idea in that these types of tanks are easy to assemble and inexpensive to construct while offering long life expectancy.

I also want you to realize that I am at your disposable at any time to assist you in the design of your water supply system, drainage system, and or aeration system. If you desire additional design work on your facility I am more than happy to assist you in any way possible.

Good luck in your new venture, and look forward to working with you in the future.

Sincerely,

Greg S. Jakob
Aquaculture Engineer/Extension

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