EXECUTIVE CHAMBERS

HONOLULU

GEORGE R. ARIYOSHI
GOVERNOR

February 2, 1983

Mr. Roy R. Takemoto, Chairman
Environmental Quality Commission
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Mr. Takemoto:

Subject: Environmental Impact Statement for the Kahana Valley Water Development Project

Based upon the recommendation of the Office of Environmental Quality Control, I am pleased to accept the environmental impact statement for the Kahana Valley Water Development Project as a satisfactory fulfillment of the requirements of Chapter 343, Hawaii Revised Statutes.

This environmental impact statement will be a useful tool in deciding whether this project should be allowed to proceed. My acceptance of the statement is an affirmation of its adequacy under applicable laws and does not constitute an endorsement of the proposal.

When the decision is made regarding this action, I expect the proposing agency to carefully weigh the societal benefits against the environmental impact which will likely occur. This impact is adequately described in the statement, and, together with the comments made by reviewers, provide a useful analysis of alternatives to the proposed action.

With warm personal regards, I remain,

Yours very truly,

George R. Ariyoshi

cc: Honorable Kazu Hayashida

Revised Environmental Impact Statement for the Kahana Valley Water Development Project

TMK: 5-2-01, 02, 03 & 06

[redacted]

December 1982

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU

CITY AND COUNTY OF HONOLULU
BOARD OF WATER SUPPLY

REVISED

ENVIRONMENTAL IMPACT STATEMENT FOR THE KAHANA VALLEY WATER DEVELOPMENT PROJECT

TMK: 5-2-01, 02, 03, 06

This Environmental Document is Submitted
Pursuant to Chapter 343, HRS

PROPOSING AGENCY:

BOARD OF WATER SUPPLY
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96843

ACCEPTING AUTHORITY:

Governor, State of Hawaii

BOARD MEMBERS:

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Robert A. Souza, Vice Chairman
Milton J. Agader
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Walter A. Dods, Jr.
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Manager and Chief Engineer

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DECEMBER 1982

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SECTION I
SUMMARY

A. PROJECT DESCRIPTION

The Board of Water Supply (BWS) proposes to develop four well fields within Kahana Valley. Kahana Wells III, IV and V will produce an estimated total of 6 million gallons per day (mgd) of potable water. These are located on the western slope of Kahana Valley. Kahana Wells II, located on the eastern slope, will produce an estimated 1.0 mgd of potable water. Each well field will have an associated control building and access road. The wells will be connected to either the proposed Kahana Reservoir or the existing transmission main along Kamehameha Highway. The BWS hopes to develop the water resources in Kahana Valley to help meet the increasing water needs of Oahu. Development of the facilities is estimated to cost $9 million.

The domestic water needs of Oahu are met mainly by groundwater sources. The demands of an increasing population require the development of the available groundwater resources of the island. Kahana Valley is the site of a developing State Park. The BWS is working closely with the State Department of Land and Natural Resources so that development of the water sources within the park area will be designed for minimum adverse impacts upon the park setting.

B. DESCRIPTION OF THE ENVIRONMENTAL SETTING

Kahana Valley is a large, deep valley located at the southern end of the Koolauloa District in windward Oahu. It spreads over 5,260 acres and ranges in elevation from sea level at Kahana Bay to over 2,700 feet along the crest of the Koolau Range. The ridges on either side of the valley are from 1,000 to 2,000 feet high.

The dominant soil types are clays, silty clays and silty clay loams. Thick vegetation cover most of the valley. Studies have identified 13 major plant communities in the valley ranging from native kukui forests in the gulches to ohia forests in the back portions and cultivated fields and pastures at the mouth of the valley.

Kahana Valley and Kahana Stream are natural resources of great value. To preserve the scenic beauty of the valley, the Department of Land and Natural Resources plans to develop the valley into a State Park. The Kahana marsh and stream are classified as areas of secondary importance to endangered water bird species and have been proposed as a wildlife refuge. Kahana Stream has also been identified as one of two streams on Oahu still of high natural quality and has been included in the Department of the Interior, National Park Services Nationwide Rivers Inventory.

Native and introduced waterbirds have been observed in the lower valley areas. Two endangered species, the Hawaiian coot and the Hawaiian Gallinule have been found in Huilua Pond adjacent to Kahana Bay. Kahana marsh lands, stream and pasture lands have been identified as areas of secondary importance to endangered species in the "Hawaii Waterbirds Recovery Plan."

Introduced species of birds are common in the mid-elevation areas. Native songbirds exist in the upper valley areas. The Oahu honeycreeper, a rare and endangered specie may be found in the ohia forests.

With the exception of the feral pig, relatively few animals are found in Kahana Valley. Kahana Stream supports three species of worms, four insects, one snail, three prawns and nine fishes. Of these, the mountain shrimp, o'opu nakea, o'opu okuhe, mullet, Hawaiian prawn, Tahitian prawn and aholehole are of economic importance.

The State-owned valley supports a small, rural, agrarian community. Most of the residents reside in the lower makai portion of the valley. Some of the tenants are engaged in commercial agricultural activities. Most of them raise fowl and grow vegetables in their backyards.

The Department of Land and Natural Resources has developed plans to create a low-density use, multi-purpose park for the entire valley with particular emphasis on preserving an environment where Hawaiian values and culture will be embodied in a "living park" concept wherein individuals living there shall participate in the activities of the park.

No archaeological or historic sites of significance will be affected by the proposed project. This has been verified by archaeological surveys.

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

The project site is within the State-owned Kahana Valley which is designated as conservation on the State Land Use District Boundary Map. It is designated as Parks and Recreation on the County's General Plan and is zoned P-1.

The proposed action does not conflict with the general objectives and specific terms of the land use plans, policies and controls of the State Land Use Commission.

D. PROBABLE IMPACTS OF THE PROPOSED ACTION AND MITIGATIVE MEASURES PROPOSED

The principal beneficial impact will be the planned increase of 7 mgd of domestic water to meet the near-future requirements of Windward Oahu by the BWS.

The adverse physical impacts expected from the project are those short-term impacts normal to any construction activity of a similar nature. Temporary increases in noise levels, air pollution from dust and vehicular emissions, disruption of traffic and inconvenience to tenants of the valley and other users of valley roads are to be expected. Dust control measures, such as sprinkling, will be implemented along with careful supervision to reduce dust levels. Noise control devices to lessen vehicular noise will be required for all construction equipment. Compliance with the conditions of a noise permit required by the Department of Health will be required to control noise levels.

A long term adverse impact will be the visual effect of the four control buildings, 8 to 16 wells, and access roads. The dense vegetation and steep terrain of the valley will shield the well sites from open view from all areas except along the access roads. The access roads to the well sites will require some improvements. However, the well sites will not be visible except from the adjacent access road. Landscaping and architectural measures with the control structures and

wells will soften the visual impact. The natural and densely vegetated relief of the Koolau Range rising to over 2,700 feet in the background will further minimize the visual impact. Construction activities could cause excessive turbidity in Kahana Stream which could adversely affect certain species. Careful construction techniques and supervision should minimize the turbidity to an acceptable level. The withdrawal of groundwater from the high level dike system will reduce the dry weather flows of Kahana Stream although the extent will not be known until the well fields are put into service. The BWS, therefore, plans to incrementally develop the well fields. As the well fields are each put into service, the stream and groundwater heads in the vicinity of the wells will be closely monitored to ensure that there is no significant adverse effect upon the stream.

E. PROBABLE ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

The unavoidable adverse environmental impacts are those short term, construction related, physical effects of air pollution from dust and vehicular emissions, noise from construction equipment and inconveniences to resident and park traffic.

The long term adverse impact, unavoidable because of the nature of the project, is the visual impact from the presence of the three well fields and the associated control buildings and access roads. The groundwater withdrawal will reduce the dry weather flow in Kahana Stream although the effect is not expected to adversely affect the stream. Should groundwater withdrawal show signs of affecting the stream, well pumping will be curtailed in accordance with State guidelines.

F. ALTERNATIVES

Election of the "no project" alternative would deny the development of one of the largest water source development projects in the BWS list of required projects.

Alternate well locations within Kahana Valley have been considered. They would require more construction effort, increasing the environmental impacts of the project as well as its cost. Additional sites for water are also being developed in other valleys on the windward side of Oahu.

Future alternate sources include reuse of wastewater and demineralization and are under continuing study by the BWS. They all involve much higher capital and operating costs, making groundwater much more favorable for development at the present time. The alternative of water conservation is being gradually implemented by the BWS but will not be sufficient to make water development unnecessary at this time.

SECTION II
PROJECT DESCRIPTION

A. INTRODUCTION

The proposed project will consist of the incremental development of four well fields (Kahana Wells II, III, IV and V), each with a control building, connected by an access road and a transmission main to tie into the proposed Kahana Reservoir or into the water main carrying water to Kaneohe along Kamehameha Highway. The project is part of the Oahu Water Plan, City and County of Honolulu, 1975. The new wells will assist in meeting the future needs of the water system that serves the Windward, Honolulu, and Pearl Harbor Water Use Districts, shown on Figure 1.

B. PROJECT OBJECTIVES

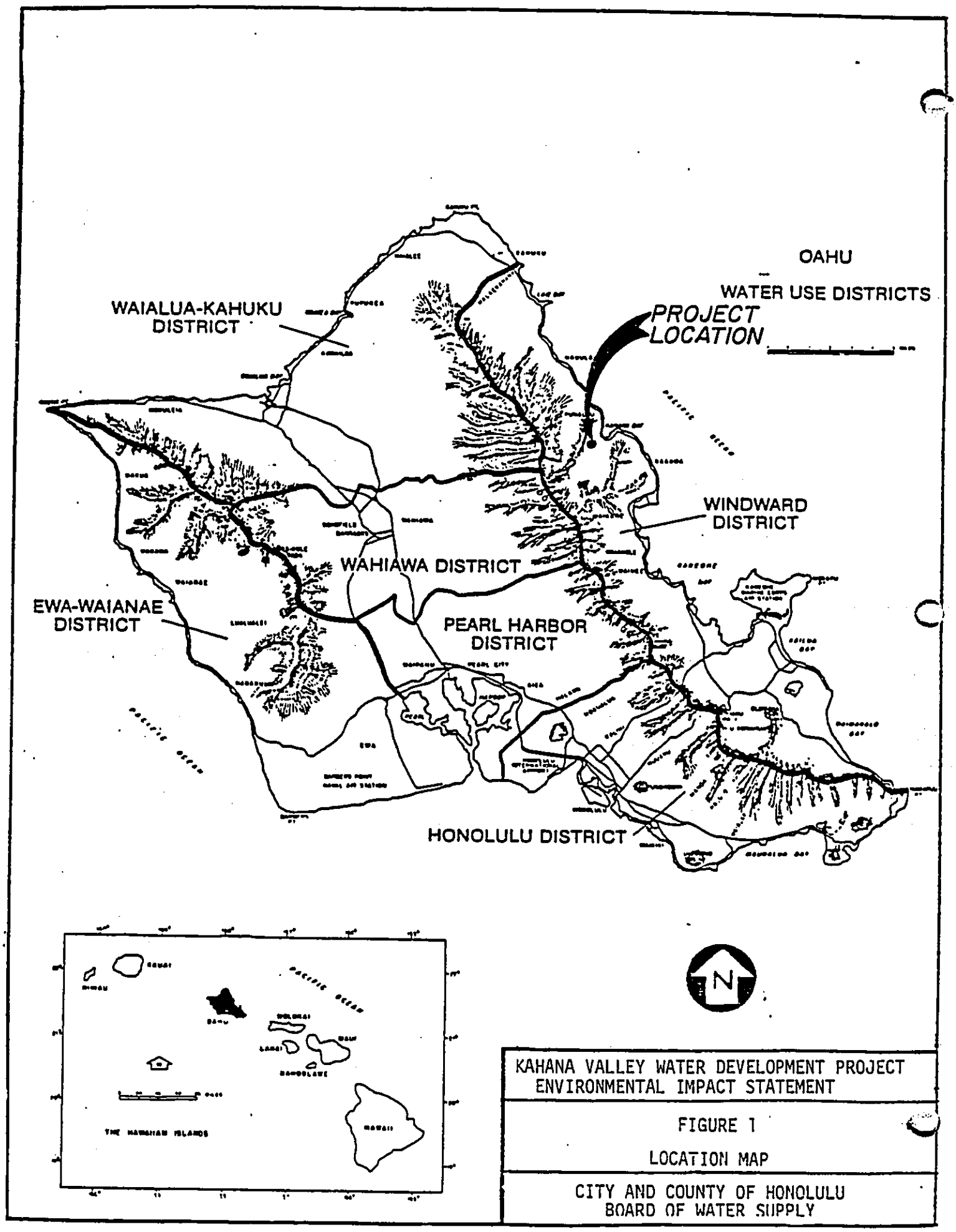
The objectives of the proposed project are to develop the water resources within Kahana Valley to assist in meeting the increasing domestic water demand on Oahu and to minimize any adverse impact of the development upon Kahana Valley.

C. BACKGROUND

Nearly all fresh water on Oahu is presently obtained from groundwater sources. Oahu has a geological structure which results in locally complex hydrologic conditions. Impervious dikes, caprock and basaltic aquifers allow a large quantity of fresh groundwater to be stored. It has been computed by the BWS that an average of about 650 mgd of rain water infiltrates into the ground to recharge the high level dike impoundments and basal aquifers.

Of the 700 mgd (including return irrigation) that does infiltrate into the ground, hydrologists estimate the dependable yield of our groundwater resources is between 480 and 630 mgd, assuming a greater recovery factor than 75 percent for the latter quantity. This is the amount of groundwater that can be withdrawn daily without depleting or harming the system.

During the 1979 calendar year, the total pumped from groundwater resources of Oahu was approximately 408 mgd of which 134 mgd was drafted by the BWS, 222 mgd was used for sugar irrigation, and 52 mgd was consumed by predominantly military and private industrial users. The groundwater drafted



KAHANA VALLEY WATER DEVELOPMENT PROJECT
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 1

LOCATION MAP

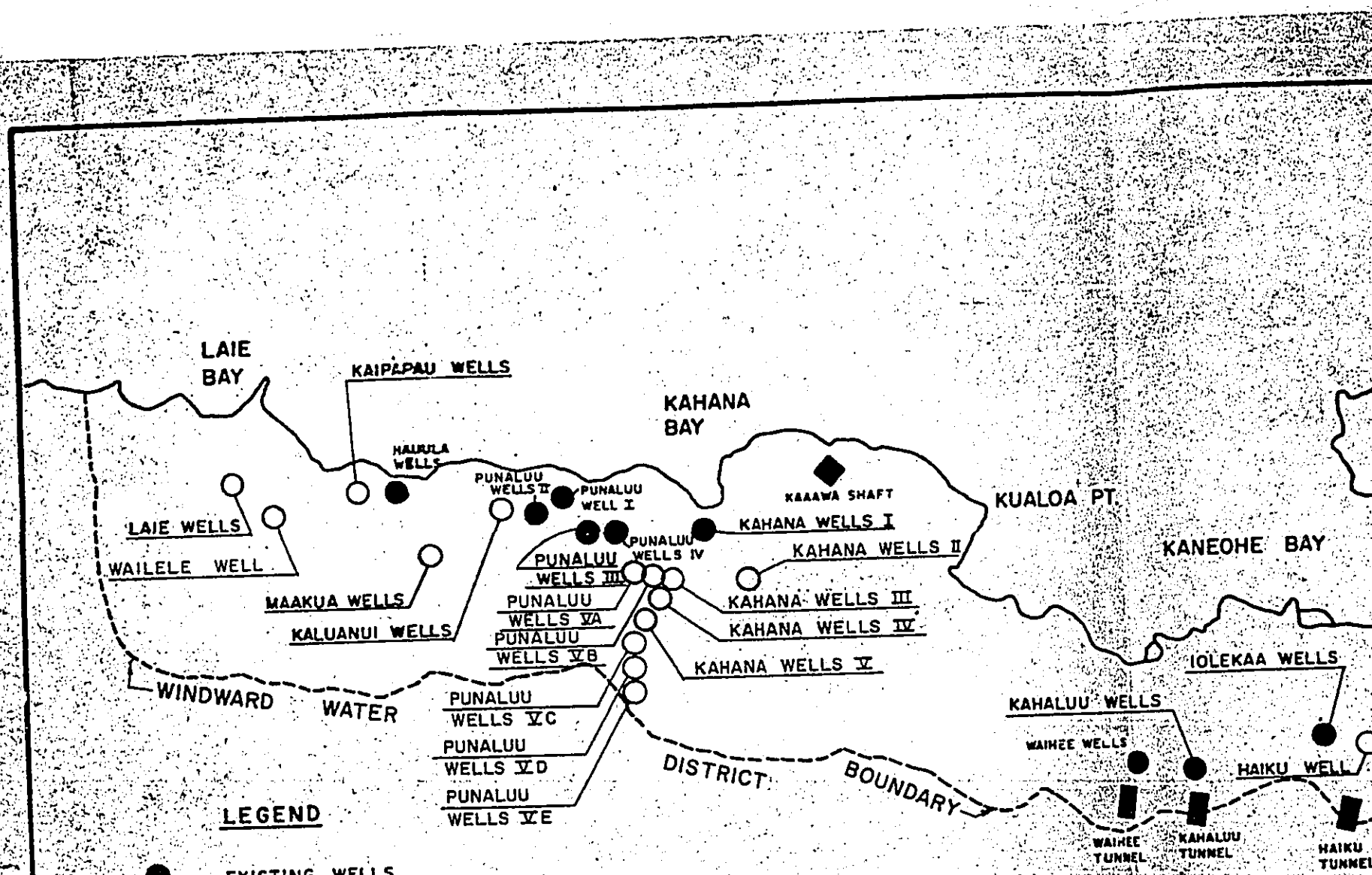
CITY AND COUNTY OF HONOLULU
BOARD OF WATER SUPPLY

by the BWS is expected to increase from 134.0 mgd in 1979 to about 205 mgd in 2000. Assuming that the quantity consumed by other users (sugar, military, industry) does not exceed 280 mgd, the "limit" (480 - 280 = 200 mgd) on the amount of groundwater that can be safely extracted by the BWS will be reached around the turn of the century.

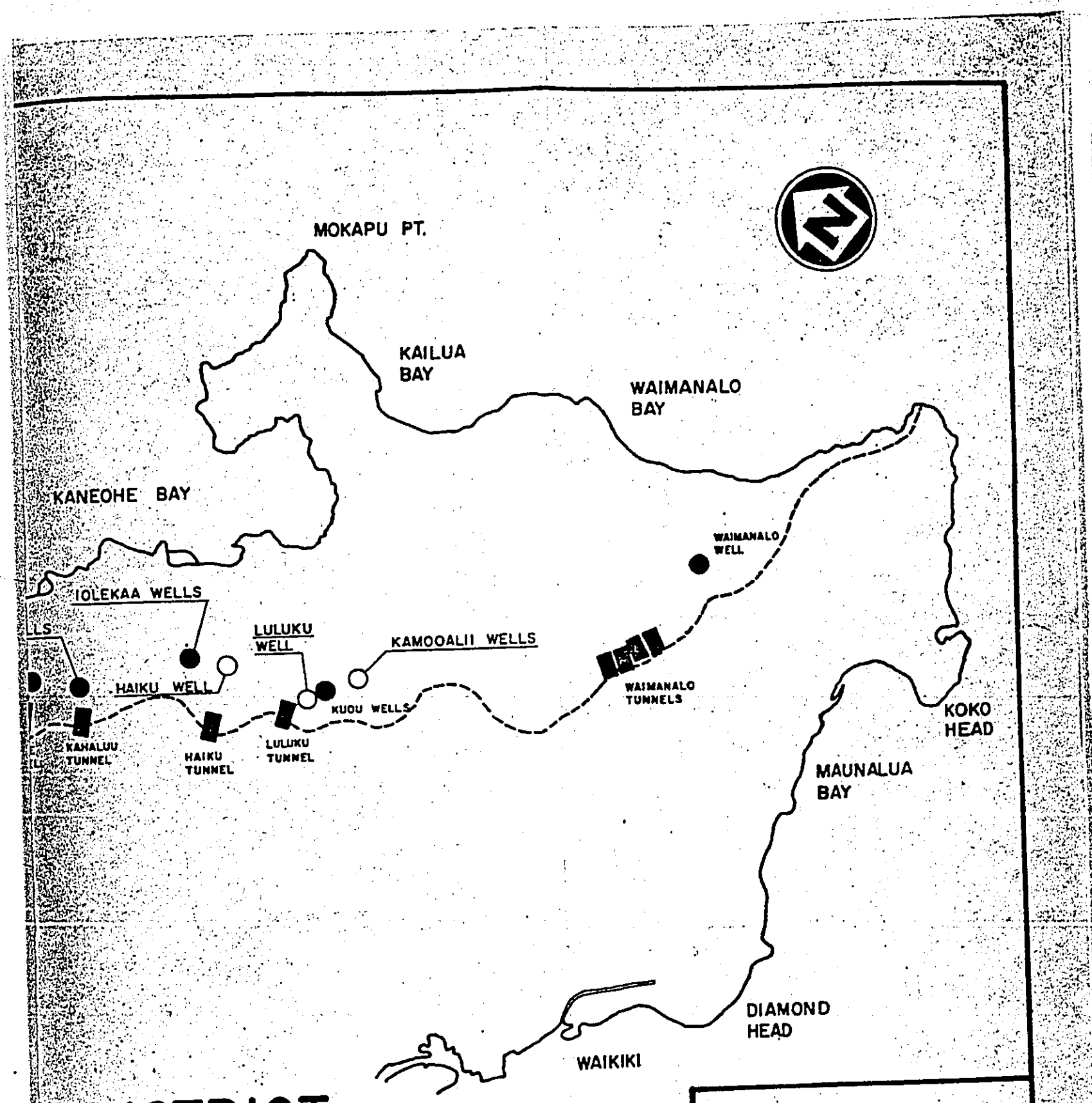
Due to the island's geological structure, terrain, and population distribution, there are water use districts with more developable groundwater sources than the demand within the area and vice versa. With the projected growth of the population, the total island-wide water demand will approach the total amount of groundwater that can be safely extracted. Thus, the full development of groundwater within each district is necessary to meet the island's needs. Although the island is divided according to water use districts, it is the water system that determines what area a given source will serve. A water system can join two or more Water Use Districts and the water extracted from each district goes into its associated water system to provide for the needs of that system. Presently, the Windward District is connected to the same system that services Honolulu and the Pearl Harbor Districts. Future BWS plans call for the joining of all the water systems into a single, integrated and island-wide system which will effectively interconnect each water use district.

In order to meet the projected water demands within the Island of Oahu, the BWS has proposed the installation (Figure 2) of a variety of water development facilities (generally wells) in the Windward District as summarized in the Oahu Water Plan, July 1975. Although recent developments have made revisions to the Plan necessary, the basic priorities will be retained.

In the State Water Commission's report entitled, "Hawaii's Water Resources: Directions for the Future," January 1979, priority recommendations were outlined (Appendix B) for State administrative and legislative implementation. The report emphasizes the importance of the development of new and alternate water sources on Oahu. Kahana Valley, among other areas, has been cited in the report as an area with available water supplies: "Large groundwater supplies are available



WINDWARD WATER DISTR
GROUND WATER SOURC
EXISTING AND PROPOSED



DISTRICT
SOURCES
OSED

KAHANA WELLS
KOOLAUPOKO, OAHU, HAWAII

FIGURE 2
WINDWARD DISTRICT
GROUND WATER SOURCES
CITY AND COUNTY OF HONOLULU

in the Windward Oahu areas of Kahuku, Kahana, and Koolaupoko. Streams in Windward Oahu, especially Kahana and Punaluu, appear most promising for development of large supplies."

Recent court decisions on water rights in Waihee Valley, Windward District, have caused the BWS to reevaluate its proposed schedule for source development. Realizing that it would not be able to develop as much groundwater in Waihee Valley, the BWS has made a reevaluation of their source development plans for the Honolulu and Windward Districts. Recommendations on Source Development, published by the BWS, are given in a report entitled "Honolulu and Windward Water District's Water Supply Status, December 1977." In this report, the BWS lists a number of potential sources that could be developed to meet the Honolulu demand. These potential sources include groundwater development of Hawaiian Electric Company's Waiau tunnel water (about 5.0 mgd), windward surplus, sugarcane irrigation water exchange, and other more complex brackish water conversion schemes. The report recommends the development of groundwater sources in the Windward District as the most viable plan. It cites that if the State approves the development of water in Kahana Valley and if Punaluu groundwater is also developed, additional water may be available for transport to the Honolulu District. New BWS water requirement projections have necessitated revisions to the 1977 report. The water to be developed in Kahana will now be used by the Windward Water District which has a shortage of developed sources. Any excess water will be exported to the Honolulu and Pearl Harbor District.

Planning for the development of the Kahana source has been accelerated to meet projected water demands in the Windward District. Development of other sources, as outlined in the Oahu Water Plan and the capital improvements program, will also be undertaken to meet the projected demand in the future. The proposed Kahana Valley water development is a significant portion of the overall facilities required to meet the projected demand on the Windward side.

The Oahu Water Plan, published in 1975, was based upon the State Department of Planning and Economic Development's population projection E-2 which results in higher future population figures than their new population projection II-F. All BWS water demand projections, which

are essentially based upon per capita demand with commercial and agricultural requirements included, have been revised to conform to the new II-F population projection.

At present the new Kahana Wells I field is in service. These wells tap the basal groundwater. The proposed fields of Kahana Wells III, IV, and V will withdraw high level dike water. Kahana Wells II is in the eastern part of the valley and will draw water from basal groundwater. A 6.0 mg reservoir near well site IV is also proposed in Kahana Valley to improve the water transmission from the Punaluu Wells to Kaneohe.

The State Department of Land and Natural Resources (DLNR) has developed plans to create a "living park" out of the State-owned Kahana Valley. Items planned for the park development include a visitor's center in the lower valley near Kamehameha Highway, new houses for the valley residents, and hiking trails. The concept requires that everyone living in the valley take part in maintaining and operating the park as a requirement for residency there. The BWS is coordinating the proposed water development of Kahana Valley with the Division of State Parks, Outdoor Recreation and Historic Sites, of the DLNR. The water requirements for domestic and agricultural activities in the proposed park will be preserved and assured. Final plans for water development must be approved by DLNR in terms of land management, compatibility with the planned State Park and construction in Conservation District lands.

The Board of Water Supply is expediting the development of potential water sources along the Windward coast. EIS Preparation Notices have already been filed for the proposed Kahaluu, Kaluanui, and Luluku Wells. Table 1 indicates the existing water development facilities in the Windward District. Table 2 lists 21 additional proposed sources. These are mainly small sources ranging from 0.5 to 2.0 mgd per well. The Board of Water Supply is also interested in developing some larger alternate sources of supply, which are also listed, to sustain growing demand while exploration and development of the smaller sources continues. Kahana Valley is the first of two areas to be considered, Punaluu being the second.

TABLE 1

EXISTING WATER DEVELOPMENT FACILITIES
WITHIN THE WINDWARD DISTRICT

EXISTING SOURCES	MGD
Waihee Tunnel*	4.0
Kahaluu Tunnel*	2.1
Haiku Tunnel*	1.6
Luluku Tunnel*	0.3
Waimanalo Tunnels*	0.6
Kuou Well	2.0
Waimanalo Well	0.1
Waihee Wells I & Incline Wells	**
Hauula Wells	0.2
Punaluu Well I	1.0
Punaluu Wells II, Punaluu Wells III	5.0
Kahana Wells I	0.5
Kaawa Shaft	***
	17.40

* Yield for tunnel is base flow. Flow manipulated by bulkhead pressure and system demand.

** Quantity varies to meet court order to allow 2.7 mgd flow at stream gage station located below Waihee Wells I.

***Inactive

TABLE 2

PROPOSED WINDWARD SOURCES

The Board of Water Supply is studying the possible development of the following sources:

SOURCE	ESTIMATED CAPACITY (MGD)
Haiku Wells	1.0
Iolekaa Well	0.3
Kahaluu Well	1.0
Luluku Well	1.0
Kaaawa Well I	0.5
Kaaawa Well II	0.5
Kamooalii Well I	0.5
Kaluanui Wells	2.0
Punaluu Wells V	4.0
Punaluu Wells IV	0.5
Kamooalii Well II	0.5
Hakipuu Well	0.5
Kaipapau Wells	1.0
Kuou Well II	0.5
Laie Wells	1.0
Wailele Well	1.0
Maakua Wells	0.5
Kahana Wells III, IV, V	6.0
Kahana South Well (Kahana II)	0.5
Waimanalo Well II	1.0
Kamooalii Well II	1.0
	24.8 MGD

To meet the projected demand beyond the year 2000, alternate fresh water sources must be developed. The BWS is evaluating the following sources for future development in that time frame:

1. Exchange of potable water used for irrigation with water of lower non-potable quality but still suitable for irrigation.

2. Collection and treatment of surface runoff.

3. Demineralization of brackish sources.

4. Wastewater reclamation for irrigation.

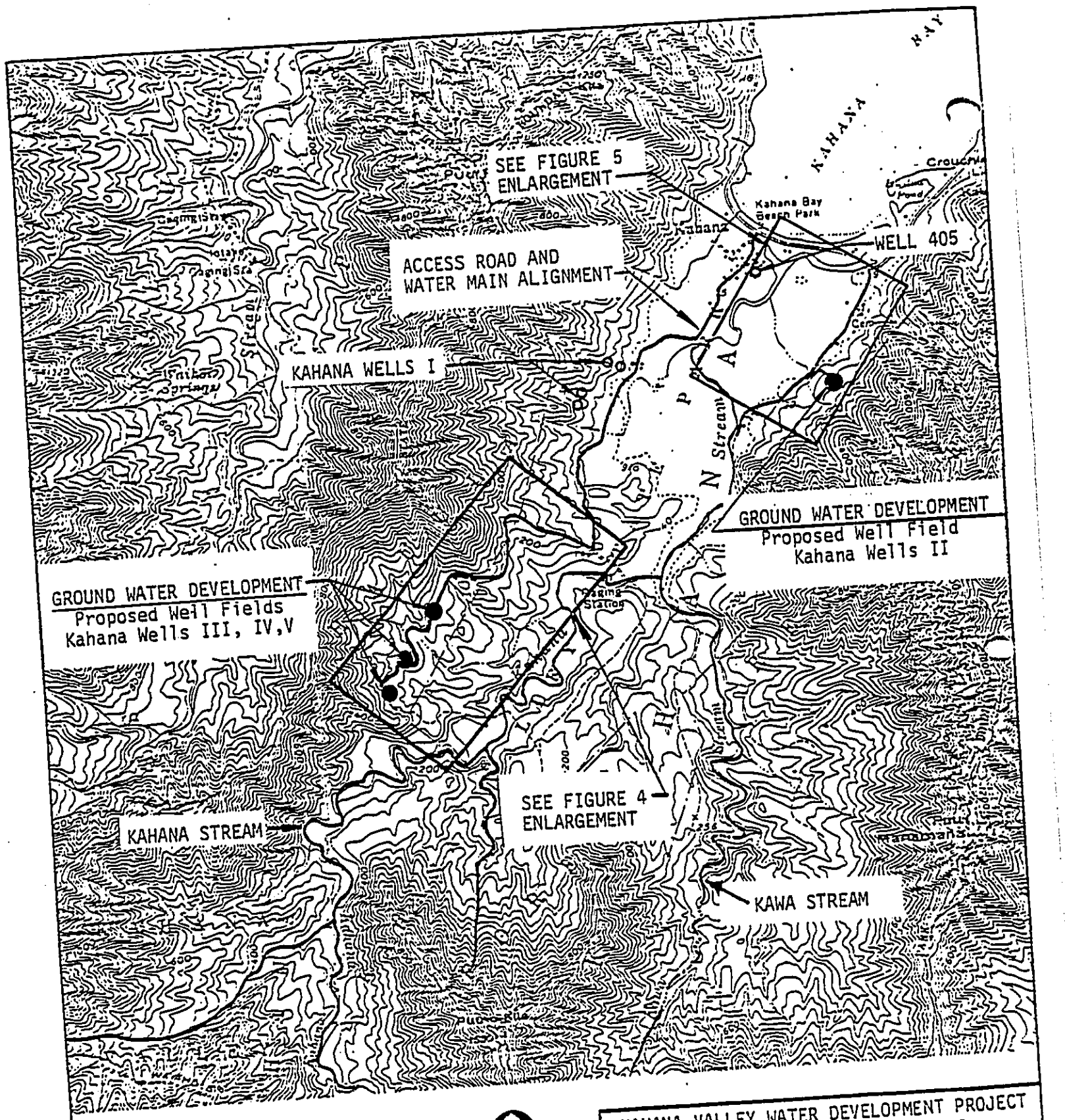
5. Desalination of seawater.

Due to the higher capital and operational costs involved in developing these sources, the complete utilization of the available groundwater will be accomplished before any large scale development of these alternate sources. Appendix A provides additional information on the status of these long-range development alternatives.

D. DESCRIPTION

The Board of Water Supply is presently proposing the development of water resources within Kahana Valley. This is expected to require the following development actions which will be coordinated and compatible with the State Park Plan. To insure compatibility, the BWS is working closely with the various divisions of the DLNR.

The development of the groundwater sources in Kahana Valley will be done in four increments. Kahana Wells III, IV and V will each consist of a 2.0 mgd well field of two or more wells. Kahana Wells II will have a 0.5 to 1.0 mgd well field of one or two wells. All sites will include the necessary access roads, control buildings, and transmission lines for connection to the existing facilities. The approximate locations of the proposed and existing wells are shown in Figure 3. If the desired flows per well field cannot be achieved, an additional well field site may be required to develop the desired capacity.



KAHANA VALLEY WATER DEVELOPMENT PROJECT
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 3

SITE PLAN

CITY AND COUNTY OF HONOLULU
BOARD OF WATER SUPPLY

Minimal access roads will be developed to allow passage of the drilling equipment. The road to the western sites for Wells III, IV and V will follow the old military road. Access to Well II will be effected along Trout Farm Road. Both routes will require improvements of the existing roads to sustain the weight of the drilling and construction equipment.

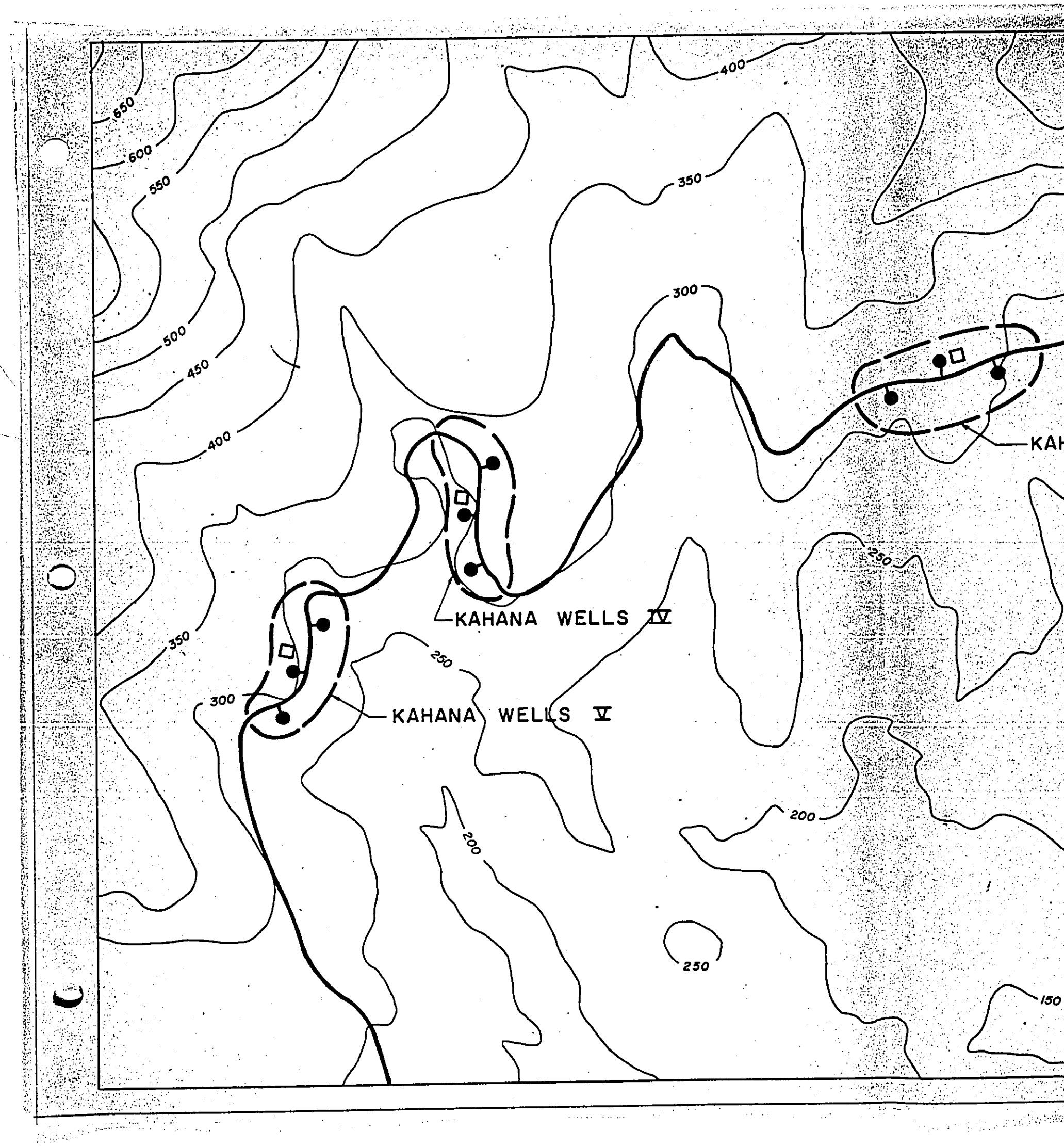
The construction of the four proposed well fields will require two major steps. The first phase involves the location and drilling of the well fields. The development of improvements will then follow as the second phase, to make the wells operational.

1. Location of Wells

The drilling of 2 to 4 exploratory wells within a well field will be done at sites expected to be favorable for groundwater development. Minimal access roads will be developed along the existing access road alignments to permit passage of the drilling equipment. Each exploratory well will be tested to determine its sustainable capacity. In addition, Kahana Stream will be monitored by the USGS during the well tests. If the wells are found to have a suitable capacity, they will be formed into a well field. If the wells do not have a suitable capacity, either additional wells may be drilled in the area to supply the required capacity, or a new nearby well field area may be selected and the procedure repeated. Since it costs approximately $250,000 to drill and test each well, a great deal of research and investigation will first be performed to determine the optimum location of the test wells. This process will be repeated until four well fields (Figures 4 and 5) are selected. A minimum separation distance of 1,000 feet is planned between the well fields. Individual wells within a specific well field will be a minimum of 150 feet apart. The wells will be 12 inches in diameter and, generally drilled to a depth of at least 100 feet below sea level.

2. Development of Improvements

Following the location and proving of the four well fields, the following series of improvements will be developed to make the fields fully operational: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KAHANA WELLS IV
KAHANA WELLS V
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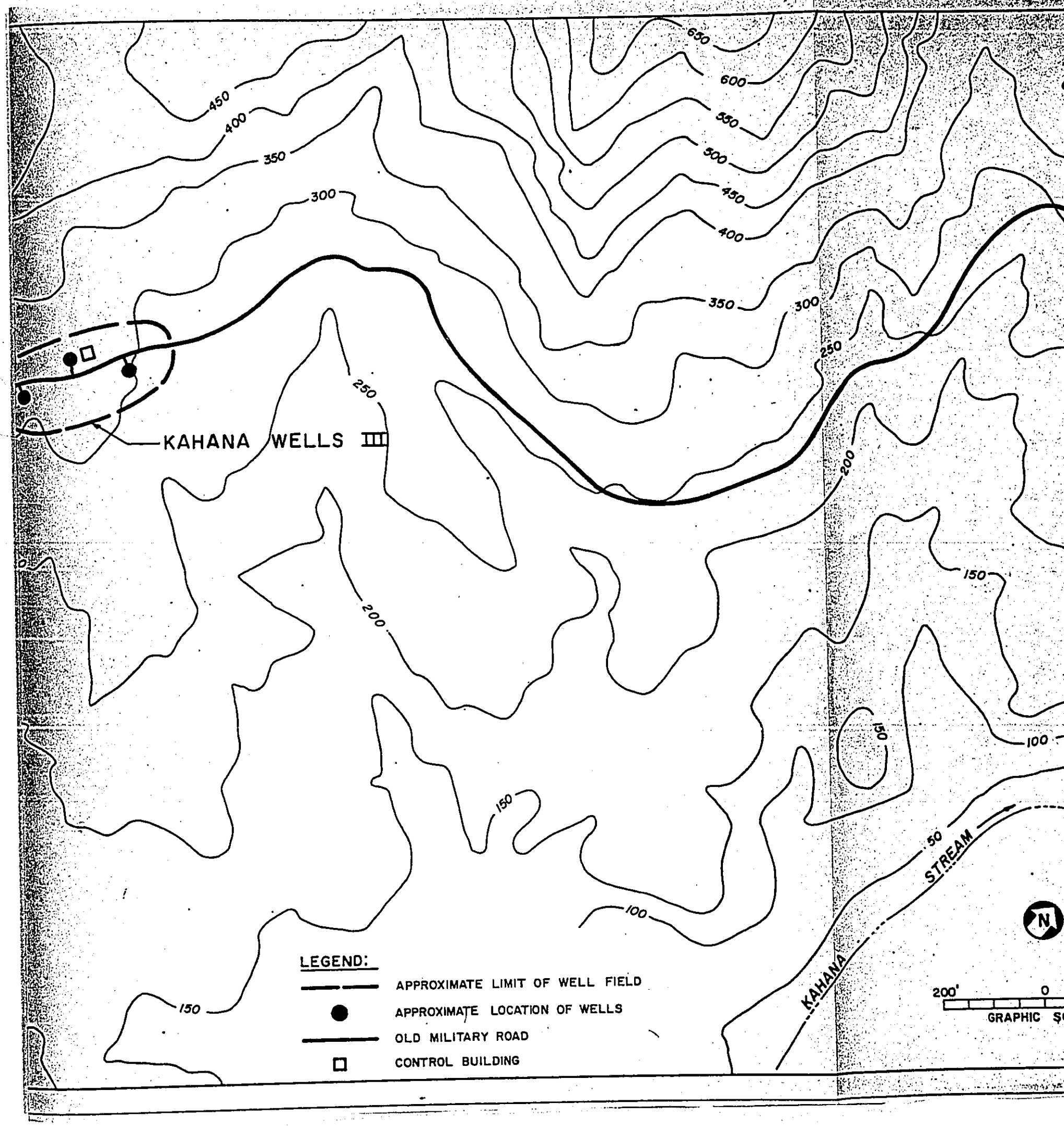
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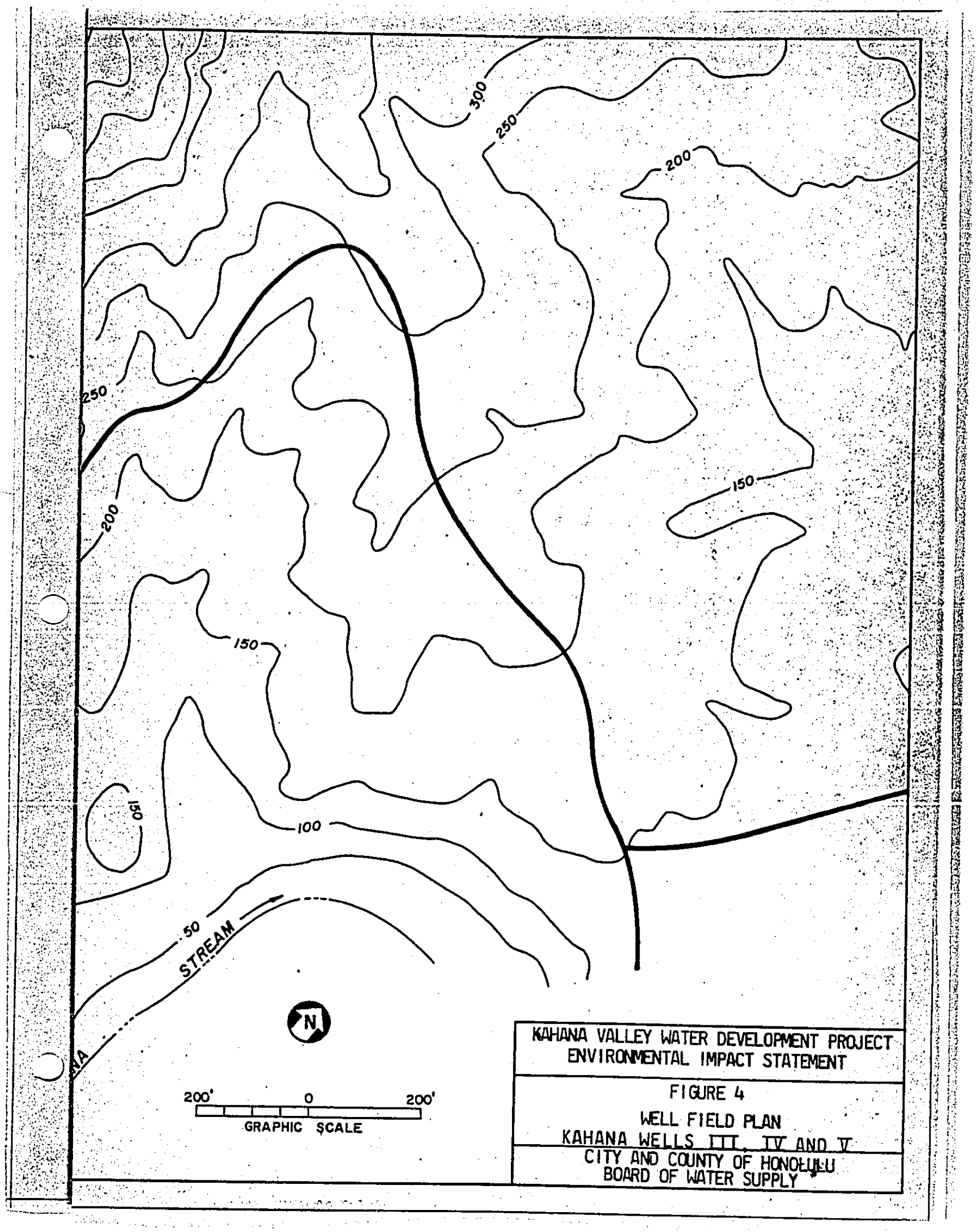
LEGEND:
APPROXIMATE LIMIT OF WELL FIELD
APPROXIMATE LOCATION OF WELLS
OLD MILITARY ROAD
CONTROL BUILDING

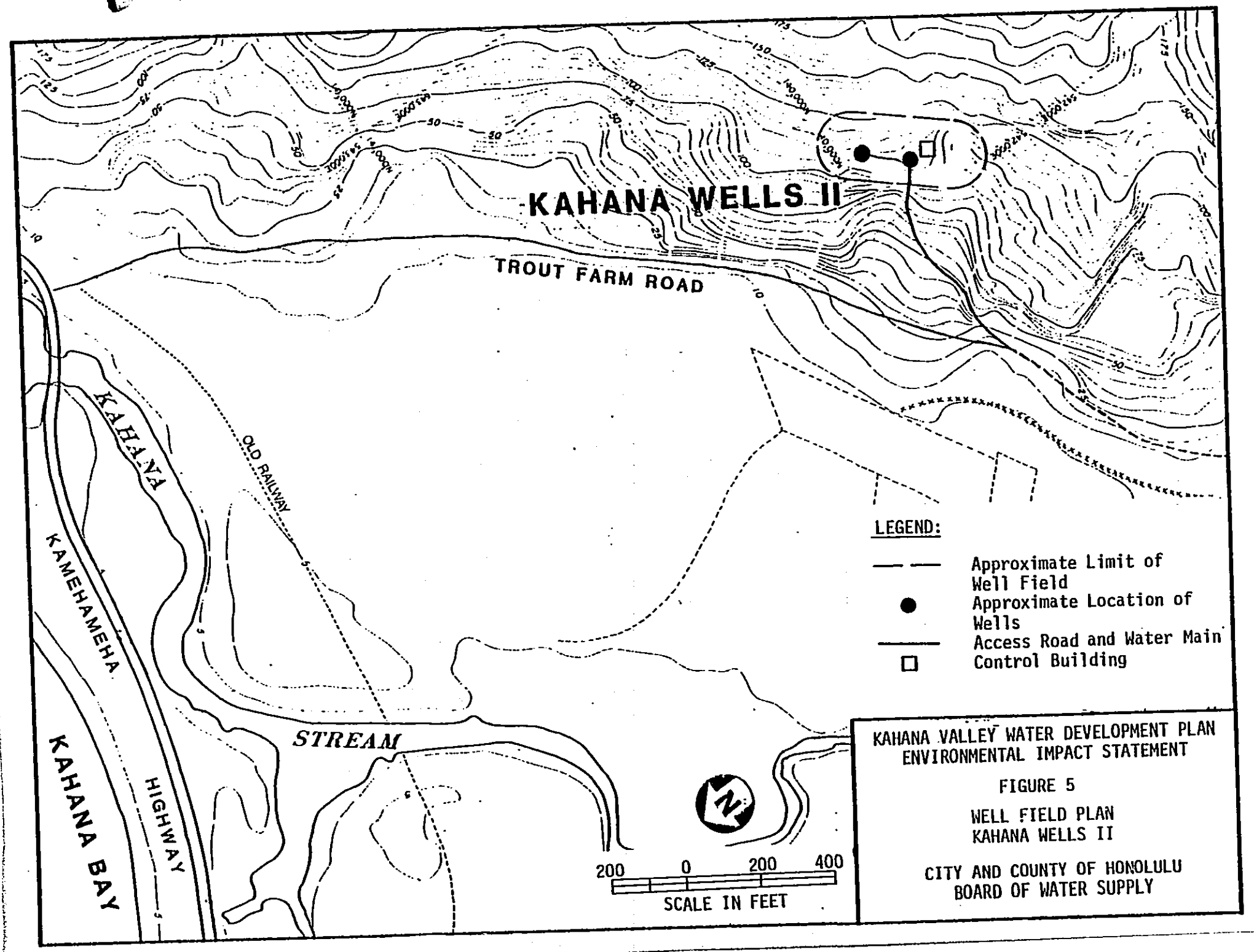


KAHANA VALLEY WATER DEVELOPMENT PROJECT
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 4

WELL FIELD PLAN
KAHANA WELLS III, IV AND V

CITY AND COUNTY OF HONOLULU
BOARD OF WATER SUPPLY



KAHANA VALLEY WATER DEVELOPMENT PLAN
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 5

WELL FIELD PLAN
KAHANA WELLS II

CITY AND COUNTY OF HONOLULU
BOARD OF WATER SUPPLY

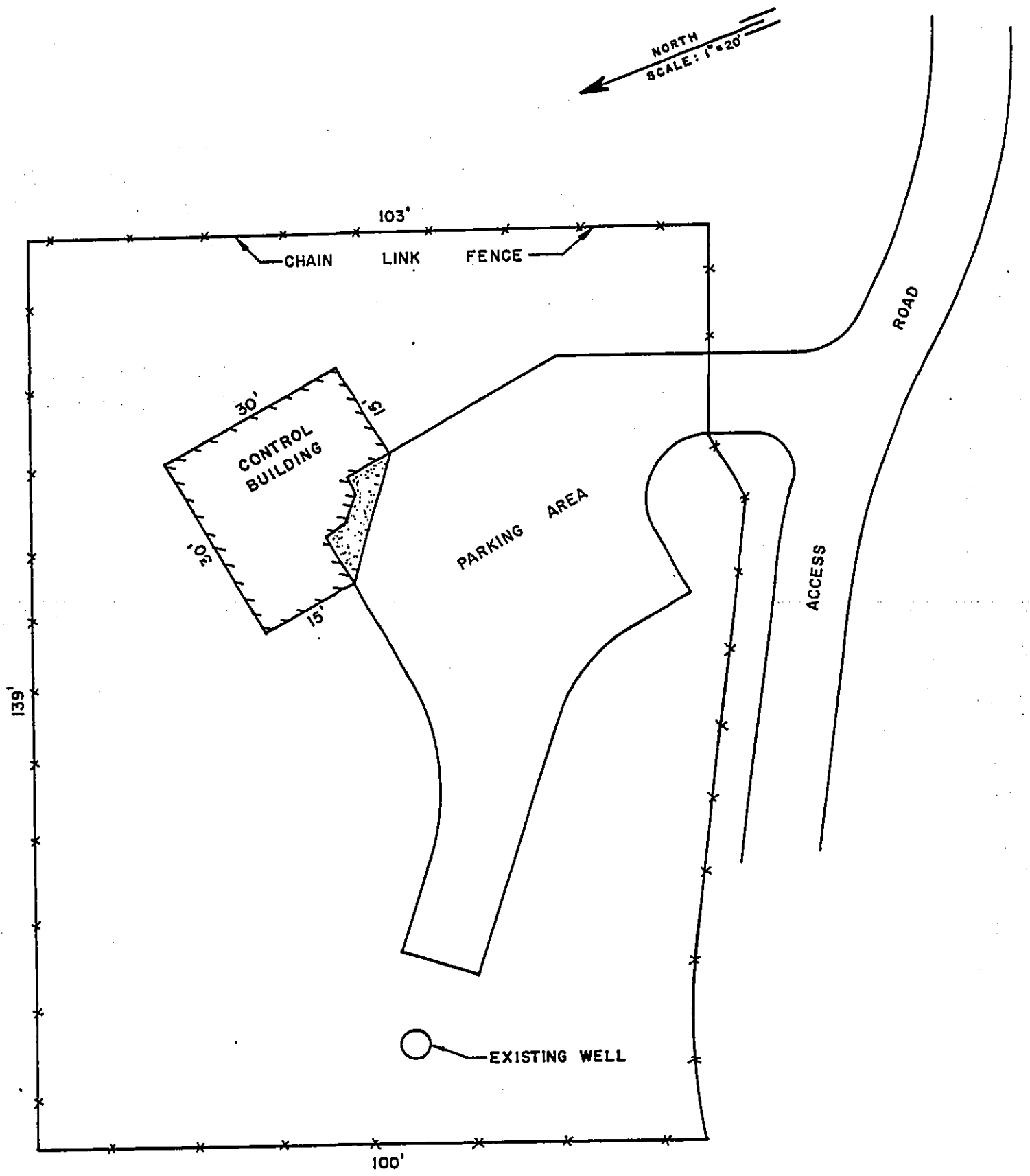
a. Development of improved access roads to the four well fields, as an integral part of the State Park road network. The existing roadways in the valley will be used, with restoration to meet minimum design requirements. Within each well field, minimal access roads will be constructed as required. The BWS design requirements limit the maximum grade to 20 percent and a minimum road width of 12 feet. Compacted crushed coral surface roads will be used to comply with recommendations as presented in the State Park EIS.

b. Construction of a control building at each well field. This is typically a small but attractive single-story concrete block building (Figure 6 and Figure 10) constructed to house the control equipment, chlorination system, flow meters, etc.

c. Installation of power and telephone cables to each of the control buildings and wells. These are normally installed on overhead poles since it is the least expensive system. However, since the State Park EIS recommends that utilities be underground, the project power and communication cables in Kahana Valley will be installed underground.

d. Installation of an underground transmission main from Kahana Wells III, IV and V to the 20-inch transmission main on the access road and then along the access road to either the proposed Kahana Reservoir or to the existing BWS line on Kamehameha Highway. An underground transmission main will also be installed from the Kahana Wells II site to the existing BWS line on Kamehameha Highway.

e. Development of the test wells into service wells. This generally includes lining the upper portion of the wells and installation of permanent BWS pumps. To restrict access to the wells, a chain link fence will be installed around each individual well. The control building for each well field will be sited within the fence of one of the wells.



TYPICAL PLAN OF CONTROL BUILDING

FIGURE 6

When all of the well fields have been tested and proven for adequate production, each field will be put into service in increments. The possible effects of well water withdrawal on the water in Kahana Stream will be monitored per each increment. This will be accomplished using the existing USGS gaging station and measuring groundwater heads at the well fields. If at any time the withdrawal appears to affect the stream flow, pumping will be curtailed to maintain the minimum desired stream flow.

The BWS estimates a cost of 9 million dollars to construct the well fields, access roads, control buildings and transmission main.

SECTION III

DESCRIPTION OF THE ENVIRONMENTAL SETTING

A. PHYSICAL CHARACTERISTICS

1. Climate

a. General

Hawaii's mild seasons are a direct consequence of its latitude and its location in the middle of the Pacific Ocean. Because of its location there is a small variation in the amount of energy received from the sun and the ocean acts to decrease large temperature swings. The range of temperature between day and night averages about 7 degrees. During the summer, the day time temperature averages in the mid 80's while the night time temperature is in the low 70's. In the winter, the average day time temperature is in the high 70's and the night time temperature is in the mid 60's.

Oahu is the third largest island in the Hawaiian Island chain. On the windward side of Oahu, the Koolau Mountain range has elevations generally in the range of 2,000 to 2,500 feet. The highest peak is Puu Konahuanui at 3,150 feet. On the leeward side, the higher Waianae Mountain range has elevations generally in the range of 2,000 to 3,000 feet and includes Mount Kaala with an elevation of 4,020 feet, the highest on Oahu. These mountains determine the rainfall distribution of Oahu and therefore the distribution of water resources.

On Oahu, the northeasterly trade wind prevails 90 percent of the time from May to October but drops in frequency to 50 percent from November to April.

There are parts of the Koolau Range that average over 300 inches of rain a year. This rainfall recharges the water supply for Honolulu. East of the Koolau Mountains the coastal rainfall averages between 30 and 50 inches of rain a year. Central Oahu receives about 35 to 40 inches. The Honolulu area receives about 24 inches a year but this

amount increases to about 60 or 70 inches by moving inland 2 miles. The driest area is the coast west of the Waianae Mountains where rainfall averages about 20 inches a year. However, these are only long-term averages and the rainfall variations from year to year are considerable. This is also true for month to month values but the trend is more rain over the entire island during the winter months from large scale cyclonic disturbances that move in when the trades are absent or weakened.

Severe weather is uncommon in Hawaii. The "winter" season from October to April brings intense rain that can cause localized flash flooding. Thunderstorms are infrequent and usually mild. A few tropical cyclones have struck the island since 1950.

b. Kahana Valley

The climate of Kahana Valley is the two-season year that typifies the climate of the State. Mild temperatures and humid conditions exist all year round. There are extreme variations in rainfall between Kahana Bay and the upper reaches of the valley. The trade winds are the predominant wind of the valley. The minimum and maximum daily temperatures have the same seasonal variation that the island does.

Over the year the average humidity for the late morning is 70 percent, although the winter season has days with humidities much higher and lower than the average.

The trade winds move through the valley from the north-northeast over 90 percent of the time during the summer. The wind velocity in the Valley averages about 11.7 knots with small deviations from the average velocity. During the winter the trade winds are present less than 50 percent of the time and are usually weaker than in the summer. Storms coming

mainly from the southwest are present more often than the trade winds and have gust velocities frequently over 30 knots. The topographic relief and vegetation play as important a role as the wind in determining the microclimatic conditions of specific sites.

The rainfall of Kahana Valley averages 60 inches per year at the coast and rises to over 300 inches per year at the crest of the Koolau Range. The recording station at the mauka end of the valley measures a monthly rainfall average of 20 inches that is relatively constant. On the makai end, the average rainfall is about 6 inches a month and varies from 3 inches in the summer to over 8 inches in the winter. Measurable rainfall occurs 55 to 60 percent of the time at the makai end of the valley and 65 to 70 percent of the time near the Koolau Range.

2. Topography

The project site for Kahana Wells III, IV and V is located on the west slope of Kahana Valley at an elevation of about 300 feet. Kahana Wells II is located on the eastern slope of Kahana Valley at an approximate elevation of 100 feet. Much of the land has slopes of well over 30 percent. The wells and control buildings will be sited where the slopes are much gentler although slopes of over 10 percent will be tolerated if the need arises. The wells for III, IV and V will be situated along an abandoned military road and an existing hunting road. Kahana II is approximately 500 feet east of the existing Trout Farm Road and will require the improvement of about 500 feet of an existing access road. The roads are completely surrounded by vegetation and trees. Most of the trees are over 20 feet tall and many of them exceed 30 feet in height.

3. Geology

Kahana is a large, deep, amphitheater-headed valley located at the southern end of the Koolauloa district on Windward Oahu. It

encompasses over 5,260 acres, with elevations ranging from sea level at Kahana Bay to over 2,700 feet along the crest of the Koolau Range. The ridges on either side of the valley are from 1,000 to 2,000 feet high.

The valley has been eroded into the relatively thin bedded basaltic lava flows and the nearly vertical basaltic dikes of the Koolau Volcanic Series. Overall, 71 percent of the total area has a slope in excess of 30 percent. By excluding the floor of the lower valley that lies within the flood plain, the usable area reduces to under 10 percent of the total.

All of Kahana Valley falls within one of the dike regions of the major rift zone of the Koolau Volcano. The dike zone is the dominant geologic feature of the valley and may be divided into two components called the dike complex and the marginal dike zone. The essential difference between the dike complex and the marginal dike zone is the greater number of dikes across the trend of the rift in the dike complex as compared to the marginal dike zone. In Kahana the dike complex extends from an elevation of 270 feet to the range crest while the marginal dike zone begins below this elevation including the lower valley and extends offshore.

4. Hydrology

Kahana Stream is the largest stream on the windward side of Oahu. It originates up in the Koolaus, dissecting the dike complex and marginal dike zone of Kahana Valley. By dissecting the dike complex and marginal dike zone normal to its trend, dike-impounded water drains preferentially into Kahana Stream. For this reason, Kahana Stream continually gains flow from headwaters to mouth.

Kahana Stream along with Kawa Stream (principal tributary), are the main water courses in Kahana Valley. The Department of the Interior, National Park Service's Nationwide Rivers Inventory, has included Kahana Stream for its important scenic and historic values. The characteristics of the reaches vary from steep, narrow and rocky gorges in the upper valley to a wide, level, and heavily vegetated flood plain in the lower area.

A U. S. Geological Survey (USGS) stream gaging station on the valley floor registers an average flow of 23.1 mgd. During an 18-year period, the lowest and highest discharges were 6.3 and 3512.3 mgd, respectively. The entire watershed discharges an average flow of over 30 mgd. As a result of the withdrawal of water through the Waiahole Ditch/Kahana Tunnel system, streams above elevation 800 feet display intermittency except during periods of moderate to heavy rains. Flooding of the valley floor to depths of about 12 inches occurs at least once every 2 years, and to depths of about 3.5 feet every 7 to 10 years. Due to the low velocities, damage from flood waters has been minimal.

Groundwater in Kahana Valley is stored underground in two ways. The first is a basal freshwater lens truncated by dikes that floats on top of denser salt water. The second is high level water stored in porous and permeable rock between volcanic structures of low porosity and permeability, called dikes. Dikes are leaky but yet prevent the water in the porous rock compartments from effectively flowing down and out to sea. In Kahana the basal fresh water forms a wedge under the valley floor while the high level dike water is found several miles inland from the coast.

Well No. 405 taps the artesian basal water of Kahana Valley. This free flowing well provides the water used by most of the families in Kahana Valley. The confining sedimentary deposits that underlie the valley floor give the well an artesian head that averages about

15 feet above mean sea level. According to the Kahana Valley State Park Revised EIS, Well No. 405 only provides for the water needs of about 90 residents at Kahana Valley. Present withdrawal does not exceed 3,000 gallons per day (gpd).

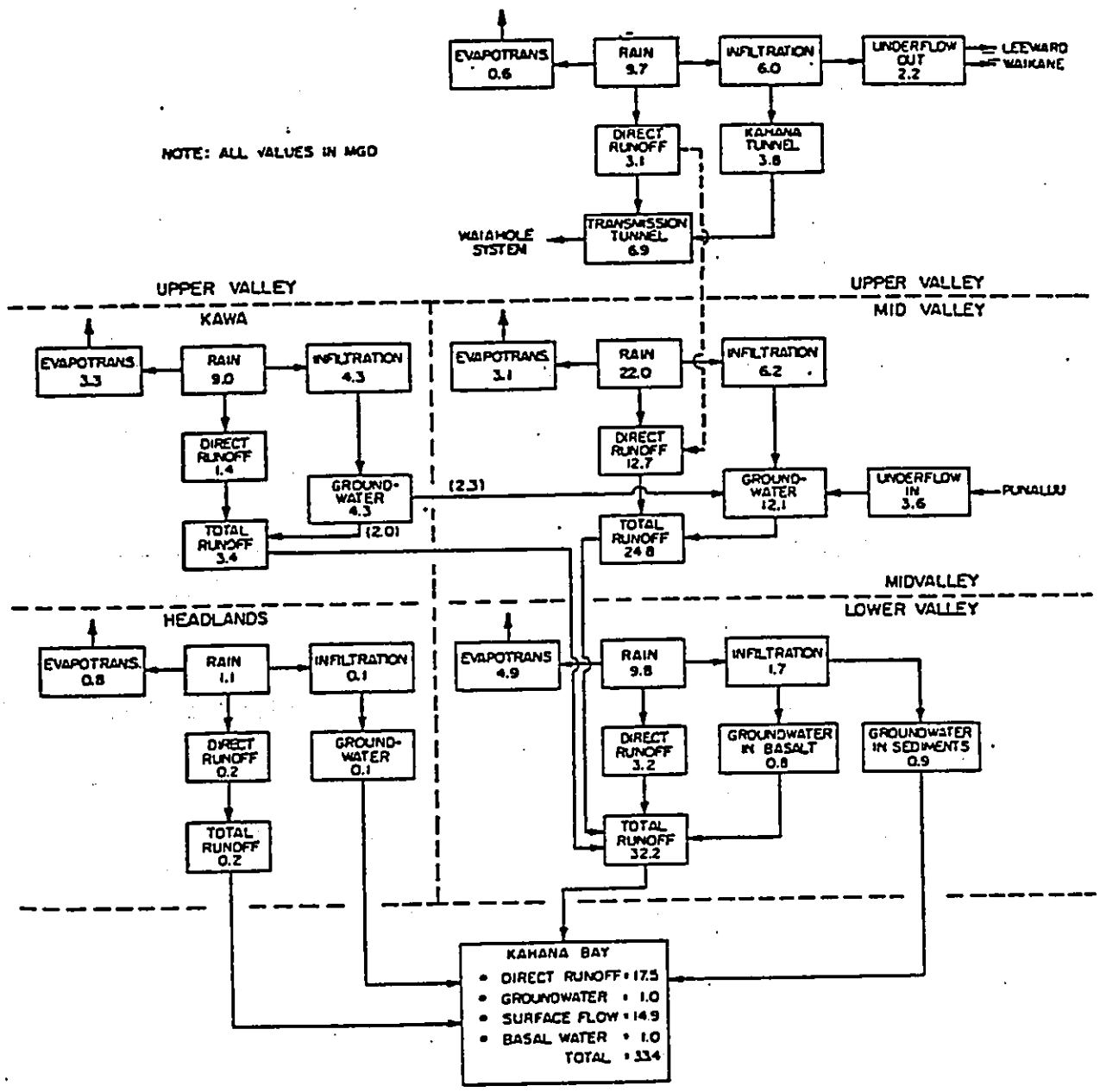
Lava flows of the Koolau Volcanic Series comprise the aquifer in which groundwater is stored. Over half of the rainfall in the valley percolates through the lava to replenish the aquifer. It is estimated that if no water were withdrawn from this system the backed up water in the Koolau dike system might exceed 1,000 feet in elevation. This dike water is tapped by the Kahana Development Tunnel of the Waiahole Ditch System. The water flows essentially parallel to the dikes and therefore enters the tunnel, which is driven perpendicular to the trend of the dikes. The taking of about 4.0 mgd water by the Waiahole Ditch system from the Kahana Development Tunnel has lowered the water in the dike system to an elevation of 800 feet, the elevation of the tunnel.

The hydrologic system can be described by a "water budget" for the area. This budget takes into account all the water "deposited" into the system by rainfall and all the water "withdrawn" by evapotranspiration, runoff, wells, diversions and underflow. The water budget for Kahana Valley was initially made by the USGS in Water Resources of Windward Oahu. The budget was revised by the Water Resources Research Center. Figure 7 presents this water budget in diagramatic form. More detailed hydrologic data is provided by an excerpt (Appendix C) from the University of Hawaii Water Resources Research Center's Technical Report No. 77, The Quality of Coastal Waters; Second Annual Progress Report.

The major withdrawal of water from the Kahana Valley watershed is being made by the Waiahole Ditch/Kahana Tunnel Complex. The Waiahole Ditch system takes water from both the dike complex and Kahana Stream. Since 1931 an average of 3.2 million gallons per day (mgd) is withdrawn from Kahana Stream

FIGURE 7

HYDROLOGIC BUDGET OF KAHANA VALLEY*



*Source: Water Resources Research Center, Rpt. No. 77.

and another 4.0 mgd is withdrawn from the high level groundwater system by the Waiahole Ditch system. The Waiahole Water Company uses the water for irrigation use on the leeward side of Oahu. Kahana Bay is a seaward extension of Kahana Valley. Its width varies from 2,400 to 4,000 feet and is nearly 3/4 mile long. The waters in it and in the estuary of Kahana Bay are designated Class AA under the State's water quality regulations. The AA classification is the most restrictive for marine waters in the regulations. Kahana Stream and its tributaries are Class 1.a. inland waters. Class 1.a. is the highest and most restrictive classification for inland waters in the State regulations. The demarkation between fresh and estuarine portions has not been determined exactly but it has been estimated to be about 3/4 mile from the stream mouth.

The average gradient for the estuarine section of the stream is 10 feet per mile. The channel width varies from 35 to about 245 feet and depth varies from 4 to 16 feet. Peak flows during the winter storms flush debris and sediment from the estuary, minimizing its potential as an incubator of adverse water quality.

Kahana Stream, as most Hawaiian streams, is subject to flash floods because of the steep slopes and high rainfall of the valley. During a large rainstorm the peak flows may be 1,000 times greater than the lowest recorded flow. The main source of Biochemical Oxygen Demand (BOD) is the organic matter washed into the stream by surface runoff.

5. Soils

The Soil Conservation Service has classified the soils present in Kahana Valley into 15 different soil series and 17 soil types. Each is defined by a unique range of values for a large number of different parameters. Texture, color, structure, consistence, presence or absence of hardpan, and type of parent material, are measures of the physical characteristics inherent in the soil material. Other measurements, such as depth to

seasonal high water table, slope, and depth to bedrock, are more a function of the soil's location rather than the material of which it is made. The dominant soil types are clays, silty clays and silty clay loams. The specific soils at the project sites belong to the Waikane series. This series is characterized by well-drained soils on alluvial fans and terraces. They developed in alluvium and colluvium derived from basaltic igneous rock. They are nearly level to very steep, ranging in elevation from 200 to 1,000 feet.

The specific soil type for the Kahana Wells II project site is comprised of Waikane silty clay, 25 to 40 percent slopes (WpE). This soil is found on steep terraces and alluvial fans. In a representative profile the surface layer is dark brown silty clay about 8 inches thick. The subsoil, about 52 inches thick, is dark reddish-brown silty clay that has subangular blocky structure. The substratum is soft, weathered, gravelly alluvium and colluvium.

The project site for Kahana Wells III, IV and V is characterized by Waikane silty clay, 40 to 70 percent slopes (W_pF). This soil type has rapid to very rapid runoff and the erosion hazard is severe.

B. BIOLOGICAL CHARACTERISTICS - FLORA AND FAUNA

Studies have identified 13 major plant communities in Kahana Valley. They range from native kukui forests in the gulches, ohia forests in the back portions, and cultivated fields to pastures at the valley's mouth. Table 3 lists common native and naturalized species of vascular plants of the valley. A listing of interesting, rare, or unusual plants is given in Table 4.

Native and introduced waterbirds such as the Black-Crowned Night Heron and the Cattle Egret can occasionally be found in the lower areas of the valley. The Hawaiian Coot (Fulica americana alai) and the Hawaiian Gallinule (Gallinula chloropus sandvicensis),, recorded annually in Huilua Pond, in the lower valley, are two endangered bird species. For this reason, Kahana marsh lands, streams,

TABLE 3

COMMON NATIVE AND NATURALIZED SPECIES
OF VASCULAR PLANTS OF THE KAHANA VALLEY

Acacia koa - koa
Aleurites moluccana - kukui
Bidens pilosa - ko'oko'olau
Brassaia actinophylla - Octopus tree
Cibotium splendens - hāpu'u pulu
Clidemia hirta - Koster's curse
Cordyline terminalis - ti
Dicranopteris linearis - uluhe
Eugenia cuminii - palama
Eupatorium riparium - pā-makani
Freycinetia arborea - 'ie'ie
Hedychium coronarium - 'awapuhi ke'oke'o
Hibiscus tiliaceus - hau
Metrosideros collina - 'ōhi'a-lehua
Microsorium scolopendria - laua'e
Pandanus odoratissiumus - hala
Psidium cattleianum - waiwaī 'ula'ula
Psidium guajava - kuawa (guava)
Rubus rosaefolius - 'ola'a
Scaevola gaudichaudiana - naupaka - kuahiwi
Sphenomeris chusana - pala'ā
Wikstroemia oahuense - 'akia
Zingiber zerumbet - 'awapuhi kuahiwi

Source: Kahana Valley Botanical Survey, William L. Theobald and Nengah Wirawan, March 1973.

TABLE 4

INTERESTING, RARE, OR UNUSUAL PLANTS OF THE KAHANA VALLEY

Acacia koa - koa - many uses
Aleurites moluccana - kukui - many uses
Artocarpus altilis - 'ulu - many uses
Bixa orellana - 'alaea - several uses
Canavalia cathartica - mauna-loa - medicinal
Charpentiera obovata - papāla - botanical interest
Cibotium chamissoi - hāpu'u 'i'i - several uses
Cibotium splendens - hāpu'u pulu - several uses
Clidemia hirta - Koster's Curse - introduced noxious weed
Colocasia esculenta - taro - several uses
Cordyline terminalis - ki, ti - many uses
Cuscuta sandwichiana - kauna'oa - leis
Cyrtandra spp. - largest genus in Hawaii
Diospyros ferrea - lama - lumber
Elaeocarpus bifidus - kalia - several uses
Eucalyptus sp. - pale-piwa - timber, medicinal
Korthalsella latissima - kaumahana
Morinda citrifolia - noni - several uses
Osmanthus sandwichensis - olopua - timber
Peperomia spp. - large genus in Hawaii
Pisonia umbellifera - pāpala-kēpau - lumber
Pityrogramma spp. -
Pritchardia sp. - loulu palm
Psilotum spp. - moa
Scaevola spp. - naupaka
Sida fallax - 'ilima - leis, medicinal
Stypelia tameiameiae - pūkiawe - several uses
Touchardia latifolia - olonā - rope, fish netting

Source: Kahana Valley Botanical Survey, William L. Theobald and Nengah Wirawan, March 1973.

and pasture lands have been indentified as areas of secondary importance to endangered species in the "Hawaii Waterbirds Recovery Plan." Introduced species of birds such as the Kentucky Cardinal, California Linnet, Mynah, White-Eye, House Sparrow and Rice Birds are common throughout mid-elevation areas. It is likely that native birds such as the apapane (Himatione sanguinea sanguinea), amakihi (Loxops virens chloris) and iiwi (Vestiaria coccinea) exist in the upper valley, particularly along the crests of ridges. It is also possible that a few Oahu honeycreepers (Loxops maculata maculata) a species on the rare and endangered list, may be found in the ohia forest.

With the exception of feral pigs, mongoose, rats and mice, there are relatively few land animals in Kahana. At present, the pig population is controlled by public hunting. The Limnological Survey of Kahana Stream, Oahu, by Amadeo S. Timbol for the U. S. Army Corps of Engineers identified 20 species of macrofauna in the streams of Kahana Valley. Of the 20 species, 10 are native to Hawaii and 5 of the 10 are endemic. The mountain shrimp, o'opu nakea, o'opu okuhe, aholehole, mullet, Hawaiian prawn and Tahitian prawn are of economic value. The list compiled by Timbol is presented in Table 5. The o'opu nakea, mountain shrimp and Tahitian prawn are sensitive to excessive siltation and reduced flows. The o'opu napili, an endemic goby fish, has disappeared from Kawa Stream due to the natural or man-made stream flow reduction in areas such as those that exist in the critical habitat area of Kahana Stream.

C. SOCIO-ECONOMIC CHARACTERISTICS

1. Population

The population of Oahu was 701,298 in 1980 according to the Preliminary Census Results for the Population of Hawaii, 1980. The Board of Water Supply is using the Department of General Planning Distribution No. 4, (Table 6) to determine the population growth and future water demand. The Kahana Wells will provide water to the water system that services the Windward, Honolulu and Pearl Harbor Water Use Districts. The planning

Table 5. List of Macrofauna in Kahana Stream and its Tributaries, Hanalele and Kawa (August 1979).[1]

Scientific Names	Common, Local Names	Origin[a]	Listing[b]
Annelids (worms)			
Hirudinea	Leech	Unknown	None
Nemalycastis abiuma	Polychaete worm	Endemic	None
Oligochaeta	Earthworm	Unknown	None
Insects			
Diptera: Chironomidae	Midge larva	Endemic	None
Odonata: Zygoptera	Damselfly naiad	Unknown	
Trichoptera:			
Cheumatopsyche analis	Caddisfly larva	Exotic	None
Oxyethira maya	Microcaddisfly larva	Exotic	None
Mollusks (Snails)			
Melania sp.	Pond snail	Indigenous	
Crustaceans (Prawns and Shrimp)			
Atya bisulcata	Mountain shrimp Opae kala'ole	Endemic	None
Macrobrachium grandimanus	Hawaiian prawn Opae oeha'a	Indigenous	None
Macrobrachium lar	Tahitian prawn	Exotic	None
Fishes			
Awaous genivittatus	Goby, o'opu naniha	Indigenous	None
Awaous stamineus	Goby, o'opu nakea	Indigenous	Depleted[c]
Clarias fuscus	Chinese catfish	Exotic	None
Eleotris sandvicensis	O'opu okuhe	Endemic	None
Kuhlia sandvicensis	Aholehole	Endemic	None
Mugil cephalus[d]	Mullet, ama'ama	Indigenous	None
Poecilia reticulata	Wild guppy	Exotic	None
Xiphophorus helleri	Swordtail	Exotic	None
Xiphophorus maculatus	Moonfish	Exotic	None

(a) Terms used in this column:
Endemic-occurring naturally in Hawaii only.
Indigenous-occurring naturally in Hawaii and also elsewhere.
Exotic-brought to Hawaii either intentionally or accidentially by man.

(b) Considered as endangered or threatened in official register or scientific publications. The following definitions are from Miller (1972). Endangered-facing extinction, needs special protective measures. Depleted-(threatened)-still occurs in numbers adequate for survival but heavily depleted and continues to decline at a rate substantially greater than can be sustained.

(c) Depleted on Oahu (Miller, 1972).

(d) Two other mullet species may be present; *Neomyxus chaptali* (uoa'uoa, indigenous) and *Chelon engeli* (mullet, exotic).

[1] SOURCE: U. S. Army Corps of Engineers, Limnological Survey of Kahana Stream by Amadeo S. Timbol, 1979.

TABLE 6

DEPARTMENT OF GENERAL PLANNING DISTRIBUTION NO. 4 1/

YEAR	WATER DISTRICTS						
	Honolulu	Windward	Waialua Kahuku	Wahiawa	Ewa Waianae	Pearl Harbor	Total
1980							
Resident Population	366,840	117,320	17,610	56,280	74,150	121,500	753,700
Population Served By BWS*	393,730	111,070	14,290	38,410	59,440	87,240	704,180
Water Demand MGD	78.7	18.7	2.9	6.5	18.4	15.0	140.2
1985							
Resident Population	382,410	121,780	19,150	62,690	88,490	129,280	803,800
Population Served By BWS*	413,480	115,310	18,650	44,760	76,800	95,270	764,270
Water Demand MGD	83.5	19.6	3.8	7.7	23.9	16.6	155.1
1990							
Resident Population	392,730	124,490	20,530	68,720	102,930	135,600	845,000
Population Served By BWS*	427,820	117,800	21,820	50,740	94,330	101,850	814,360
Water Demand MGD	87.7	20.4	4.5	8.9	29.9	18.0	169.4
1995							
Resident Population	401,950	126,810	21,930	74,990	118,290	141,830	885,800
Population Served By BWS*	441,550	119,920	25,010	56,950	113,240	108,040	864,710
Water Demand MGD	92.7	21.0	5.3	10.1	36.4	19.7	185.2
2000							
Resident Population	419,440	131,670	23,830	83,360	137,600	151,300	947,200
Population Served By BWS*	462,470	124,540	28,690	65,240	135,070	117,420	933,430
Water Demand MGD	99.4	22.2	6.2	11.7	43.9	22.0	205.4

*Includes Visitors

1/ Subject to change (pending 1980 census).

distribution shows an increase of 26 percent for Honolulu, 19 percent for windward Oahu, and 47 percent for Pearl Harbor by the year 2000. To meet this growth, new water sources such as Kahana are necessary. At the present time, there are approximately 90 residents within Kahana Valley.

2. Land Use

The land uses of the area of the water system to be served covers the entire list from Forest Reserve to sugar. Figure 8 is a Generalized Land Use map of the area developed for the Hawaii Water Resources Regional Study in 1970. Within Kahana Valley, land use ranges from forest reserve to grazing, miscellaneous public use (park), and rice, taro and vegetable utilization.

3. Economic Aspects

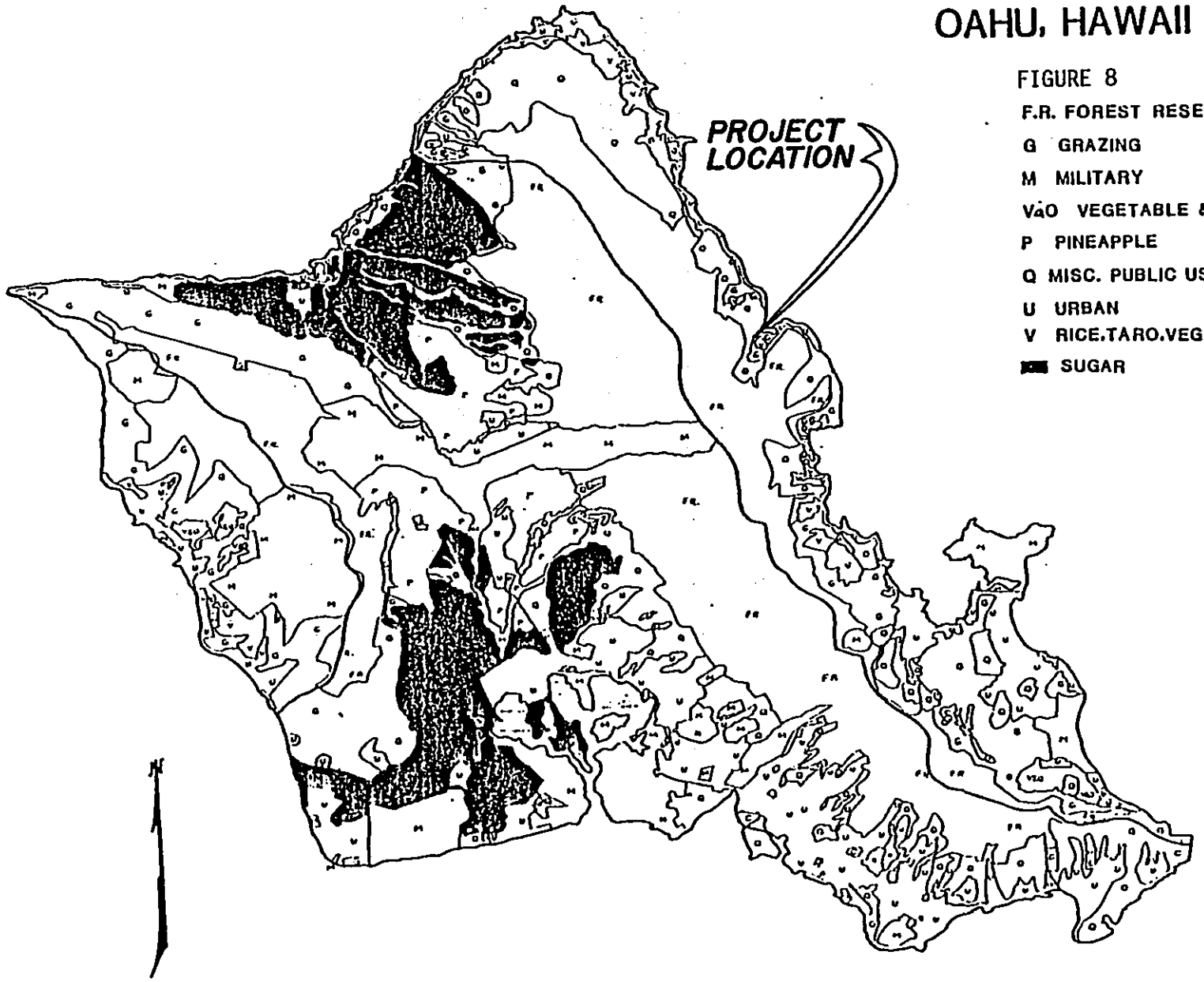
The economy of Hawaii, its growth and development, is directly related to its location and climate. About 80 percent of the economic activity of Hawaii takes place on Oahu. The economy is basically service oriented with some manufacturing and agriculture. Part of this is due to the decline of agriculture.

Tourism, defense, sugar and pineapple are the four major export industries. Tourism is now the major industry, but at one time it was sugar and pineapple. Other industries exist because of the revenues earned by the people who work for the major export industries.

The valley is owned in its entirety by the State of Hawaii and supports a small rural community. Most of the residents live in the lower makai portion of the valley. Their homes are generally old, most of which are in poor condition. A majority of the families raise chickens, ducks and geese and grow fruits and vegetables in their backyards. Some are engaged in commercial agricultural activities such as grazing of cattle and horses and growing of papayas, bananas and ti leaves.

GENERALIZED LAND USE MAP
OAHU, HAWAII

FIGURE 8



F.R. FOREST RESERRVE
G GRAZING
M MILITARY
V&O VEGETABLE & ORCHARD
P PINEAPPLE
Q MISC. PUBLIC USE
U URBAN
V RICE.TARO.VEG.
SUGAR

The lifestyle within Kahana Valley can best be described as being a rural/agrarian community. Many individuals possess skills in quilt making, lauhala weaving, net making, taro raising, and canoe building. Most of the men in the area are knowledgeable in fishing methods. Hui O Kanani O Kahana is the association that speaks for most of the valley's long term residents.

The existing Kahana Valley Road leading into the western portion of the valley is the only access for the village and upper valley residents to and from Kamehameha Highway. The roadway is paved for about 3/4 of a mile into the valley with the mauka (landward) portion being restricted to four-wheel drive vehicles or foot traffic. Generally, the internal road system is substandard.

4. Kahana Valley State Park

Much of Phase I of the park's development plan has been started. The main access road, parking and comfort station, orientation building and the Hawaiiana Demonstration Area are all under construction. The implementation of Phase II (the remainder) awaits the allocation of the necessary funds.

D. INFRASTRUCTURE

1. Roads and Traffic

The project site for Kahana Wells III, IV and V is located along the western slope of Kahana Valley. The well fields will be adjacent to a hiking trail that was once a military road. This abandoned road will be improved to provide the access to the wells by BWS. The trail begins at the end of an unimproved road that is now used primarily by hunters and hikers. This road is a branch of Kahana Valley Road which leads into the valley from Kamehameha Highway. Only fifty percent of the valley road is improved. Kamehameha Highway transits the Kahana Valley coastline.

The Kahana Wells II project site is located on the eastern slope of Kahana Valley approximately 500 feet east of Trout Farm Road. The access road will follow an existing access road that branches from the road to the site.

2. Water

The Board of Water Supply has recently installed two new wells (Kahana Wells I) in lower Kahana Valley. A 12-inch transmission line links the wells to the 30-inch transmission main along Kamehameha Highway. The desired sustained capacity of 1.0 mgd from the two wells, however, could not be achieved due to the geologic structure of the sites. Average pumpage from the well is about 0.5 mgd, although the installed pump capacities are 1.0 mgd. The wells presently feed into the 30-inch main on Kamehameha Highway. The State Department of Health has given its approval to use the new well in accordance with the State's Safe Drinking Water Regulations.

High level water is presently withdrawn from the Kahana Tunnel system located in the upper valley region. Approximately 5 mgd of water presently enters the Waiahole Ditch system which conveys water to the leeward side of Oahu for the irrigation of sugarcane. Water rights of this system are currently leased by Oahu Sugar Company from the State.

The Board of Water Supply is proposing to build a 6.0 million gallon reservoir along the same hunting road that will serve as the alignment for the access road to the proposed well fields. The reservoir's main function will be to remove the surges in the transmission main along Kamehameha Highway due to the intermittent operation of the Punaluu Wells. This will improve the water service to Kaneohe and Kailua.

E. ARCHAEOLOGICAL/HISTORICAL CHARACTERISTICS

Numerous archaeological sites can be found in Kahana Valley. These sites are discussed in greater detail in the Revised Environmental Impact Statement for the Kahana Valley State Park dated October 1978 (Reference 2). These archaeological sites include auwais, cleanups, dry terraces, enclosures, graves, Kuleanas, midden deposits, mounds, platforms, walls, wells, wet terraces, habitation structures and the Huilua Fishpond. These sites are concentrated in the lower valley areas in the proximity of Kahana Bay and along the upper reaches of Kahana Stream.

With the exception of an auwai which crosses Kahana Valley Road, along which the 20-inch transmission main will be laid, no archaeological sites are known to exist within the project limits of Kahana Wells III, IV and V. The auwai is relatively shallow and is not in operation or use at the present time. The 20-inch main will be laid below the auwai grade and the auwai will be restored to its present condition after trenching and pipe laying operations.

Bishop Museum was engaged to conduct an archaeological survey of the proposed sites for Kahana Well Fields III, IV and V. The results of this survey, conducted in May 1980, are herein included:

> "The archaeologists encountered no significant archaeological remains. Since the area was once used as an Army road, it has already been greatly modified and disturbed.
>
> "Based on this surface reconnaissance, there are no archaeological objections to the proposed project. Although unlikely, it is possible that subsurface archaeological features such as stone alignments or artifacts could be encountered once the project has begun. If this occurs, archaeologists at Bishop Museum should be contacted immediately."

An archaeological reconnaissance of the Kahana Wells II site was accomplished on May 20, 1981 by archaeologists from the Division of State Parks of the State Department of Land and Natural Resources. The archaeologist's recommendation for the site is as follows:

> "Between the enclosure and agricultural complex (#1556) is a gently sloping area devoid of any archaeological features. This as the well site would be clear but the enclosure and terraces must be addressed in any proposed plans because they would be impacted during construction. The access road to the site is an existing dirt road and there are no archaeological sites that would be impacted. However, a fairly large impact area in the proposed well site must be considered.
>
> "Archaeological recommendations for this proposed site include mapping and testing. Further testing of site #1555 will depend on the impact and definitive plans for the well site. If this site cannot be protected, salvage would be recommended. However, the site value does not warrant preservation. The agricultural complex should be mapped to define the limits of the site and configuration of the individual terraces. Again, a determination of any further archaeological work will require definitive plans for the well site."

SECTION IV

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

A. GENERAL

The land use controls for the project site are as follows:

1. State of Hawaii

   Kahana Valley is within a State Conservation District boundary.

2. City and County of Honolulu

   The land is zoned P-1 and designated Parks and Recreation by the City and County's General Plan. The entire valley falls within the City and County's Special Management Area.

3. Kahana Valley State Park

   The Department of Land and Natural Resources (DLNR) has developed plans to create a "living park" out of the State-owned Kahana Valley. The Environmental Impact Statement (EIS) that was prepared to assess the consequences of this proposal describes the proposed park plan. The first phase includes the development of a visitor's center in the lower valley near the highway. New houses for the valley residents and the development of hiking trails are also part of the overall plan. The concept requires that everyone living in the valley take part in operating and maintaining the park as a requirement of residency there. Any use of the valley by government agencies must be in consonance with the "living park" concept.

   Although much of the knowledge and skills from the old Hawaiian culture are not practiced today, DLNR's park plan has been instigated to foster these diminishing Hawaiian ways. An important goal of the "living park" is to nurture the old lifestyle and to promote the teachings of its culture and values.

B. CITY AND COUNTY OF HONOLULU

The statement of Objectives and Policies of the City and County of Honolulu's General Plan designates the land in and around Kahana Valley

as rural. The project is one of many that will supply additional water to be used in other areas. The areas and their designations are as follows:

Kaneohe-Ahuimanu	Urban Fringe
Kailua	Urban Fringe

1. Population

   a. Objective B

      To plan for future population growth.

      Policy 1

      Allocate efficiently the money and resources of the City and County in order to meet the needs of Oahu's anticipated future population.

      The proposed project will provide water to meet the anticipated future needs.

   b. Objective C

      To establish a pattern of population distribution that will allow the people of Oahu to live and work in harmony.

      Policy 1

      Facilitate the full development of the primary urban center.

      The proposed project will facilitate the development of the Primary Urban Center.

2. Economic Activity

   a. Objective G

      To bring about orderly economic growth on Oahu.

      Policy 1

      Direct economic activity primarily to Honolulu, Aiea, and Pearl City; and, secondarily, to Ewa.

Policy 2

Permit the moderate growth of business centers in the urban-fringe areas.

The proposed project will help the City and County to implement these policies by providing the water necessary for the increased economic activity.

3. Transportation and Utilities

a. Objective B

To meet the needs of the people of Oahu for an adequate supply of water and for environmentally sound systems of waste disposal.

Policy 1

Maintain an adequate supply of water for both future residents and future visitors.

Policy 2

Maintain an adequate supply of water for future agricultural and industrial needs.

The proposed project will help meet this objective.

4. Physical Development and Urban Design

a. Objective B

To develop Honolulu (Waialae-Kahala to Halawa), Aiea, and Pearl City as the island's primary urban center.

Policy 1

Stimulate development in the primary urban center by means of the City and County's capital-improvement program.

The proposed project will help facilitate the attainment of this objective.

C. STATE OF HAWAII

1. Hawaii State Plan

Several objectives stated in the Hawaii State Plan relate in some way to the proposed project. One which relates to population is as follows:

"Section 5 (b) (3): Insure that adequate support services and facilities are provided to accommodate the desired distribution of future growth throughout the State."

Objectives regarding facility systems include the following:

"Section 16 (b) (1): Relate growth activities to existing and potential water supply.

Section 16 (b) (2): Support research and development of alternate water sources.

Section 16 (b) (4): Assist in improving the quality, efficiency, service and storage capabilities of water systems for domestic and agricultural use.

Section 16 (b) (5): Support water supply services to areas experiencing critical water problems."

The proposed project is consistent with these objectives.

2. State Water Commission Report

The State Water Commission was appointed by the Governor in 1977 to review the availability of water supplies. The Commission first reviewed available reports and received testimony from major water purveyors, then the Commission concentrated on major problems and issues. After they were through, the Commission recommended appropriate administrative and legislative action. The findings and recommendations are in a report titled "Hawaii's Water Resources, Directions for the Future." The priority recommendations from the report are in Appendix B.

3. Coastal Zone Management

Kahana Valley is contained entirely within the City and County of Honolulu's Special Management Area (SMA). The SMA describes

an area the City and County of Honolulu has chosen to protect under the State's Coastal Zone Management Program:

"The objectives of the special management area shall be the maintenance, restoration and enhancement of the overall quality of the coastal zone environment, including but not limited to its amenities and aesthetic values."

The proposed action of the BWS will comply with the requirements of the City and County of Honolulu SMA Program and the State of Hawaii's CZM Program.

4. 208 Water Quality Management Plan for the City and County of Honolulu By the State Department of Health and the City and County of Honolulu

This Environmental Ethic that forms the basis of the Hawaii 208 Plan is stated in the Preface as follows:

> "Following an initial reaction of dismay, in view of the awesome requirements, limited budget, and the time allowed, the Department of Health saw the 208 planning process as a way to improve the management of the State's environmental programs, provide better coordination between the State and the Counties, and between the Department of Health and other state and federal agencies. The Department could also use the planning process to open up the lines of communication to citizens and industry, to get them involved in the decision making. In particular, the Department could really look at ways to prevent pollution instead of just chasing after the problems, cleaning up the messes. It was an opportunity to turn the environmental policy goals of the State into reality, and, incidentally, meet the federal requirements.
>
> "This has become the theme of the 208 planning program, to make the concept of an environmental ethic a working policy guideline."

The proposed project will comply with the intent, standards and criteria of the Hawaii 208 Plan.

5. State Environmental Policies

The State Environmental Policy Act, Chapter 344, H.R.S. The first section of the Act states that:

"The purpose of this chapter is to establish a state policy which will encourage productive and enjoyable harmony between man and his environment, promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man, and enrich the understanding of the ecological systems and natural resources important to the people of Hawaii.

"The environmental policy of the State is set forth as follows:

"It shall be the policy of the State, through its programs, authorities, and resources to:

"(1) Conserve the natural resources, so that land water, mineral, visual, air and other natural resources are protected by controling pollution, *by preserving or augmenting natural resources*, and by safeguarding the State's unique natural environmental characteristics in a manner which will foster and promote the general welfare, create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of the people of Hawaii.

"The second portion of the policy reads in part:

"(2) Enhance the quality of life by:

"(D) Establishing a commitment on the part of each person to protect and enhance Hawaii's environment and reduce the drain on non-renewable resources.

"The recommended policies in this plan are designed to implement the overall Environmental Policy of the State. The key elements are conservation, prevention management, and cooperation. The major policies are designed to support the ahupua'a concept of managing the land on a watershed basis, from the mountains to the sea, for long-range sustained use of resources in harmony with the environment. This translates to:

" *Keep the soil and water on the land. Keep natural drainage channels.

" *Recycle, reuse. A pollutant is only a resource in the wrong place.

" *Manage first. Regulate only as necessary. Keep regulations simple.

" *Take responsibility. Everyone--government agencies, industry, individuals. When everyone is willing to care for the environment, it will be protected.

" *Open up the system. Open decisions, public participation.

" *Develop a process. A plan is a beginning, not an end."

The proposed project will comply with the intent, standards and criteria of the State Environmental Policy.

6. State Environmental Impact Statement Regulations

The State EIS Regulation, Chapter 343, HRS, are applicable to the proposed project. Their requirements make this EIS document necessary as described in Section 343-5, Applicability and Requirements:

"(a) Except as otherwise provided, an environmental assessment shall be required for actions which:

"(1) Propose the use of state or county lands or the use of state or county funds, other than funds to be used for feasibility or planning studies for possible future programs (or) projects which the agency has not approved, adopted, or funded, or funds to be used for the acquisition of unimproved real property; provided that the agency shall consider environmental factors and available alternatives in its feasibility or planning studies.

"(2) Propose any use within any land classified as conservation district by the state land use commission under chapter 205.

"(3) Propose any use within the shoreline area as defined in section 205-31.

"(4) Propose any use within any historic site as designated in the National Register or Hawaii Register as provided for in the Historic Preservation Act of 1966, Public Law 89-665, or chapter 6E.

"(5) Propose any use within the Waikiki-Diamond Head area of Oahu, the boundaries of which are delineated on the development plan for the Kalia, Waikiki, and Diamond Head areas (map designated as portion of 1967 City and County of Honolulu General Plan Development Plan Waikiki-Diamond Head Section A.

"(6) Propose any amendments to existing county general plans where such amendment would result in designations other than agriculture, conservation, or preservation except actions proposing any new county general plan or amendments to any existing county general plan initiated by a county.

"(b) Whenever an agency proposes an action which falls within the categories in subsection (a), other than feasibility or planning studies for possible future programs or projects which the agency has not approved, adopted, or funded, or other than the use of state or county funds for the acquisition of unimproved real property, which is not included in any of the specific types of actions referred to in section 343-6, that agency shall prepare an environmental assessment for such action at the earliest practicable time to determine whether an environmental impact statement shall be required. A statement shall be required if the agency finds that the proposed action may have a significant effect on the environment. The agency shall file notice of such determination with the commission which shall, in turn, publish the agency determination for the public's information pursuant to section 343-3. The statement, if required, shall be made available for public review and comment through the commission. The commission shall inform the public of the availability of the statement for public review and comments pursuant to section 343-3. The agency shall respond in writing to comments received during the review. Following this review by the public and any subsequent revision by the agency, the commission, when requested by the agency, may make a recommendation as to the acceptability of the statement. The final authority to accept such a statement shall rest with:

"(1) The governor, or his authorized representative, whenever an action proposes the use of state lands or the use of state funds or, whenever a state agency proposes an action within the categories in subsection (a); or

"(2) The mayor, or his authorized representative, of the respective county whenever an action proposes only the use of county lands or county funds.

"Acceptance of a required statement shall be a condition precedent to implementation of the proposed action. Upon acceptance or nonacceptance of the statement, the governor or mayor, or his authorized representative, shall file notice of such determination with the commission. The commission shall, in turn, publish the determination of acceptance or nonacceptance of the statement pursuant to section 343-3."

This EIS is in compliance with Chapter 343 of the Hawaii Revised Statutes.

7. Hawaii Water Resources Regional Study

The Hawaii Water Resources Regional Study conducted by the Department of Land and Natural Resources and published in 1977, "summarizes the results of a statewide study aimed at balancing conservation, development and use of Hawaii's water and related land resources through the next 15 to 25 years to the year 2000. Emphasis of the study has been on an appropriate balance of economic and environmental considerations in water and related land resources planning." The priority recommendations from the study are included in Appendix D.

The priority recommendations include the development of water resources islandwide on Oahu and the protection of unique ecosystems. The BWS will develop water in Kahana Valley only to the extent that it can comply with these and other priority recommendations.

D. UNITED STATES DEPARTMENT OF THE INTERIOR

1. Hawaiian Waterbirds Recovery Plan

Kahana marsh lands, stream, and pasture lands are areas of secondary importance to endangered species. The project will comply with the requirement to preserve these waterbird habitats.

SECTION V

ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATIVE MEASURES TO MINIMIZE ADVERSE IMPACTS

A. INTRODUCTION

The proposed project will generate potential long-term and short-term environmental impacts. Some will be beneficial and others adverse. Most of the short-term impacts will be produced by the construction of the facilities. The potential long-term impacts will arise from the use of the facilities.

B. DISCUSSION OF IMPACTS FROM THE PROPOSED PROJECT

1. Short Term Impacts from Construction

Several short-term physical impacts will arise from construction of the facilities. These adverse impacts are those normally associated with construction activities and are unavoidable. Construction will be confined to weekdays (Monday to Friday) and limited to daylight hours (generally between 7:00 a.m. and 4:00 p.m.) and it is not anticipated that these impacts will be significant although special construction methods may be required. Since access to the valley inland of the park and picnic areas near Kamehameha Highway is permitted by Department of Land and Natural Resources permit request only (generally by hunters and hikers), construction impacts will primarily affect the small number of residents of the valley. These residences are widely scattered and only a few homes are located within the immediate construction area in the lower valley floor.

a. Dust and Emissions

Dust and vehicular emissions will be generated during excavation for the pipeline and the hillside access road and the drilling at the well sites. Dust control measures, such as sprinkling, will be implemented to reduce dust levels when they are unacceptable, especially if fugitive dust threatens the stream.

b. Erosion

Excess turbidity may cause adverse effects on the fauna of Kahana Stream. Care must be taken to insure that the construction areas are protected and stabilized against erosion.

c. Noise

Construction equipment will raise noise levels. The project operations must conform to the State Department of Health's Public Health Regulations, Chapters 44A and 44B. A noise permit will be required from the Noise and Radiation Branch of the Department of Health and the Contractor must comply with the conditions issued with the permit. Mufflers for noise control will be required for all construction equipment.

d. Traffic

Construction of the proposed facilities will require use of the existing Kahana Valley Road and Trout Farm Road. The required transmission mains will be laid in trenchs excavated along the roads. Construction equipment will use the road to haul away surplus excavation and bring construction material needed to construct the facilities proposed. The increased traffic from construction vehicles will cause some inconvenience to residents of the valley.

Residents of the valley will be apprised of pending construction. The Contractor will be required to keep Kahana Valley and Trout Farm Roads open to traffic at all times and to use proper construction signs, barricades, flagmen to control traffic and any other devices necessary to insure minimum inconvenience and maximum safety to valley users.

e. Economic

The construction will have a beneficial impact by providing jobs to local construction firms and residents. Local material suppliers and retail businesses may also benefit from the increased construction activities.

f. Archaeological

There is always the possibility of uncovering previous unidentified archaeological sites during construction. The Contractors will be required to exercise caution and to report any such finds to the State Historic Preservation Office.

Special precautions will be taken with the archaeological sites identified near the Kahana Wells II site. During the design phase, both topographic and archaeological surveys will be conducted to ensure minimal impact of the project upon the sites. At this time it is believed that the project can coexist with no disturbance of the sites required. The archaeological work will be evaluated further during the design process.

g. Biological

According to the Plant Communities Map of the Kahana Valley Area developed for the Division of State Parks by W. L. Theobald and Nengah Wirawan in their report called the Kahana Valley Botanical Survey, Kealauloa District, Island of Oahu, the well fields and access road of Wells III, IV and V will intrude into three different plant communities (see Figure 9 and Table 7). They are:

1. Kukui Forest
2. Koa-Pandanus Forest
3. Koa-Pandanus Woodlands

The well field of Kahana II will affect the Brassaia Forest plant community. These plant communities still contain many plants native to Hawaii. Native plants tend to be more specialized than introduced plants so care will be taken not to foster the growth of any plant that could possibly upset the existing plant community during and after the construction of the wells and access road.

Construction activities could cause increased turbidity in Kahana Stream which will degrade the aquatic life in the stream. The endemic hihiwai may have disappeared from Kahana Stream due to excessive harvesting and increased stream turbidity. Careful construction techniques must be used along with careful supervision to prevent the degradation of Kahana Stream due to excessive turbidity. The stream will not be crossed by the access road.

FIGURE 9

PLANT COMMUNITIES MAP OF THE KAHANA VALLEY AREA

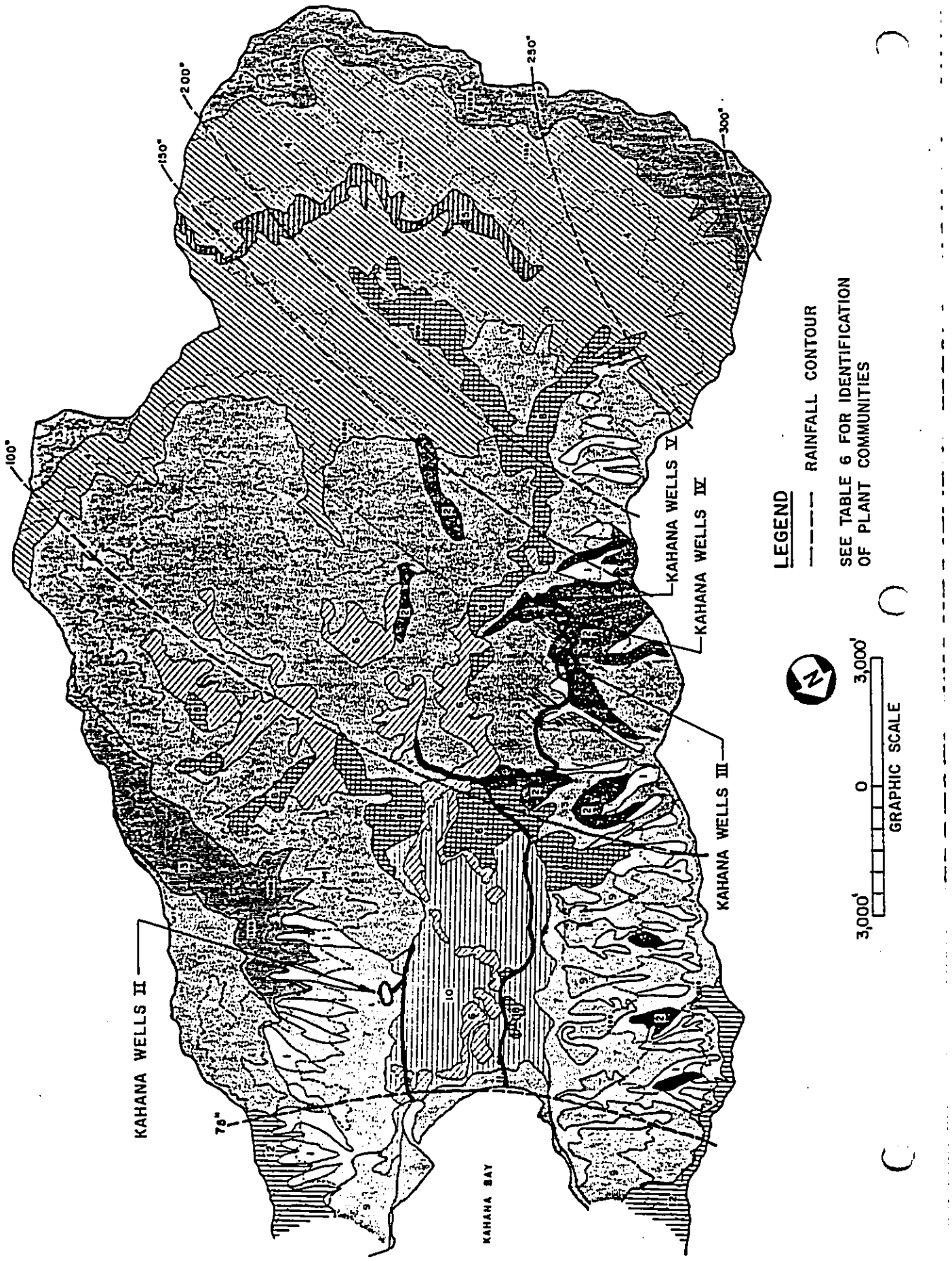


TABLE 7

PLANT COMMUNITIES OF THE KAHANA VALLEY AREA*

The following communities have been recognized.

1. Kukui Forests
2. Koa-Pandanus Forests
3. Koa-Pandanus Woodlands
4. Metrosideros Woodlands
5. Albizia Forests
6. Hibiscus Forests
7. Brassaia Forests
8. Mixed Forest-Scrub
9. Mixed Grass-Scrub
10. Pasture and Cultivated Ecosystems
11. Strand
12. Dry Cliffs
13. Wet Cliffs

*The locations of the numbered communities are indicated on Figure 9.

2. Long Term Impacts

Because of the nature of the proposed facilities, long term impacts on the environment will be associated with the presence and use of the wells and control buildings and the hillside roadway from the Kahana Valley Road and Trout Farm Road to the well fields. Also, because the wells from Kahana III, IV and V tap the high level dike water that also sustains the flow of Kahana Stream, reduction of stream flow will, to some extent, occur. Because the proposed well site for Kahana II is approximately 1,000 feet from Kahana Stream and is located within thick alluvium, no adverse effects are anticipated to stream flow during well testing and production pumping. The thick alluvium acts as a barrier which effectively separates surface stream water from basal water and is the reason that no effect is expected from groundwater withdrawal below the USGS gaging station.

a. Well Fields

Each well field will consist of 2 to 5 wells (total flows of 1 to 2 mgd) and a control building. This will require the removal of all plants in the immediate vicinity of the wells and the control building.

An individual well will require approximately a 20' x 20' piece of land enclosed by a chain link fence. The well will stand about 6 feet high because of the noise baffle placed around the pump motor to reduce any audible impact from the well. Careful planting outside of the fence will effectively hide most of the well from view and reduce its visual impact.

The control building will be sited to reduce the amount of necessary grading required. A typical control building has the dimensions 30' x 30' x 14' high. There is usually one well close by and this well and the control building are enclosed by a chain link fence. The topography, location of the well, and the location of the control building with respect to the access road will determine the actual amount of land to be affected. Once again careful grading and planting will reduce the visual impact of the control building.

The visual impact of the wells and the control building is limited. They can only be seen from the access road as the entire well field will be hidden from the rest of the valley by forest. Figures 10 and 11 are photographs of the existing Kahana Well I control building and well.

b. Access Roads

Access to the well fields will be via the existing valley roads and the old military road. Thus, the land has already been impacted. The additional access roads to the individual wells will only impact the affected area to a limited extent. The old military road has become overgrown now so it could be considered as having almost returned to its natural state in several sectors. Figure 12 is a photograph of the vegetation as seen along the existing road bed leading to Kahana Wells III, IV and V.

The access roads will have a physical impact on the area. The road areas will be changed from an overgrown area to a cleared road alignment with no plants and a crushed coral surface. Still, the access road width will be limited to only 12 feet so its effect on the environment will be minimized. Care will be taken where the road crosses small stream beds. Culverts will be put in to allow the flood waters to follow in their natural course to the valley floor. At no time will the access road cross Kahana Stream. The Contractor will be required to develop the road improvements during the dry summer season when stream turbidity by runoff will be minimized. He will also be required to use special construction techniques to carefully control his contruction activities in order to minimize the downstream impacts of erosion and stream turbidity. The BWS will also monitor the stream to insure the prevention of excessive turbidity due to runoff.

The access road will provide a benefit of improved access to the upper valley for hikers and for emergency use. All utilities to and from the wells and control buildings will be buried in the access roads.

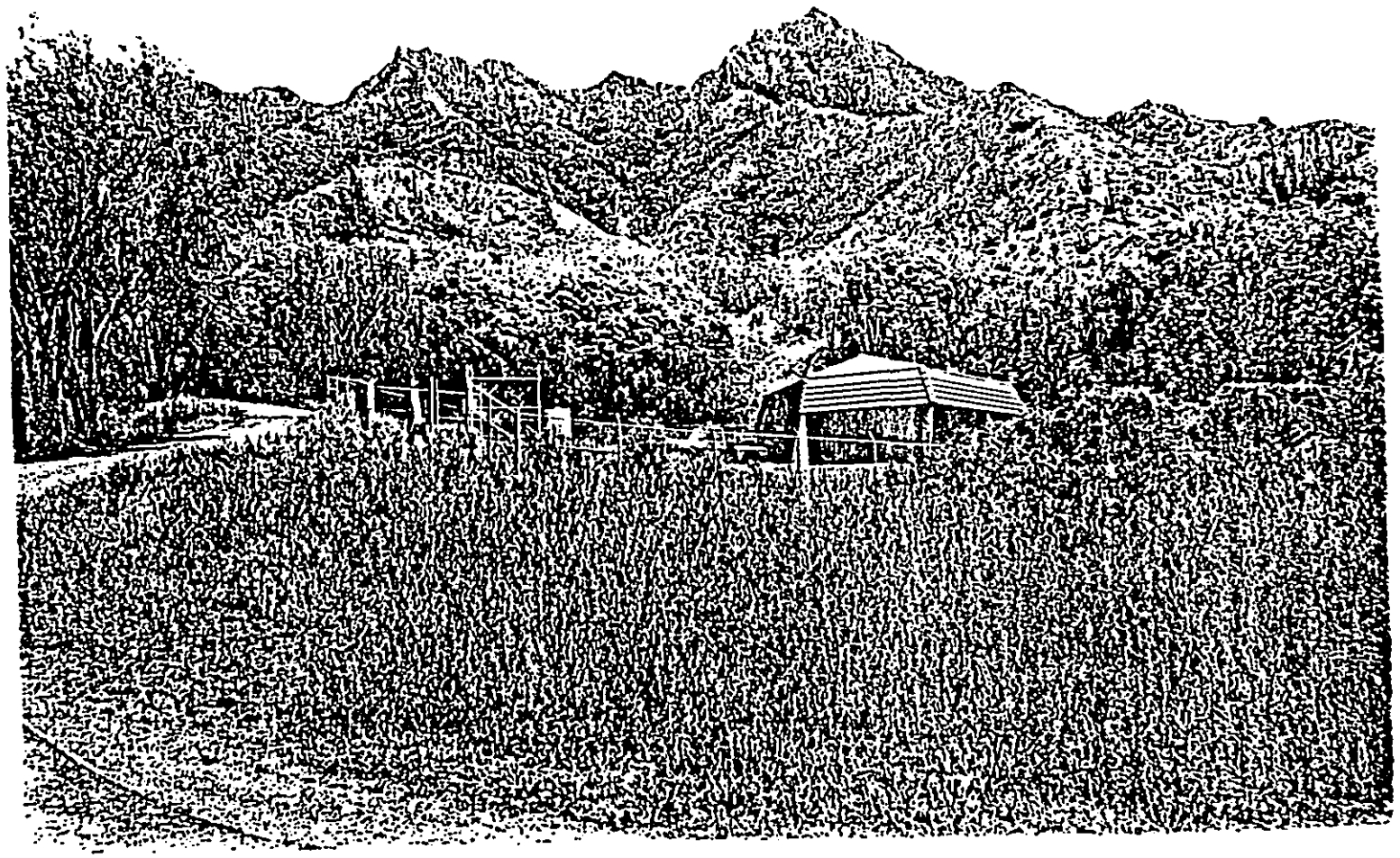


FIGURE 10

KAHANA WELLS I CONTROL BUILDING WITH WELL IN BACKGROUND

FIGURE 11

KAHANA WELLS I STANDBY WELL

FIGURE 12

TYPICAL VEGETATION OF KOA-PANDANUS FOREST
(40-Foot Maximum Tree Height)

c. Kahana Stream

The withdrawal of 6 million gallons a day by Kahana Wells III, IV and V from the high level dike water will have an effect on Kahana Stream because the dike system is the source of most of the water that flows in Kahana Stream during the dry season. Although some dikes are partially visible, the number, size and shape of the dike compartments of the area are not known, so it is not possible to develop a water budget for the dike compartments to be tapped by the wells. The proposed wells are located near the transition between the dike complex and the marginal dike zone and will withdraw dike water moving parallel to the predominant dike trend toward Kahana Stream. Well Fields III, IV and V are in a position to tap dike compartments that provide water to the reach where the greatest gain in groundwater occurs. This is the reach between elevations 115 and 300 feet where 52 percent of the Q_{90} (dry weather base flow) is gained. Thus, the well pumping will have an effect upon Kahana Stream which will be measurable during the dry season if the ultimate development is obtained.

The overall geology and hydrology of Kahana Valley is well documented but there is little known about the individual well field sites. While much can be inferred from the overall knowledge of the area, more knowledge of the well field sites will be obtained during well testing and later during well development. This is the reason for the incremental development of the well fields.

During well testing, the groundwater head drawdown will be measured until a steady state is reached. This will probably withdraw some of the water that flows preferentially parallel to the dike trend towards Kahana Stream, not only from the dike compartment which the well taps but also from the compartments around it. Depending upon the weather prior to and during the test, the USGS may detect an effect upon Kahana

Stream due to the well testing. In any case, the USGS will monitor the stream during well tests for the three well fields. Well test monitoring may require the installation of temporary gages at selected sites along the stream. Should a well field provide an inadequate amount of water, a new well field will be chosen. (The additional well field will require a supplementary EIS). Only after all three well fields have been completely tested and proven will the first well field be developed and integrated into the water system.

After the first well field is put into service, there will be time to study the effects of pumping upon Kahana Stream before the next field is put into service. The USGS continually monitors Kahana Stream and the BWS will monitor the groundwater heads at the individual well sites so there will be a considerable volume of information available from which to draw conclusions about the effect of the wells upon the stream. As the rest of the well fields are put into service, any effect upon the stream will probably be more noticeable, requiring quick response by the BWS. The BWS has all of its wells tied into a central control station so curtailment of pumping can be done immediately in response to any adverse findings of the USGS stream monitoring or BWS groundwater head data.

The BWS controls all of its well pumping from its Beretania Pump Station and will curtail pumping should the groundwater head at the well begin to go down below the equilibrium level. A drop below this level would mean that the pumping rate has exceeded the recharge rate of the dike compartment and pumping must be curtailed to prevent excessive drawdown of the head of the compartment. Decreasing the pumping rate protects the integrity of the water source during times of low recharge and will also protect Kahana Stream.

Groundwater stored in the dike complex and marginal dike zone moves toward the ocean or Kahana Stream because of the difference in elevation of the water surface elevations or head. Thus, the lowering of the groundwater head in the dike compartments tapped reduces the hydraulic gradient that drives the stored groundwater through the permeable rock, cracks, fissures, and dikes toward Kahana Stream from these and surrounding compartments. A maintainable equilibrium of groundwater head does not mean that the groundwater will not be diverted from Kahana Stream. For this reason, the USGS stream data is of great importance in the maintenance of the integrity of Kahana Stream. Should a decrease in stream flow occur that is deemed detrimental to Kahana Stream, pumping will also be curtailed.

Close monitoring of the stream should prevent any adverse effects upon the "secondary habitat" for endangered species. In a recent report by Amadeo S. Timbol for the U. S. Army Corps of Engineers, entitled Limnological Survey of Kahana Stream, Oahu, the minimum stream flows are discussed in the report summary:

"Minimum instream flow at 10, 30 and 60 percent, based on methods developed by Tenant (1976), of the average discharge are discussed. It is suggested that 10 percent minimum flow is not adequate for the maintenance of desirable macrobiota in Kahana Stream. The stream will suffer serious degradation, with the definite loss of the critical habitat in the main stream.

"Thirty percent minimum stream flow could lead to the eventual disappearance of the o'opu nakea, a threatened endemic goby that is also a food fish. The most obvious detrimental effect is on the critical habitat caused by the decrease in water velocity and other changes that go with it.

"Sixty percent minimum stream flow had no significant detrimental effect both the biota and physical features of Punaluu

Stream (Timbol herein refers to a similar study recently completed on a stream diversion on Punaluu Stream in the adjacent Punaluu Valley). Some form of degradation must have taken place upstream of the diversion, but not below.

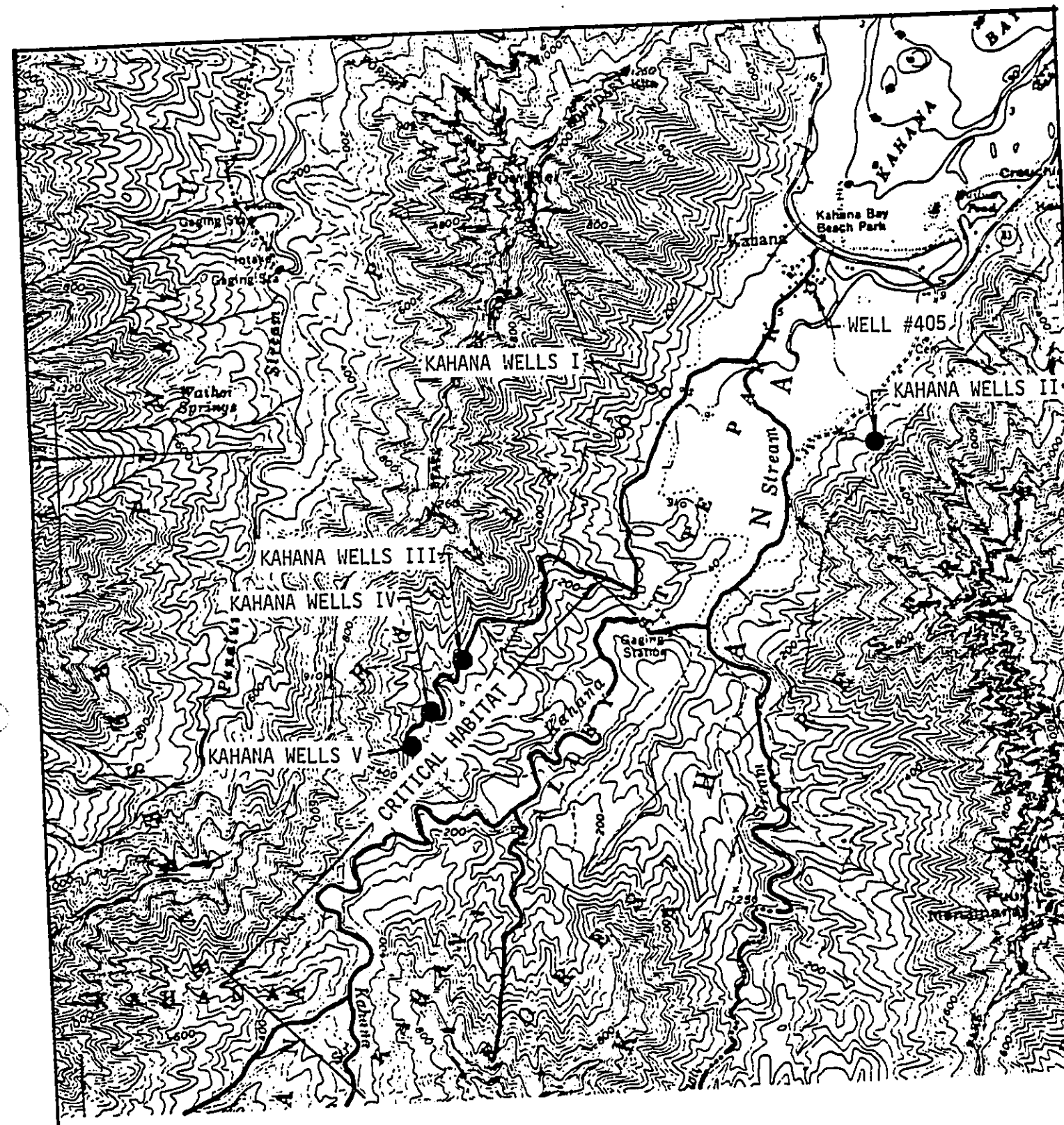
"Thus, this study suggests that 60 percent is the base flow needed to sustain good survival conditions for Kahana macrobiota, and to maintain economic and intrinsic values, and general recreational qualities."

The value suggested is 60 percent of the average flow measured by the USGS gage or 13.9 mgd. While this gage is not at the mouth of Kahana Stream, no measureable effects below the gage are anticipated because the sediments of the valley retards the movement of groundwater into the stream.

Some precautionary statements on the minimum stream flow recommendations are also provided by Timbol:

"Some precautionary statements are needed at this point. Hawaii streams are minute when compared with continental rivers (e.g., the discharge of the Sacramento-San Joaquin River is 80 times more than that of Wailuku River in Hilo, Hawaii's largest). Climate also makes streams in Hawaii different from U. S. mainland streams because the high mean annual temperature and lack of greater seasonal changes here give these streams a much milder external environment than streams of temperature regions. The methods of Tenant (1976) are based on continental stream ecosystems and have not been tested in Hawaii. Thus, even the 10, 30, 60 percent values may be not appropriate for Kahana Stream."

An approximate value of 13.9 mgd for a minimum stream flow has been suggested by Timbol. The critical habitat he refers to is shown in Figure 13. This is the basis upon which the BWS will initially set its minimum stream flow reduction. This basis suggested by Timbol will be modified by the findings of State, and Federal agencies on the effects of the wells upon the flora and fauna of Kahana Valley and by the proposed minimum stream flows yet to be determined by the DLNR. The DLNR will use one of many "state of the art" techniques to determine the minimum stream flow such as the Instream Flow Group Method developed by the United States Department



REF: USGS QUAD.

N

2000' 0' 2000'

Graphic Scale

KAHANA VALLEY WATER DEVELOPMENT PROJECT
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 13

CRITICAL HABITAT

CITY AND COUNTY OF HONOLULU
BOARD OF WATER SUPPLY

of the Interior. These methods use much more detailed analysis and will be tailored for Hawaiian streams whereas the "Tenant Method" proposed by Timbol is not. For this reason, the BWS water development project in Kahana will be flexible and responsive to the on-going studies of water withdrawal in Kahana Valley.

d. Water Mains

A 20-inch water main will carry the well water from Kahana Wells III, IV and V down the valley to the proposed Kahana Reservoir or into the transmission main along Kamehameha Highway. A smaller line will take water from the Kahana Wells II site to the transmission main along Kamehameha Highway. The trench excavation will be along the road and no adverse long term impacts are expected to be generated.

e. Kahana Bay

The withdrawal of 6 million gallons a day from Kahana Valley is not expected to affect the water quality of Kahana Bay. The Water Resources Research Center Technical Report No. 77, The Quality of Coastal Waters: Second Annual Progress Report, September 1973, had these findings:

"The study produced evidence that during times of heavy rainfall the turbidity of the nearshore water of the bay increases and a measurable loss of clarity occurs. A lowering of the salinity of this water at such times also indicates that dilution with fresh water is sometimes appreciable, perhaps sufficient to make the nearshore waters marginal for some types of coral found there.

"Studies of biota in Kahana Bay--sea urchins, coral, and miscellaneous invertebrates as well as micromolluscs--show variations within the bay environment which are more related evidently to the oceanography and other characteristics of the bay than to the quality of water and sediments dicharged from the stream. There was no evidence that the diversity of life in Kahana Bay was limited by quality factors originating on the land. The biological data presented are therefore subject to little interpretation in terms of response of living organisms to discharges from Kahana Stream. They do, however, give some

baseline data, as do the results of chemical analyses, against which to compare the results of similar observations in other land use situations--urban, industrial, and agricultural."

f. Other Areas

According to the Water Resources Research Report No. 77, groundwater flows as underflow from the adjacent Punaluu Valley eastward toward Kahana Valley and also flows down the upper valley to the leeward side of the Koolau Range and possibly to Waikane Valley. The wells are located in the mid valley and are most likely to affect the groundwater flowing from Punaluu toward Kahana Valley. It is not expected to affect Punaluu Valley in any way as this flow exists at present and is not expected to be increased due to the groundwater withdrawal.

g. Long Term Benefits

There are benefits to be gained by the well fields that are believed to outweigh the adverse visual and physical impacts on the land. The water gained is valuable and necessary to meet the immediate projected water demands for Windward Oahu. The Kahana Wells will feed into the water system that supplies the Windward, Honolulu and Pearl Harbor Water Use Districts. The BWS hopes to one day have its six water use districts integrated into just one island-wide water system. Kahana Wells II, III, IV and V will then become part of a system that supplies water to the entire island.

The access roads will also provide an easier access into the deeper reaches of the valley, benefiting visitors, scientists, hikers, emergency rescue groups and others.

h. Long Term Adverse Effects

The development of groundwater in Kahana Valley, will also enable population growth in the Windward area as projected in the States II-F population. This growth will change the lifestyle of the area to a faster pace and will increase the stresses related to overcrowding. Growth will also increase the

demands upon the other public services such as sewage treatment, police protection, hospitals and schools. Only the orderly planning of the City and County of Honolulu can mitigate these adverse effects.

i. Cumulative Effects of the Water Development, Water Reservoir and State Park Projects

The three projects now planned for Kahana Valley will have a cumulative short term effect due to construction activities unless these activities are coordinated so that the effects can be mitigated. This is the reason that the BWS is working closely with the DLNR's Division of State Parks, Outdoor Recreation and Historic Sites, to insure the orderly development of the resources of the Valley and preserve its natural beauty. The sensitivity of some of the Kahana Stream biota to excess turbidity is of continuing concern and will require careful construction techniques to mitigate this problem.

The wells and control buildings will impact visually upon the visitors that hike the old jeep trail and will require careful landscaping to decrease the adverse effect. This is a problem that cannot be mitigated completely. The proposed 6 million gallon water reservoir will also have a visual impact because it may not be possible to completely shield it from views from other parts of the valley.

The combined activities of water recreation, fishing, agriculture and water development will be coordinated by the State Department of Land and Natural Resources to assure that these activities are compatible and do not affect the environment adversely.

SECTION VI

PROBABLE ADVERSE ENVIRONMENTAL IMPACTS WHICH CANNOT BE AVOIDED

The unavoidable short term adverse impacts are those related to construction activities. Temporary air pollution from dust, vehicular emissions, noise from construction equipment and inconvenience to resident and visitor traffic will occur. Particular care will be taken to avoid any damage to the archaeological sites near Kahana Wells II and excess trubidity in Kahana Stream during construction to the extent practicable.

The long term adverse impacts, which are unavoidable because of the nature of the project, will be the visual impact and physical land changes caused by the well fields and the access road and the potential adverse effect on the flow of Kahana Stream and the endangered species secondary habitat in the lower valley. The stream flow will be reduced but to a signficant level only during the dry season when water withdrawal may have to be curtailed. Should the reduction in stream flow show signs of impacting adversely the stream or the waterbird habitat, water withdrawal will be curtailed until the Federal and State agencies find increased withdrawal acceptable. Due to the dependence of the stream and the marsh lands upon both rainfall and groundwater, the adverse impacts from groundwater withdrawal will have a seasonal dependence. For this reason, the BWS will be flexible in its pumping operations in Kahana Valley.

Improvements to the access road will again signal man's intrusion into the valley as will the wells and their associated control buildings. It should be noted that the well field areas and the valley at higher elevations were used extensively for jungle warfare training by Army troops during World War II. Still, the affected area is relatively small and only those traveling along the access roads will be able to see the effects of construction. The access road on the opposite side of the valley from Kahana Wells III, IV and V is available as an alternate route for visitors on foot to avoid the visual intrusion of the well sites. The noise generated at the individual well sites will be greatly reduced by sound attenuators. Proper landscaping will blend the individual wells and control buildings into their surroundings.

SECTION VII
ALTERNATIVES TO THE PROPOSED ACTION

A. NO PROJECT

The "no project" alternative would result in the continued deficit of water capacity versus demand. The amount of water available to meet present and future domestic demands on Oahu has been substantially reduced due to court decisions on the Waihee Valley water rights issue. Also less than anticipated amounts of water will be available from the lower Punaluu wells due to water quality restrictions. The Kahana Water Development project is intended to provide additional capacity to meet this deficit so that the the BWS planning for future water supplies can be realized.

B. ALTERNATE WELL LOCATIONS AND ACCESS ROAD ALIGNMENTS FOR THE DEVELOPMENT OF GROUNDWATER WITHIN KAHANA VALLEY

The exact location of the wells will be determined by field investigations and actual test wells. At this time, there are two general alternatives to the proposed location of the wells. The alternatives are as follows: 1) locate three well fields on the east side of the valley; or 2) locate one to two well fields on each side of the valley. The following is a brief description of what each of these alternatives involve.

1. Locate Three Well Fields on the East Side of the Valley

This alternative involves locating three well fields on the east side of the Kahana Valley at ground elevations between 250 and 350 feet above MSL. The proposed well fields would be approximately 1,500 feet apart and vary from 7,500 feet to 11,000 feet inland of the coastline. Access to the well sites can be partially provided by using the existing access road either on the east or west side of the valley. In either case, at least one stream must be crossed which will require the construction of a bridge or a flood proof culvert. Other than the stream crossing, provisions for access will be similar to the proposed action.

Approximately 7,000-8,000 feet (depending on which side of the valley is used for access) of existing access road will be improved as required. Approximately 3,000-4,000 feet of the east Army Loop Road will be cleared of thick vegetation, graded as required, and surfaced with a coral base. In addition, 1,500-2,500 feet of new road will have to be constructed to complete access to the upper most well field.

Three reasons why this alternative does not now appear attractive are: (1) it is expected to have a more significant impact on the physical environment of the valley than an access road on the west side; (2) it would require at least one stream crossing; and (3) from a geological and hydrological standpoint, it is not as desirable as the west side for water development.

2. Locate One to Two Well Fields on Each Side of the Valley

This alternative could be used in an attempt to tap dike compartments on each side of Kahana Stream. It is similar to the proposed action in all respects except for the construction of the third and uppermost well field. This alternative considers turning the access road east at a point beyond the second well field and down to Kahana Stream, construction of a stream crossing (i.e., bridge or flood proof culvert) and the improvement of the east portion of the old Army Loop Road until suitable sites for 1 or 2 well fields are located on the east site.

This alternative has the advantage of reaching dike compartments on each side of the stream. However, it requires a stream crossing, and the east side of the valley is not believed to be as geologically favorable for the development of groundwater.

C. FUTURE ALTERNATIVE WATER SOURCES

This subject was discussed in great detail in the recent EIS Preparation Notice for the Honouliuli Wells of the Board of Water Supply. It is reproduced herein as Appendix A. The non-groundwater sources described therein are much more expensive to develop and are therefore not under active development by the BWS at this time.

SECTION VIII

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

The proposed Kahana Valley Wells II, III, IV and V will result in no permanent loss of land area. The use of the land area is reversible, i.e., the surface facilities can be removed and the area returned to its natural state if so desired at some future time. The project will not result in short term gains at the expense of long term losses or vice versa due to the careful development planned by the BWS. The proposed action will not prevent the implementation of future options and will give the BWS time to test the feasibility of proposed alternatives. It will provide a much needed source of domestic water for the near future requirement.

By carefully monitoring the measured flow of Kahana Stream any significant detrimental effect to the biota of the stream can be avoided. The project will not limit the beneficial uses of the environment or pose any long term risk to health and safety.

SECTION IX

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

City and County funds, labor, and materials, will be irreversibly committed to the project. More funds will be required for operation and maintenance. No other commitment of resources is considered irreversible or irretrievable. The land can be reclaimed if it becomes desirable to do so and no significant irreversible effect is expected on Kahana Stream or the groundwater system.

It is possible that construction activities and reduced flows to Kahana Stream could irretrievably affect the fauna of the stream. Construction activities could cause increased turbidity in Kahana Stream which will affect the stream inhabitants. Excess turbidity is one of the causes for the disappearance of the limpet hihiwai. Turbidity and reduced flows could change the streambed environment, affecting the migration of the o'opu nakea, mountain shrimp and the Tahitian prawn. Reduced flows and the subsequent diminution of the riffle areas from Kawa Stream caused the disappearance of the o'opu napili from the stream. Reduced flows, if excessive, could affect the riffle areas of Kahana Stream causing a reduction in the o'opu napili population and possibly their disappearance from the stream. The BWS priorities of preserving the "Critical Habitat" portion of Kahana Stream, the waterfowl habitat and of compliance with present and future DLNR requirements for protecting Kahana Stream should prevent this irretrievable loss from occurring.

SECTION X

AN INDICATION OF WHAT OTHER INTERESTS AND CONSIDERATIONS OF GOVERNMENT POLICIES ARE THOUGHT TO OFFSET THE ADVERSE ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

In Section V, Anticipated Environmental Impacts and Mitigative Measures to Minimize Adverse Impacts, it was concluded that there are no significant long term adverse impacts expected. The adverse impacts of construction are all short term and can be mitigated. The long term impacts are basically visual in nature and can easily be deemed necessary to accommodate the planned growth of Oahu's population. The impact upon Kahana Stream cannot be determined in advance but, with careful implementation of the production of the well fields, no significant adverse impacts will be incurred. The development of the well fields is in accordance with the 1977 City and County of Honolulu's General Plan Policy Objectives because it promotes the projected growth of Honolulu with minimal adverse environmental effects.

SECTION XI
SUMMARY OF UNRESOLVED ISSUES

The proposed project could affect the dry weather flow of Kahana Stream to some extent. The hydrogeologic complexity of the groundwater system in Kahana Valley makes the estimation of the extent of flow reduction difficult. For this reason, stream monitoring must be done to insure no adverse impacts upon Kahana Stream although the minimum stream flow reduction is unresolved. While a minimum stream flow reduction has been recommended by Timbol using the "Tenant Method," the method has certain deficiencies. This is because the method was based upon continental United States rivers and streams which are much different from Hawaiian streams and some of Timbol's recommendations are inferred from Punaluu Stream which may not completely apply to Kahana Stream. Timbol also did not take into account the fact that the USGS has recorded a minimum stream flow of 6.5 mgd in his assessment of the effect of stream flow reduction. This low flow was recorded for three days in 1961 so only short-term flow reduction conclusions can be inferred from this piece of information. Still, the fact that the average flow of Kahana Stream is equaled or exceeded about three to four months out of the year, may be important in the determination of the minimum flow required.

The DLNR is conducting a study to determine minimum stream flows for Windward streams using one of the "state of the art" methods (e.g., the Instream Flow Group Method. The method chosen will be much more accurate and will be tailored for Hawaiian streams. Until the results of this study are made available to the BWS, the minimum stream flow will be 60 percent of the average flow or 13.9 mgd. When the DLNR study of Kahana Stream is complete, the BWS will comply with their findings.

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APPENDICES

APPENDIX A

FUTURE ALTERNATIVE SOURCES OF WATER

APPENDIX A

FUTURE ALTERNATIVE SOURCES OF WATER[1]

A. WATER EXCHANGE PROGRAM

This program would consist of an exchange of water between Oahu Sugar Co. and the Board of Water Supply. Presently, Oahu Sugar is using approximately 40 to 50 mgd of domestic quality water for sugarcane irrigation. The BWS would trade water of lower quality for this potable water on a one-to-one basis. The lower quality water for exchange would come from any of the potential sources listed below. In addition, another 20 mgd could be converted to domestic use if this water were to be blended with water of lower mineral content; thus, from 40 to 70 mgd would be available for exchange.

1. Sewage Effluent [6.1]

It is estimated that approximately 33 mgd of sewage effluent would be available for use in the exchange program. About 25 mgd could be supplied by the Honouliuli WWTP, and about 8 mgd by the Mililani STP. It would be mixed with higher quality water on a ratio of one part effluent to three parts water and then used for drip irrigation.

The existing Mililani Sewage Treatment Plant is located on the West Bank of Kipapa Gulch, 15,000 feet north of the Oahu Sugar Co. mill in Waipahu. The effluent is presently discharged into Kipapa Stream and flows down to Pearl Harbor. The most feasible way to use this effluent for sugarcane irrigation is to pump it from the plant to the Waiahole Ditch, about 8,000 feet mauka.

The Honouliuli WWTP is the other sewage treatment plant in this cane growing area that can furnish cane irrigation water. It will be located outside the east boundary of Barbers Point Naval Air Station, about 4,000 feet north of the Ewa Plantation mill. To make this effluent available for cane irrigation, it is necessary to pipe it about 20,000 feet toward the present location of Ewa shaft, although it may be applied to the cane fields on

[1]SOURCE: City and County of Honolulu, 1979, Board of Water Supply, Honouliuli Wells Environmental Impact Statement, Notice of Preparation.

the plain surrounding the WWTP. However, piping the effluent to Ewa shaft will make its application more widespread, affording opportunities for selective applications and dilution.

The cost of supplying the sewage effluent has been estimated at $0.09 per thousand gallons for the Mililani STP and $0.13 per thousand gallons for the Honouliuli WWTP [6.2].* Studies by the University of Hawaii Water Resources Research Center indicate that the 1-3 mixture ratio is adequate to meet State Department of Health standards and sugar needs as well [6.3].

2. Pearl Harbor Springs [6.4]

The average discharge of water from the Pearl Harbor Springs is about 55 mgd. About 13 mgd of this is pumped to sugarcane fields, and the remaining 42 mgd discharges into the sea after flowing through water cress or other wetland crops [6.5]. Thus, spring water could be captured and used for additional cane irrigation, or possibly mixed with effluent and then applied.

Three major springs are located at Kalauao, Waiau, and Waiawa. They were used in the past for irrigation, and redevelopment of the springs would be feasible. To regain the use of the springs for sugarcane irrigation, these waters must be collected and pumped westward to the cane growing areas overlying the caprock. A more feasible scheme would also encompass an integrated pipeline pumping system involving all three spring areas and two surface streams -- Waikele and Waiawa. Assuming that the pumping installations are sized to accommodate the lower flows expected during the summer months, up to 40 mgd of water suitable for cane irrigation can be delivered to cane growing areas from the three spring areas and the two surface streams. It is estimated that the cost of supplying water from the springs will be approximately 12 cents per thousand gallons [6.6].*

3. West Loch Reservoir [6.7]

Another alternative which has been suggested is to dam West Loch to create a reservoir to capture flood flows from Waikele Stream.

*Additional information provided by the BWS is shown in Figure A-1.

Although the dry weather flow is presently being used for irrigation, flood flows rush into West Loch unused because there is no large storage basin to capture them.

A large storage reservoir in West Loch would make it possible to store the high flows during the rainy months for use during the drier summer months. A dam extending 2,700 feet on a bearing of north 75° east from Nichol's Point to Waipio Peninsula can form a 2.3 billion gallon reservoir. Using existing hydrographic data, the proposed reservoir would be able to sustain a flow of about 10 mgd.

To deliver the stored flood water, an intake structure pumping station and pipeline would have to be constructed. Delivery of this source of water to the Waikele area would require a pipeline of 16,500 feet long. Consequently, this would be a relatively expensive source, at $0.68 per thousand gallons [6.8], and the environmental impacts would need to be studied in some detail before proceeding.* Trapping of sediments in the reservoir would shorten the useful life span of the reservoir unless periodic dredgings were performed.

4. Brackish Water*

Brackish water wells are another potential source of irrigation water. These could be developed in the caprock of the Ewa plain or Waianae coast. As long as the chloride content is below 1,000 ppm, the water would be suitable for this use. Some 20 mgd is presently being drafted from this area for irrigation.

B. BRACKISH WATER DEMINERALIZATION

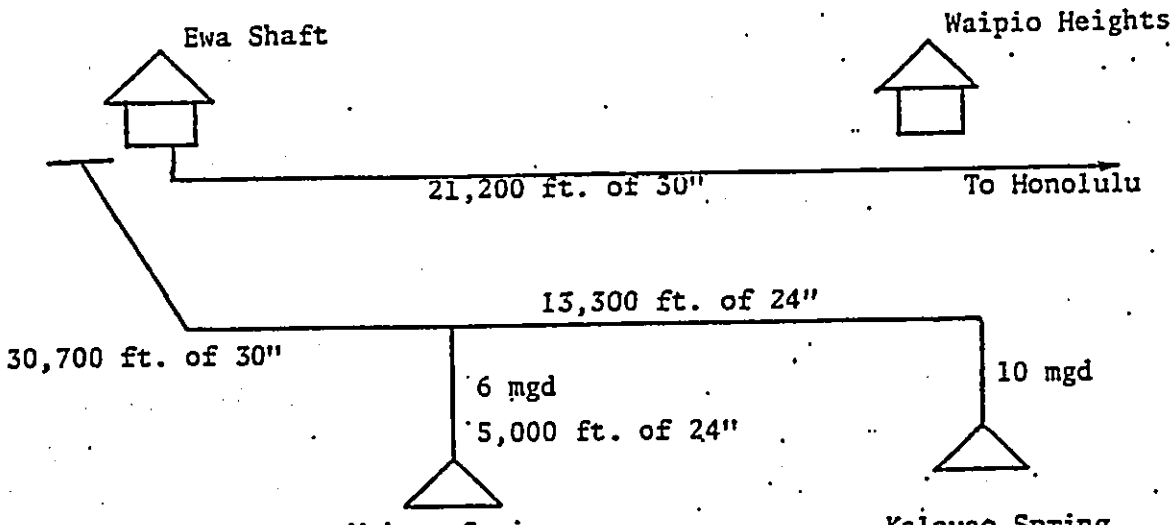
Brackish water in the caprock and transition zone comprises a large potential water source presently unused due to excessive mineral content. Caprock water occurs in the Ewa plain and Waianae coastal areas. In the Ewa area, chloride content of the water ranges up to 2,000 ppm and total dissolved solids (TDS) up to 4,000. Transition zone wells are located along the shoreline of Pearl Harbor and in the Metropolitan area

*Additional information provided by the BWS is shown in Figure A-1.

Figure A-1

Exchange Concept

16 MGD Irrigation Water from
Kalauao & Waiawa to Ewa Shaft in
Exchange for Ewa Shaft



	Waiawa Spring	Kalauao Spring
Capital Costs:		
Irrigation System:		
Station:		$ 1,800,000
Pipeline:		
18,300 ft. of 24"		2,470,000
30,700 ft. of 30"		5,066,000
Total		$ 9,336,000
Domestic System:		
Stations: (Renovate Ewa Shaft or		$ 3,000,000
Pipeline: develop new source)		
21,200 ft. of 30"		3,816,000
Total		$16,152,000
Grand Total - Irrigation + Domestic		$16,152,000

Annual Domestic Water Production @ 90% load factor:
16 x 365 x 0.9 = 5,256 mil gal

Annual Costs:	
Irrigation System:	
Operating Cost: - 5,256 x 410 x 0.21 =	$ 453,000
Amortization: - 9,336,000 x 0.07265 =	680,000
Domestic System:	
Operating Cost: - 5,256 x 250 x 0.21 =	275,000
Amortization: - 6,816,000 x 0.07265	495,000
Total	$1,910,000

Cost Per Million Gallons:
1,910,000 ÷ 5,256 = $364

SOURCE: BWS Planning Department

of Honolulu. The two most advanced demineralization processes are electrodialysis and reverse osmosis.

1. Electrodialysis

In electrodialysis, brackish water is pretreated and filtered, and then forced through an electrically-charged stack of selectively permeable membranes. The mineral salts in the water separate into positively-charged and negatively-charged ions that pass through the membranes, leaving fresh water behind [6.9]. After chlorination, this product water is suitable for domestic use.

A single stack may contain as many as 600 membranes and pass up to 250,000 gallons per day of product water. To obtain higher feed-to-product concentration ratios, multiple stacks in stages (series) are required. The number of stages selected is based on feed water hardness (calcium and magnesium concentration), total dissolved solids (TDS), temperature and the presence of any particularly troublesome ions [6.10]. The conceptual design of the process is shown in Figure 6-1.

Operational problems include corrosion, scale formation, and a phenomenon known as "concentration polarization," which limits the portion of dissolved solids that can be removed in a single stack to 50 percent of the dissolved solids in the feed water. Pretreatment of the feed water and the addition of acid can aid in control of these problems.

The salt composition of the waste brine is nearly the same as that of the feed water, and the concentration can usually be built up to levels acceptable for disposal into the sea or coastal injection wells [6.11].

Two major operating and maintenance costs are membrane replacement and electric power. The life expectancy of electrodialysis membranes is about five years if they are properly cared for. Electric power is required to pump the fluid streams through the stacks and force the ions through the membranes. About eight kwhr

per 1,000 gallons of product per 1,000 ppm salt reduction are typical at economical current densities and without feed pre-heating. Of this power demand, 3 kwhr are for pumping and 5 kwhr are the processed power requirements. The energy requirement is nearly in direct proportion to the salt removal rate [6.12].

Electrodialysis has provided municipal water for about 10 years in plant sizes up to about 2 mgd.

2. Reverse Osmosis [6.13]

Osmosis occurs if two solutions of different concentration, but in the same solvent, are separated from one another by a semi-permeable membrane that allows the passage of the solvent but not the solute. The phenomenon of osmosis is that the solvent flows from the dilute solution to the more concentrated solution until the pressure on the more concentrated side of the membrane rises to a value known as the "osmotic pressure difference" between the two solutions. Reverse osmosis occurs when a pressure greater than the osmotic pressure difference is applied to the more concentrated solution and the solvent is forced to flow into the dilute solution. The principals of osmosis and reverse osmosis are illustrated in Figure 6-2.

In practice, brackish water is pretreated and filtered and then raised to operating pressures (usually 400 to 600 psi) and fed into reverse osmosis modules containing membranes. Part of the feed water passes through the membranes into the product water stream. The more concentrated feed stream with reduced flow then flows into other modules, where more water is added to the product water stream. A conceptual design of the process is shown in Figure 6-3. It can be seen from the design that the process is such a simple one that only mechanical force is required for its operation.

All currently available membranes allow some of the salt to pass through into the product water. The amount of salt passing through

the membrane is proportional to the salt concentration at the membrane face; therefore, higher concentration feed waters produce a lower quality product. In a multi-stage operation, the concentration of feed water will at some stage become so great that the product water produced in that stage will be unacceptable; thus, with feed waters of higher concentration (between 2,500 and 10,000 ppm total dissolved solids), only one or two stages may be the maximum that can be used.

Operational problems include the fact that with continuing operation, the water production rate tends to decline due to membrane compaction and membrane fouling by scale and contaminants. This production decline can be as high as 20 to 30 percent in a single year for high pressure (up to 1,000 psi) plants, for low pressure, less than 300 psi, plant compaction is generally insignificant.

The salt composition of waste brine is nearly the same as the feed water, as in the case for electrodialysis.

The major operating cost is electric power consumption for pumping. The power demand is typically about 400 kw per million gallons per day production capacity for low concentration feed water. This increase is about 600 kw per mgd for high concentration feed waters. The higher the recovery ratio, the less the energy required at per unit volume of production since less water is pressurized.

The major maintenance cost is the high pressure pump, which should be provided as multiple parallel pumps with standby capacity to improve plant availability. The high maintenance costs have been attributed to the high pressured corrosive fluids and entrained particulate matter.

Reverse osmosis plants have been used for several years to produce municipal water, many of them in Florida. Most of them are less than 1 mgd; however, in the City of Cape Coral, Florida, a 4.7

mgd plant went on line in March, 1977. It utilizes six reverse osmosis modules, each with 22 membranes and a 500,000 gallon per day capacity. The feed water carries approximately 1,250 ppm of total dissolved solids (TDS), while the product water contains less than 65 ppm. With an operating cost of 59 cents per thousand gallons and an allocation of 22 cents per thousand gallons to cover amortized capital costs, a total production cost of 81 cents per thousand gallons was obtained in late 1977 [6.14].

Four reverse osmosis pilot units have been tested on Oahu at the following locations: Mililani Sewage Treatment Plant, Wahiawa Sewage Treatment Plant, Well 82-2A (located on the Diamond Head side of the Neil Blaisdell Center Exhibition Hall), and Well 119 (located at Honolulu Gas Company in the Iwilei District near Honolulu Harbor). Raw sewage, primary effluent and final effluent from conventional sewage treatment plants, as well as brackish groundwater from both basaltic and reef limestone aquifers were then field tested at 600 psig operating pressure [6.15].

The operation on wastewaters suffered from the problem of performance decline. However, the operation with brackish water yielded promising results. The solute rejection was high and maintained almost unchanged throughout the test period.

Based on a cost model developed for estimating desalting costs by reverse osmosis plants with spiral-wound modules (one type of module), product water costs in Hawaii were estimated at 83.7 cents, 63.4 cents, and 49.7 cents per 1,000 gallons for 1, 10 and 50 mgd plants, respectively [6.16].

A 10 mgd reverse-osmosis plant treating water of the quality found in the Ewa plain can be built for about $8 million and operate at about $0.40 to $0.50 per 1,000 gallons [6.17]. Capital and operating costs of a like-sized electrodialysis plant are comparable. If Waiau and Waiawa springs were used as sources (with 1,000 TDS), a 10 mgd reverse osmosis plant could operate at about $0.25 to $0.30 per 1,000 gallons [6.18].

Table 6-1 gives a further comparison of these two demineralization methods. Neither has any clear advantage over the other and the final selection of one process may depend upon operational considerations.

The BWS is presently proposing a 1 mgd reverse osmosis pilot plant to be built in 1982. To be located at Hawaiian Electric Company property in Waiau, the plant would operate from two to three years. The Board would learn the true costs of constructing and operating a desalinization plant. The BWS has applied for federal funding and was selected as fifth of 37 applicants by the Office of Water Research and Technology.

If a large scale reverse osmosis plant or other costly alternative is used in future years, then the water rates will have to be restudied and may possibly increase.

C. SURFACE WATER [6.19]

In the past surface streams on Oahu have not been used for domestic sources due to the ready availability of reliable, high quality, groundwater sources. The diversion of the flow from Lulumahu Ditch in Nuuanu Valley into a modified slow sand filter is the single example of a surface water source presently in use. Raw water quality is excellent except during rainy periods.

The more typical surface stream will probably require more extensive treatment, including the usual purification processes consisting of coagulation, flocculation, sedimentation, filtration and chlorination. The desirable points of diversion typically occur far from existing distribution-transmission works and would require relatively large initial outlay of capital as well as continual treatment costs. Pumping costs will vary from case to case.

Two large windward streams, Kahana and Punaluu, present the best opportunities for surface water development. In both cases the streams largely represent the outflow of groundwater and thus present the

TABLE 6-1

COMPARISON OF DESALTING METHODS[1/]

Consideration	Electrodialysis (ED)	Reverse Osmosis (RD)
State of Demonstration	Up to 2 MGD, less than 10 years	Up to 4 MGD, less than 5 years
Design and Construction Period	1-2.5 years based on size	1-2.5 years based on size
Land Requirement	.4-4 acres	.7-6.8 acres
TDS Range	Low TDS	Greater than ED
Removal Capability	Limited to 50% per pass	Up to 99% per pass, removes organics
Sensitivity to Operating Conditions	High (voltage, pH, flow, concentration)	Low
Pretreatment	Med. requirement	Modest to extensive
Production Rate	Slight decrease with time	Decrease with time
Waste Disposal	Lesser problem	Lesser problem
Mechanical Problems	Some	Some
Corrosion	Very little	Very little
Scaling	May limit recovery	May limit recovery
Field Cleaning	Easy equipment disassembly	In-site chemical cleaning
Water Temperature	Ambient	Ambient
System Complexity	Medium	Low
System Pressure (leakage)	Low	High, leakage problem
Energy Demand	8,000 kwh/mgd, direct proportion to TDS	400 kwh/mgd, increases somewhat with TDS
O&M Cost	Least up to 4 mgd	1.2-1.6 times ED up to 4 mgd
Capital Cost	Least of all methods	1-1.5 time ED
Unit Water Cost	Low for low TDS	In range of ED

1/Based on low TDS and plant size of 0.5 to 20 mgd.

SOURCE: [6.10]

potential of groundwater development first. This potential in both cases should be thoroughly examined before resorting to surface water development because there are considerable economic and operational advantages to groundwater development. After all the groundwater potentials have been developed, the remaining stream flow can be developed via treatment plants.

A third possible surface source is the Kalauao Spring area in Aiea. It is the only one of the Pearl Harbor Springs that presently yields water that meets mineral quality standards for potable water, but needs purification to meet all other standards. The highly developed nature of surrounding land as well as the close proximity of two major highways are negative factors because of the potential for contamination beyond the capability of treatment processes. Flow varies from 10 to 15 mgd.

In addition to the above three potential major surface sources, there are a number of smaller streams in Central Oahu and Honolulu that have some potential. In central Oahu, Waialua Sugar Company is presently diverting Kaukonahua, Helemano, Poamoho and Opaeula Streams into its irrigation system. All of these streams have domestic water supply potential if given adequate treatment.

Kalihi, Nuuanu and Waiakeakua (Manoa) Streams in Honolulu have some potential for surface water development. The combined mean flows during June, 1973, was about 5.5 mgd. The option of combining the flows for centralized treatment must be weighed against high transmission costs in an urbanized setting. The straight line distance between Kalihi and Waiakeakua is on the order of 20,000 feet; however, the alternative of three separate treatment plants would cost more to operate.

Yield from surface sources can be substantially increased if large storage reservoirs are available to capture flood flows. However, local experience with reservoirs has not been good. The only successful reservoir is Lake Wilson in Wahiawa where local geology is favorable for water storage.

The more typical situation in stream valleys shows narrow elongated valley floors covered with relatively impervious strata with valley

sides exposing considerable bare bedrock. Large reservoirs in such a valley would probably hold water at shallow depths but would prove to be leaky as more of the valley sides were submerged.

Diversion of stream flows with minimal storage appears to be more economically feasible, but stream yields will not be large because flood flows must necessarily be passed through due to lack of storage. Also capture of flood flows will result in rapid silting of the reservoir and loss of storage.

D. DESALINIZATION OF SEA WATER

This alternative would use techniques similar to desalinization of brackish water, but utilizing feed water of higher salinity (15,000 to 20,000 ppm). Numerous studies have shown the cost of desalting sea water to be two to three times as much as desalting brackish waters [6.20]. Technical development of desalinization methods continues to improve and lower product water costs. However, rising energy costs and inflation tend to negate these gains. This source of domestic water will continue to be a viable choice, although an expensive one.

E. WASTEWATER RECLAMATION [6.21]

The direct reuse of reclaimed wastewater is at the far end of a scale of uses that includes industrial, aesthetic and agricultural applications. There has been an understandable reluctance to accept direct recycling of treated wastewater for human consumption in the past. Historically, there are two emergency instances where virtually direct reuse was practiced by the necessity for these two cases has long since passed. Direct reuse is presently practiced only at Windhoek, South Africa.

In all of the three above cited instances, dire necessity dictated the direct use, albeit with some dilution. The only alternative was to do without water. While wastewater would be used for irrigation, it is unlikely that direct reuse will occur since so many other alternatives are available.

F. BLENDING

Another technique which could be used here is that of blending water of high quality with water of lower quality. Water from the more brackish Pearl Harbor Springs could be blended with high quality water to meet domestic water quality standards.

G. INDIVIDUAL DEMINERALIZATION UNITS [6.22]

A final alternative is the use of compact desalting units for residential use. There would be some opportunity to use these in areas having only saline water sources. Each dwelling unit would purify only water needed for drinking and cooking. Sanitary uses would be met by the saline supply.

Some home desalting units are already in use, and a similar situation exists in Bermuda where many homes have catchment basins above their homes for fresh water, with brackish water supplying their other needs. It may be expected that such dual water supply systems will increase in use over the next 10 to 30 years.

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APPENDIX B

PRIORITY RECOMMENDATIONS OF THE STATE WATER COMMISSION

APPENDIX B

PRIORITY RECOMMENDATIONS OF THE STATE WATER COMMISSION[1]

1. Continue and intensify conservation programs undertaken by the County water departments and the military to stabilize or reduce per capita consumption of municipal water.

2. Control further development of ground water from the Pearl Harbor Basin and tributary sources by application of the Ground Water Use Act (Chapter 177, HRS). As an immediate interim measure, impose a moratorium on increase export of water from the Pearl Harbor Area.

3. To meet projected municipal water demands on Oahu, emphasize the development of new surface and ground water sources and alternative sources, together with research to improve development methods.

4. State and County Governments take into account the finite limitations of Oahu's water resources in establishing policies that influence the rate of population increase and related urban development

5. The State Legislature adopt a permit system to control the development and use of Hawaii's surface and ground water resources in order to prevent depletion and quality deterioration, and provide for an independent "Water Use Control Board" to administer the program.

6. The legislature authorize the formulation of a comprehensive water code by a designated agency to define explicitly water rights in Hawaii and to delineate the role of government in water management.

7. Accelerate and improve programs for gathering and utilizing information on water resources, including sustainable yields, water demands, water conservation opportunities, methods and costs of water development, and assessment of environmental impacts of development.

8. Upgrade municipal water services in rural communities to minimum delivery, quantity, and quality standards.

9. Provide irrigation water for diversified agriculture wherever practicable, and assure the continuing availability of water for agriculture in general.

10. Establish a comprehensive statewide program for minimum streamflow control to provide and protect water resources for ecological, aesthetic, and recreational uses.

11. Utilize the State functional plan on water resources (when formulated) to guide State funding of water programs and projects, considering State cost-sharing in and support of bond financing for County projects, coordination of federal funding of State and County programs and projects, promotion of conservation programs, and support of research programs by agencies benefitting from the results.

[1] SOURCE: State Water Commission. 1979. Hawaii's Water Resources: Directions for the Future. State Water Commission, Honolulu, Hawaii.

12. Balance the rate of urban development with the rate of municipal water development.

13. Optimize island-wide water development on Oahu, considering the island's full range of hydrologic potentials and limitations and reasonable costs.

14. Optimize island-wide water development on Maui, considering the island's full range of hydrologic potentials and limitations and reasonable costs.

APPENDIX C

EXCERPT FROM U.H. WATER RESOURCE RESEARCH
CENTER TECHNICAL REPORT NO. 77

APPENDIX C

Hydrology[1]

As explained in the section on climate, rainfall in Kahana is bountiful, ranging from an average of 60 in (152.4 cm) per year at the most seaward headlands to 300 in (762 cm) per year at the crest of the range. The average annual isohyets increase nonlinearly, msot probably exponentially, with distance from the sea toward the crest. Trade wind orography produces more of the total rain than does cyclonic circulation. The trade wind rainfall is characterized by showers, which although not as intense as cyclonic rain, occur more persistently throughout the entire year.

It is not certain that all of the unevaporated or untranspired rain that falls within the topographic limits of the drainage basin eventually finds a way to Kahana Bay; some infiltration may move as groundwater to the leeward of the crest, and another fraction may flow to Waikane Tunnel of the Waiahole System lying to the southeast of Kahana. In either case the quantity leaving the surface drainage limits of the basin would be small, probably within error of hydrologic budgeting. On the other hand, it is likely that groundwater drains to Kahana from Punaluu Valley in a significant amount.

SURFACE WATER. Kahana Stream is the largest stream on the windward side of Oahu. It originates in the dike complex and runs across the marginal dike zone, normal to its trend, before emptying into Kahana Bay. In dissecting the dike complex and marginal dike zone the stream acts as a drain for dike-impounded groundwater. As a result, it is a continually gaining stream from headwaters to mouth.

All of the stream and groundwater above the 800-foot elevation is collected in the transmission tunnel of Oahu Sugar Company's Waiahole Ditch system and removed from the valley. The 800-foot (243.84 m) contour is the approximate limit of the smoothly increasing gradient of the stream; above 800 ft (243.84 m), the headwaters consist of step-like cascades which flow only during rainy periods.

The deep position of Kahana Stream relative to the valleys to the north, in particular Punaluu Valley, enables it to capture a significant amount of the dike water that passes below the Punaluu channel. Relative to a base line along the coast, parallel to the dike trend, the comparable elevations of Kahana and Punaluu Streams approximates the expression:

[1]SOURCE: University of Hawaii, Water Resources Research Center, Technical Report No. 77, The Quality of Coastal Waters: Second Annual Progress Report.

$$H_k = .0062\ H_p^{1.635}$$

where H_k is the elevation of Kahana Stream and H_p the corresponding elevation of Punaluu Stream. For example, whereas the channel of Punaluu Stream is at the 400-foot elevation, the Kahana Stream elevation is only 110 ft. This relationship is most applicable in the mid-portion of each valley.

The fact that Kahana is a much deeper stream than Punaluu well into the dikes zones makes it a highly efficient drain of underflow from the Punaluu region. In much of the windward area there are two chief zones of natural dike water discharge. The higher occurs at elevations from about 600 to 800 ft (182.88 to 243.84 m), the upper limit of talus slopes, and represents overflow from dike compartments; the lower zone occurs at about 200 ft (60.96 m) and represents underflow from dike compartments where the relatively impermeable plaster of weathered talus is breached. While a significant portion of the groundwater component of Kahana Stream originates from the lower zone of dike discharge, a very large fraction of the base flow of Punaluu Stream comes from the higher zone.

Continuous measurements of surface flow in Kahana have been made since 1958 at USGS gage 16296500 located at elevation 30 ft (9.14 m) about 6000 ft (1828.8 m) from Kahana Bay. The Honolulu Board of Water Supply has made numerous measurements of stream flow at the 115- and 145-foot (35.052 and 44.196 m) elevations from 1958 through 1962 and at other elevations in 1927-28. In reporting on the suitability of Kahana for groundwater development, Mink (1964) summarized all flow measurements calculated as the 90 percentile flow, the minimum flow expectable 90 percent of the time. The 90 percent flow (Q_{90}) was selected as the standard of comparison because it indicates the average base flow of the stream free of storm runoff. Table 2.1 is taken from Mink's 1964 report.

Table 2.1 clearly indicates the increase in base flow of Kahana Stream as elevation decreases. Using the USGS gage as the standard, ratios and absolute values of Q_{90} for drainage areas above given elevations are listed as are the changes that take place between the given elevations. The greatest gain in flow occurs between 300 and 115 ft (91.44 and 35.05 m), where, over a drop in elevation of 185 ft (56.398 m), 52 percent of the Q_{90} at the gage is accumulated.

Kawa Stream adds a Q_{90} of 1.6 mgd (6056 m^3/day) to the mainstream below the USGS gage, but between the confluence and the bay less than 1 mgd (3785 m^3/day) is added to base flow because the deep sediments of the lower valley retard discharge of groundwater into the stream.

Figure 2.3 is a flow-duration curve for Kahana Stream at the USGS gage station (Mink 1964). Although it is based on fewer measurements than now available, its general form and statistical parameters are likely to closely approximate a curve based on the longer period of record. The average flow at the gage for the period of measurement through 1971 is 24.8 mgd (93,868 m^3/day).

FLOODS. Earlier it was pointed out that the highest instantaneous flows

TABLE 2.1. SUMMARY OF THE 90 PERCENTILE (Q_{90}) STREAM FLOW OF KAHANA STREAM.

ELEVATION[a] (ft)	AVERAGE RATIO OF FLOW AT GAGE[b]	RATIO DIFFERENCE BETWEEN POINTS	Q_{90}[c] (mgd)	FLOW BETWEEN POINTS (mgd)	NUMBER OF MEASUREMENTS[d]	REMARKS
30	1		9.50		DAILY	USGS GAGE 2965.
		.15		1.42		
115	.85		8.08		43	
		.10		.95		
145	.75		7.13		45	
		.10		.95		
180	.65		6.18		1	
		.15		1.42		
220	.50		4.75		2	
		.08		.76		
270	.42		4.00		10	
		.09		.85		
300	.33		3.15		6	SIX MEASUREMENTS EACH ON RIGHT AND LEFT BRANCHES.
		.17		1.62		
420	.16		1.53		1	ONE MEASUREMENT EACH ON RIGHT AND LEFT BRANCHES.
		.11		1.05		
570	.05		.48		1	ONE MEASUREMENT EACH ON RIGHT AND LEFT BRANCHES.
		.05		.48		
800[e]	0		0			UPPER LIMIT OF WATER SOURCE.
MISCELLANEOUS						
15	1.2		11.40			KAWA STREAM CONTRIBUTES 1.6 mgd. LOWER KAHANA 0.3 mgd.
30 (KAWA)	.17		1.60		15	KAWA (OR EAST KAHANA) STREAM.

SOURCE: MINK 1964.

[a] FROM USGS MAPS OR ALTIMETER READINGS, EXCEPT AT USGS GAGE STATION.
[b] RATIOS WERE COMPUTED FOR EACH MEASUREMENT, THEN AVERAGED. BWS MEASUREMENTS AT THE GAGE STATION WERE USED WHERE POSSIBLE.
[c] Q_{90} AT EACH POINT OBTAINED BY TAKING Q_{90} AT THE GAGE STATION (9.5 mgd) TIMES THE AVERAGE RATIO AT THE POINT.
[d] ALL MEASUREMENTS AT 115 AND 145 FEET HAVE BEEN TAKEN SINCE 9/1/60 BY THE BWS. MEASUREMENTS AT 570, 420, AND 300 FEET TAKEN BY THE BWS IN 1927-28. AT 270 FEET, FOUR MEASUREMENTS TAKEN BY THE USGS SINCE 1960, AND SIX OBTAINED BY BWS IN 1927-28. MEASUREMENTS AT 220 AND 180 FEET TAKEN BY THE USGS SINCE 1960.
[e] ALL WATER ABOVE 800 FEET IS DIVERTED TO THE WAIAHOLE WATER SYSTEM. AVERAGE FLOW FOR KAHANA PORTION IS 6.9 mgd.

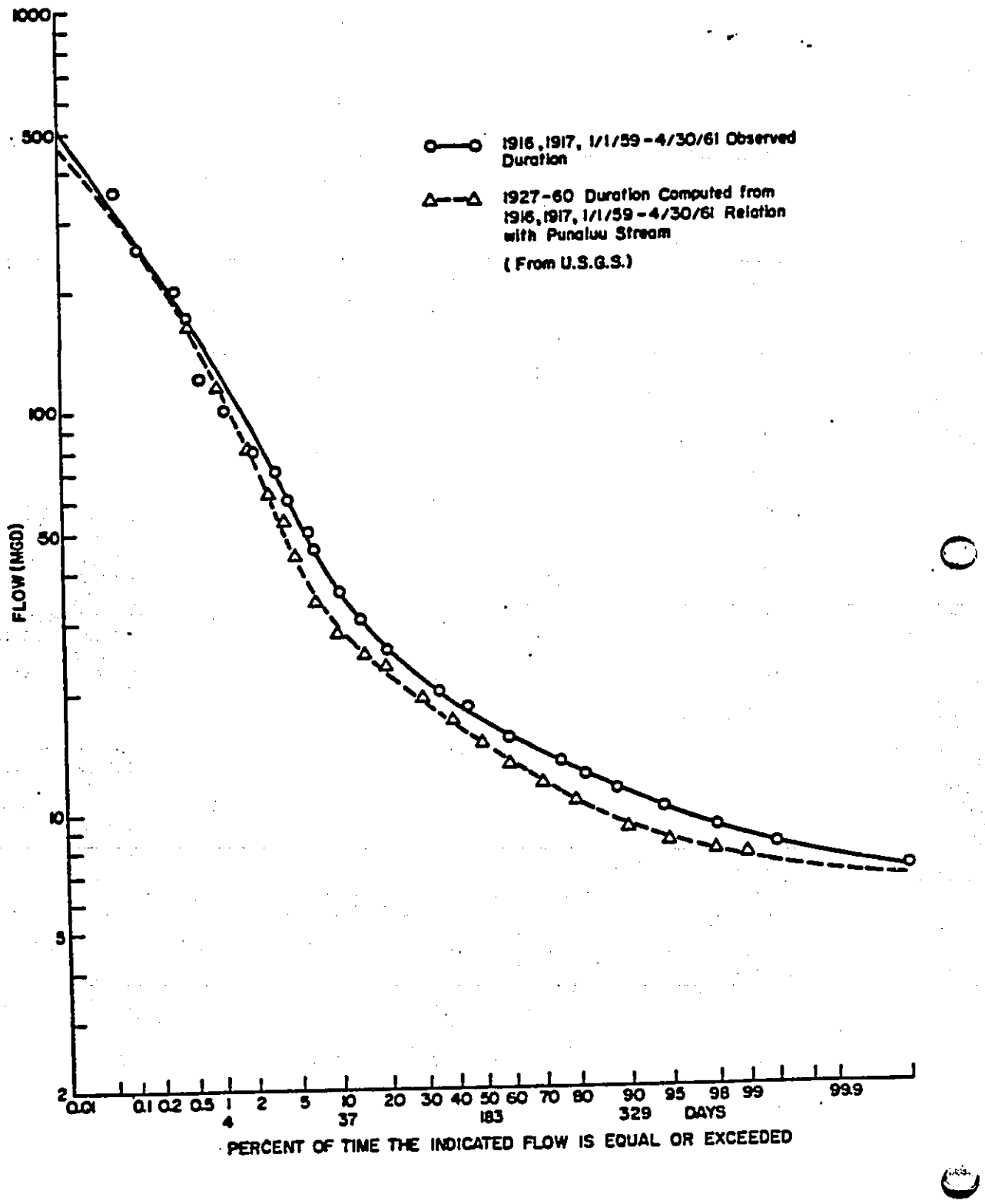


FIGURE 2.3. FLOW DURATION CURVE OF KAHANA STREAM, 30-FOOT ELEVATION.

(floods) in Kahana most often occur in the months of April and May, the period of transition as the anticylcone northeast of the archipelago moves toward its stable summer position. However, storms giving rise to floods may occur anytime throughout the year. Maximum instantaneous flows measured at the USGS gage for the period 1960-1971 are given in Table 2.2 (Nakahara and Ewart 1972).

TABLE 2.2. MAXIMUM FLOWS USGS GAGE 16296500, KAHANA ELEVATION 30 FEET.

WATER YEAR	DATE	FLOW (cfs)(mgd)
1960	05/12	1580 (1021)
1961	10/17	1810 (1170)
1962	11/01	3510 (2269)
1963	04/15	5430 (3510)
1964	07/25	3060 (1978)
1965	02/04	4120 (2663)
1966	11/14	3110 (2010)
1967	08/09	3780 (2443)
1968	12/08	4180 (2702)
1969	12/01	4620 (2986)
1970	01/27	2950 (1907)
1971	11/25	3780 (2443)

It is noteworthy that only the months of February, June, and September do not record the maximum for any year.

From the data in Table 2.2 the probable recurrence interval of floods of given magnitudes may be computed by using the relationship

$$T = \frac{N + 1}{M}$$

where T equals recurrence interval in years; N equals number of years of record; M equals relative flood magnitude, obtained by assigning the highest annual flow a value of 1 and numbering serially the others in order of magnitude. By plotting the log of each flood magnitude against the log of its computed recurrence interval and drawing a line of fit, flood frequencies may be estimated beyond the period of record (Fig. 2.4).

Another way of estimating flood frequencies is by use of the log-Pearson Type III method. Data and computations for Kahana using this method are given in Table 2.3 (from Progress Report 36, State of Hawaii Department of Land and Natural Resources), and are also plotted on Figure 2.3.

The two methods agree reasonably well within the data limits but diverge appreciably for times beyond 10 years. The expected 100-year flood by the first method is 10,000 cfs (17,000 m^3/min), but only 6211 cfs (10,588.7 m^3/min) by the log-Pearson II method.

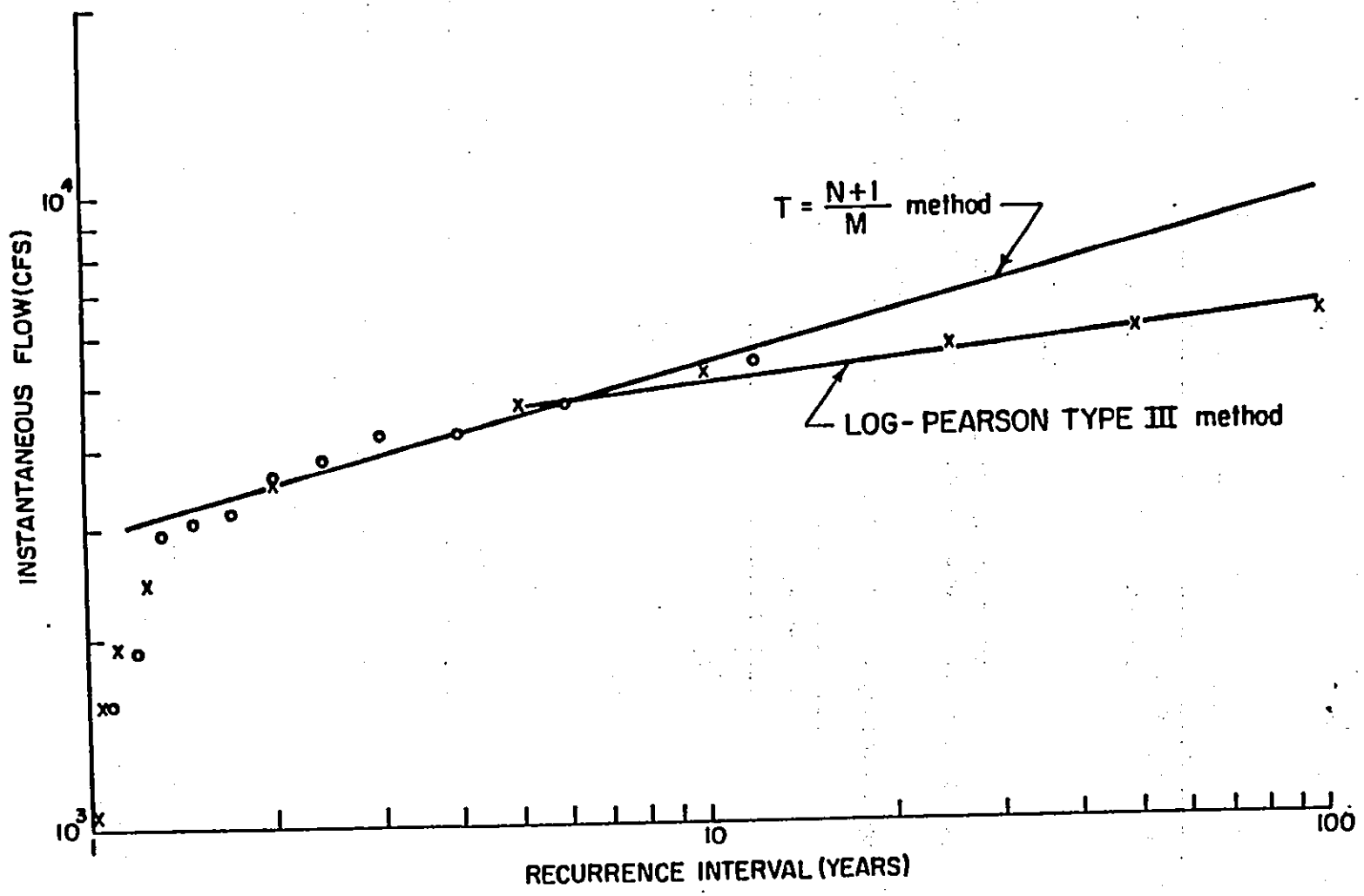


FIGURE 2.4. PROBABLE FLOOD FREQUENCIES OF KAHANA STREAM, GAGE STATION 16296500.

TABLE 2.3. FLOOD FREQUENCIES KAHANA STREAM: LOG-PEARSON TYPE III METHOD.

EXCEEDENCE PROBABILITY	RECURRENCE INTERVAL, yrs	MAGNITUDE cfs	(mgd)
.9900	1.01	1006	(650)
.9500	1.01	1578	(1020)
.9000	1.11	1948	(1259)
.8000	1.25	2450	(1584)
.5000	2.00	3524	(2278)
.2000	5.00	4627	(2991)
.1000	10.00	5164	(3338)
.0400	25.00	5680	(3872)
.0200	50.00	5975	(3862)
.0100	100.00	6211	(4015)
.0050	200.00	6404	(4140)

SOURCE: DEPARTMENT OF LAND & NATURAL RESOURCES PROGRESS REPORT 36, 1970.

It is somewhat surprising that the maximum recorded flood in Kahana on a unit area basis, 1452 cfs/sq mi (953.964 $m^3/min/km^2$), is less than for Waikane, 4000 cfs/sq mi (2628.0 $m^3/min/km^2$), where the average annual rainfall is much smaller. Even the projected 100 yr flood in Kahana would be less on an areal comparison than the maximum flood already recorded in Waikane.

Wu (1967) suggested a formula for the 100-year flood in windward Oahu based on watershed area, stream length, watershed height, and probable 100-year maximum 24-hour rain. When applied to Kahana, however, the computed value is 29,050 cfs (49,385.0 m^3/min), which is considerably in excess of predictions made by standard methods.

GROUNDWATER. All of the groundwater in Kahana Valley occurs within the dike zones. Near the coast local Ghyben-Herzberg conditions probably occur within the marginal dike zone.

Dike water refers to groundwater occurring in aquifers bounded by dikes. The confining dikes may range from being nearly completely impermeable to being quite leaky. Normally the dikes effectively restrain the movement of water through them until a head builds up that forces flow through natural openings such as fractures. The rate of flow through these openings may be too low, however, to drain all of the water moving through the compartment, in which case the water level increases until it overflows the compartment which has been truncated by erosion. The compartment is used in the sense of a prism of flow rocks bounded laterally by parallel dikes but open at either end. Water moves preferentially along the trend of the dikes. Under natural conditions an average steady state prevails in which water moving through a given unit cross-section between dikes is balanced by the quantities that overflow the section, pass through the restraining dikes, and continue down the trend.

Dike water is subdivided into that which occurs within the dike complex and that in the marginal dike zone. The groundwater of the dike complex is restrained in permeable flow rock intersected by many dikes, causing innumerable small aquifers. In the marginal dike zone the aquifers between dikes are relatively large but well-bound.

Both the dike complex and the marginal dike zone carry large quantities of groundwater. Above the 800-foot (243.84 m) elevation, which lies in the dike complex, all of the water passes into the Waiahole system. Of the average 6.9 mgd (26,116.5 m^3/day) that leaves the valley via the transmission tunnel, 3.8 mgd (14,383.0 m^3/day) is groundwater from the development tunnel.

The dike complex extends from the crest of the range down to about the 270-foot (82.296 m) elevation in the mid-valley. Between elevations 800 and 270 ft (243.84 and 82.30 m), the dike compartments are saturated but a plaster of talus and alluvium in conjunction with many intersecting dikes prevents easy discharge into the streams. Small swamps are common on flat areas between streams because the water table is at the surface. From this part of the dike complex the Q_{90}, which may be considered the groundwater component of stream flow, is about 4 mgd (15,140 m^3/day).

The rocks of the marginal dike zone are saturated with water, some of which does not discharge into Kahana Stream but leaves the area as underflow either into the caprock sediments or the sea. The upper portion of the zone between the 30- and 270-foot (9.144 and 82.296 m) elevation contribute about 5.5 mgd (20,817.5 m^3/day) to Q_{90} at the USGS gage. Kawa Stream is almost entirely in the marginal zone.

Below the approximate 30-foot elevation, the stream flows over marine-deltaic caprock sediments and no longer drains the marginal dike zone. The underlying dike compartments are saturated and leak into the caprock and the sea. Continuity with the sea exists and therefore a small Ghyben-Herzberg lens occurs along the coast within the marginal dike zone. Active springs of the shoreline show chlorides of up to 100 ppm, while the range in a well (405) drilled through the caprock into the basalt varies from 30 to 50 ppm.

Hydrologic Budget

A gross water budget for Kahana Valley is given by Takasaki et al. (1969), but for computations of mass output of dissolved solids and of sediments to the bay a more refined hydrologic analysis had to be made for this study. Hydrologic budgeting is based on averages over reasonably long periods and balances input of water against output, assuming no change in either ground- or surface water storage over the averaging period. In Kahana Valley limited measurements of the input variable, rainfall, and good measurements of an output variable, surface flow, are available. Rainfall has been recorded at the 800-foot (243.84 m) elevation for more than 40 years and occasionally near the seacoast. Continuous surface water measurements have been made at the USGS gage at the 30-foot (9.144 m) elevation since 1958 and at the Kahana Tunnel at 800 ft (243.84 m) since 1929. Many miscellaneous stream flow measurements have also been made in the valley; the first on record was in 1911 (Lippincott 1911). All of the other variables in the hydrologic equation, as well as much of the rainfall and flow volumes,

have had to be inferred.

The topographic and hydrologic boundaries of Kahana Valley do not coincide; groundwater moves into the valley chiefly from Punaluu and flows from the upper valley to the leeward side of the Koolau Range and probably also to Waikane Valley. The input-output equation for the drainage basin is:

$$P + U_i = ET + D + I + U_o$$

in which P is rainfall over the basin, U_i is underflow into the valley from outside the surface drainage boundaries, ET is evapotranspiration, D is direct runoff, I is infiltration, and U_o is underflow from the valley. At the mouth of the valley the total surface water flow, S, is composed as follows:

$$S = aD + bU_i + cI$$

where a, b, and c are fractions. Not all of D discharges to the sea because a portion is diverted to the Waiahole system. Groundwater flow to the bay consists of fractions of U_i and I.

Because of the water development project at the head of the valley and the location of the USGS continuous flow measurement station relatively close to the inland edge of the estuarine portion of the stream, for hydrologic budget purposes the valley can be conveniently divided into four major units and a minor one, which consists of headlands draining directly to the bay. The major units are:

1) The Upper Valley, bounded by the Waiahole transmission tunnel running along the 800-foot (243.84 m) contour elevation and the crest of the range, totalling 0.86 sq mi (2.227 km^2). All of the surface water, except during periods of heavy flooding, flows to the transmission tunnel; most of the groundwater drains to Kahana Tunnel but some also moves to the leeward side of the Koolaus and some to Waikane Valley. Flows have been diverted from this part of Kahana since 1916.

2) The Mid Valley, consisting of 2.88 sq mi (7.459 km^2) and extending from the 30-foot elevation (9.144 m) to 800 ft (243.84 m) as measured in the stream channel.

3) The Kawa Stream Valley, with an area of 1.9 sq mi (4.921 km^2) and an elevation range from 25 ft to 2265 ft (7.62 to 690.372 m). Kawa meets the main Kahana Stream a short distance below the USGS gage. Numerous miscellaneous stream flow measurements have been made at the mouth of Kawa Stream.

4) The Lower Valley, comprising 2.41 sq mi (6.242 km^2) including Kahana Stream between the bay and the Kawa-Kahana confluence. This sector includes the estuary and the stream underlaid by sediments which thicken toward the coast. Stream flow measurements are extremely difficult to make in the estuary, although a few miscellaneous measurements are available.

The headlands that drain directly into the bay have a total area of 0.33 sq mi (0.8547 km^2). They contribute surface runoff and groundwater flow from small Ghyben-Herzberg lenses into the bay.

Figure 2.5 is a flow diagram of the budget components for each sector showing the relationships among the sectors and to the ultimate flows to Kahana Bay. In computing the components measured quantities were used where available, and elsewhere inferred values based on hydrologic analogies were employed. All components are given in mgd (million gallons per day).

Rainfall was computed from an isohyetal map (Board of Water Supply 1963, p. 25). Evapotranspiration was derived from the relationship given by Takasaki et al. (1969, p. 22), in which pan evaporation is indicated as decreasing nonlinearly with rainfall. Evapotranspiration is assumed equal to pan evaporation, a relationship established for sugarcane where adequate water is available to meet potential requirements of the cane. The rainfall throughout Kahana is considered high enough to provide sufficient moisture to satisfy potential evapotranspiration demands. In the Upper Valley direct runoff and groundwater flow have been continuously recorded in the transmission tunnel for more than five decades.

For the Mid Valley total runoff is recorded on a USGS gage. Groundwater flow into the valley from outside its topographic boundaries was computed as the difference between the sum of the total runoff and evapotranspiration, and the total rainfall. The miscellaneous stream measurements in Kawa Valley and the Lower Valley were correlated with the longer record at the Kahana station to yield estimates of flow. For the areas directly tributary to the bay, groundwater flow was approximated from the Darcy equation, assuming a head of 5 ft (1.524 m) and a hydraulic conductivity of 1000 ft/day (304.8 m/day).

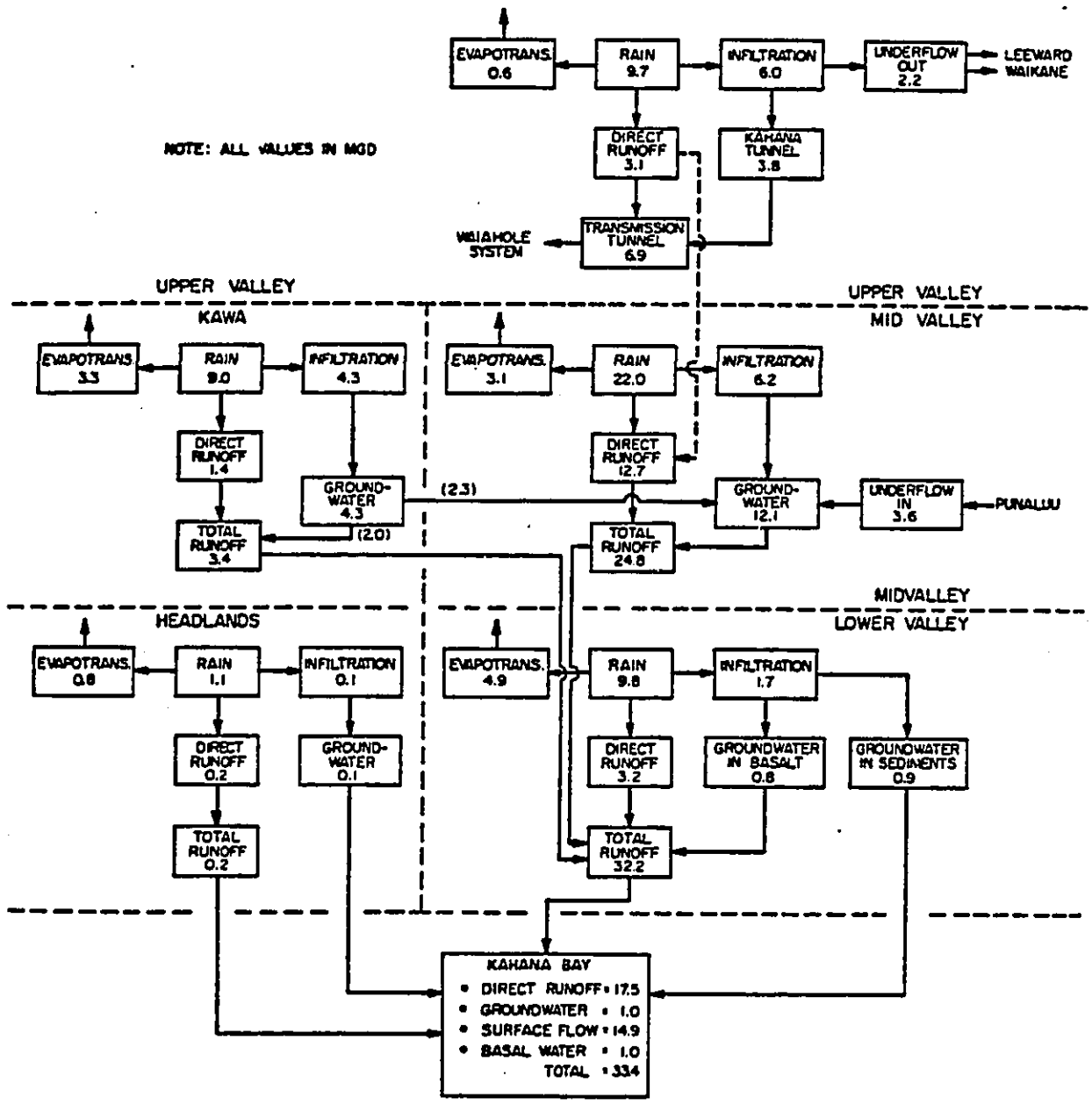


FIGURE 2.5. HYDROLOGIC BUDGET OF KAHANA VALLEY, OAHU.

APPENDIX D

PRIORITY RECOMMENDATIONS OF THE HAWAII WATER RESOURCES PLAN

APPENDIX D

29. PRIORITY RECOMMENDATIONS [1]

Prior chapters present 105 recommendations, assembled in Chapter 30. From among these recommendations, 38 selected as deserving priority implementation are presented in this chapter.

The selection has been influenced by U.S. Water Resources Council *Principles and Standards*, legislative expressions of public policy, state and county administrative goals, agency missions, and particularly by citizen response at public meetings held during the course of the study.

Also, the selection attempts to provide representative coverage of the broad spectrum of water and related land resources needs, problems, and opportunities, both from a functional viewpoint and a balanced economic/environmental perspective.

REC. NO.	RECOMMENDATIONS & SPECIFIC ACTIONS	AGENCIES	ESTIMATED COST ($1,000)	TIME FRAME 1975-1990	TIME FRAME 1990-2000
7-1	Express decisive public policy on rights to surface water use by legislative codification with due regard for: • General public welfare. • Vested private rights challenged by the Hanapepe decision. • Impact upon existing irrigation and domestic water systems dependent upon transfer of water from one watershed to another. • Impact upon agricultural production, urban requirements, and the economy. • Environmental impact, including effect on minimum streamflow requirements.	*Legislature DPED DLNR DOH DOA OEQC WRRC			
7-4	Enact legislation to codify rights to reasonable use of ground water resources.	*Legislature DLNR			
7-5	Establish rules and regulations for implementing the Ground Water Use Act (H.R.S., Chapter 177).	*DLNR			
7-6	Improve laws and regulations to reflect the substantial interrelation between ground water and surface water sources.	*Legislature DLNR			
7-7	Consider legislation to grant appropriate administrative authority for comprehensive and coordinated management of all surface and ground water resources on each island.	*Legislature DLNR DOH			
7-8	Consider legislation to grant express administrative authority to allocate water resources among competing uses.	*Legislature DLNR			
10-2	Develop alternative water sources to supply Oahu in addition to planned development from conventional ground water sources. • Restore dike storage. • Optimize development of Honolulu and Pearl Harbor aquifers. • Increase streamflow diversions compatibly with minimum streamflow requirements.	*BWS DLNR USGS WRRC DOH EPA	32,000	x	x

* Lead agency.

[1] SOURCE: Hawaii Water Resources Plan, Hawaii Water Resources Regional Study, 1979.

REC. NO.	RECOMMENDATIONS & SPECIFIC ACTIONS	AGENCIES	ESTIMATED COST ($1,000)	TIME FRAME 1975-1990	TIME FRAME 1990-2000
	• Recycle wastewater and exchange for high quality irrigation water. • Blend potable water with brackish water for a usable domestic product. • Desalt brackish water supplies for domestic use.				
10-3	Intensify water conservation programs to improve efficiency of domestic water use. • Set water rates to discourage excessive use. • Institute rigorous water system leak control programs. • Amend plumbing codes to require the installation of water-saving fixtures and appliances. • Institute a continuous community awareness program to encourage wise water use. • Operate water systems on sequential use schedules to make optimum use of storage and pipeline capacities. • Discourage urban development in areas where overdraft of ground water supplies is threatened or already exists.	*BWS/DWS Military Private	6,500	x	x
10-5	Improve domestic water systems to insure that water quality meets minimum standards of the Safe Drinking Water Act of 1975. • Obtain federal and state assistance for construction. • Conduct research on the chemical and biological quality of surface water in watersheds. • Construct water treatment plants for systems utilizing surface water sources. • Where feasible, convert systems from surface water to ground water sources. • Prevent pollution of existing sources by controlling land use in watersheds, waste injection, and overdraft of basal sources. • Initiate water quality monitoring and control.	*BWS/DWS DOH EPA DLNR USGS Private	86,000	x	x
10-6	Improve rural domestic water systems to deliver a dependable supply in adequate quantities and at sufficient pressures for droughts and fire-fighting. • Provide county water departments with legal authority to acquire control of surface and ground water sources for each system. • Develop sources by stages to meet year 2000 demands. • Replace deteriorated pipelines and storage tanks and provide additional storage. • Design systems to meet average and peak demands at adequate pressures. • Include adequate fire-fighting capabilities in system design.	*BWS/DWS DLNR DOH EDA FmHA Private	20,000	x	x

REC. NO.	RECOMMENDATIONS & SPECIFIC ACTIONS	AGENCIES	ESTIMATED COST ($1,000)	TIME FRAME 1975-1990	TIME FRAME 1990-2000
11-1	Reuse treated sewage effluent water for beneficial purposes. • Locate new treatment plants near agricultural operations. • Encourage agricultural operations to locate near existing sewage treatment plants where feasible. • Use effluent water for industrial cooling or processing. • Apply treated effluent to forest watersheds where compatible. • Design waste treatment and reuse as part of a single system to irrigate golf courses, lawns, or other open space.	*DPW/BWS/DWS DOH DOA EPA DLNR Private	7,000	x	x
11-2	Consider integration of domestic water supply and wastewater management functions at both state and county levels.	*DLNR/DOH *BWS/DPW			
12-1	Reduce the loss of life and property damage caused by storm flooding. • Provide non-structural measures such as regulation of flood plain use, zoning, building codes, and flood insurance. • Provide structural measures such as dams, lined channels, and flood proofing where non-structural measures are inadequate. • Improve flood peak records, flood mapping, and damage surveys.	*CE SCS HUD SWCD DLNR DPW USGS	150,650	x	x
12-2	Reduce the loss of life and property damage caused by tsunami and high surf. • Provide non-structural measures such as regulation of flood plain use, zoning, building codes and flood insurance. • Control coastal development in areas most subject to tsunami and high surf.	*PD DPED CZM FA			
13-1	Improve access to public shoreline and inland recreation areas. • Acquire or lease public rights-of-way. • Provide adequate patrolling and litter control.	*PR DPW DLNR BOR	5,500	x	
14-1	Use more efficient irrigation methods. • Convert to drip or sprinkler irrigation where feasible. • Reduce storage and transmission losses.	*Private DOA DLNR SWCD SCS	16,000	x	x
14-2	Provide additional irrigation water. • Improve diversion, storage, and transmission systems. • Develop more surface and ground water, compatible with environmental and recreational needs. • Determine the level of treatment necessary to reuse domestic wastewater for sugarcane irrigation.	*DLNR WRRC DOA BWS DPW SCS Private	47,000	x	x

REC. NO.	RECOMMENDATIONS & SPECIFIC ACTIONS	AGENCIES	ESTIMATED COST ($1,000)	TIME FRAME 1975-1990	TIME FRAME 1990-2000
	• Study the reuse of treated domestic wastewater for irrigating diversified crops and timber.				
	• Develop systems to reuse treated domestic wastewater as a new source of irrigation water supply.				
15-2	Increase commercial forest production from selected watersheds, at the same time preventing threat to native forests.	*DLNR DPED USFS Private	12,100	x	x
	• Complete inventory of timber and wildlife resources in watershed lands.				
	• Develop harvesting methods and equipment for Hawaiian conditions.				
	• Improve road networks and marketing systems.				
	• Develop markets for underutilized species and uses for waste products.				
	• Identify and locate unique ecosystems and wildlife resources to avoid incompatible commercial use.				
15-3	Reduce erosion of inland areas.	*SWCD SCS DLNR USGS Private	75,550	x	
	• Apply land treatment practices to cropland and pastures, such as contouring, improved vegetative cover, and strip cropping; and use structural measures such as terraces, drop structures, and check dams in gullies.				
	• Enforce erosion control ordinances on new construction.				
	• Enact and enforce ordinances to control feral game and introduced game species in areas of severe erosion.				
	• Improve programs for revegetating eroded areas such as road cuts, abandoned fields and pastures, and military practice areas.				
	• Study effectiveness of various erosion control measures.				
	• Gather data on erosion and sedimentation rates for various soils and land uses.				
	• Determine relationships between hydrologic properties of soils and storm drainage design.				
	• Determine relationships between soil erosion and sediment yield (delivery rates) for Hawaiian watersheds.				
16-3	Encourage aquaculture as an industry of potential major importance to Hawaii.	*DLNR DOA OMAC UH Private	28,000	x	x
	• Continue government support of aquaculture at a high level, including loans and tax incentives.				
	• Stock and protect selected streams, bays, and fishponds with fish and shellfish where compatible, giving preference to native species.				
	• Refurbish and utilize selected Hawaiian fishponds.				

REC. NO.	RECOMMENDATIONS & SPECIFIC ACTIONS	AGENCIES	ESTIMATED COST ($1,000)	TIME FRAME 1975-1990	TIME FRAME 1990-2000
16-4	Safeguard the commercial fishing potential of the Northwestern Hawaiian Islands. • Complete study to evaluate commercial fishing potential prior to designation as a wilderness area. • Provide the capability for additional wildlife protection and regulation.	*DLNR NOAA CG FWS	700	x	
16-5	Identify and develop opportunities for Hawaii's fishing industry within the 200-mile fishery conservation zone established under PL 94-265. • Assess the probable impact of the new law on the foreign and domestic fishing industries. • Implement an effective management program to maximize advantages to Hawaii's fishing industry.	*NOAA DLNR DPED DOT OMAC	100	x	
17-3	Establish an appropriate continuing role for Hawaii in the mining and processing of manganese deposits. • Assess the environmental and economic impact on Hawaii of participation at various levels. • Plan the allocation of resources to support an appropriate level of participation. • Continue technical and logistic support. • Pursue the establishment of archipelago status under international law.	*DPED OMAC DLNR DOT NOAA BLM Private	300	x	x
18-2	Improve inter-island marine transportation services. • Develop data on comparative demand for all marine transportation systems. • Continue to investigate methods of improving the surface transportation links between the islands for cargo, vehicles, and people. • Determine environmental and economic impacts of a marine highway system.	*DOT FMA FHWA Private	500	x	x
19-2	Develop geothermal energy as a major power source on Hawaii and investigate potential as a supplemental source on Maui and Oahu. • Accelerate geothermal source development on Hawaii. • Conduct geophysical surveys of potential geothermal areas on Maui and Oahu.	*HIG DLNR DPED DOE Private	20,000	x	
20-1	Control salt water intrusion into basal fresh water aquifers. • Design and space new wells and regulate pumping schedules of all wells to prevent excessive thinning of fresh water lenses. • Increase fresh water recharge to basal aquifers. • Determine long-term effects of periodic over-draft on ground water quality.	*DLNR DOH BWS/DWS WRRC USGS Private	10,500	x	x

REC. NO.	RECOMMENDATIONS & SPECIFIC ACTIONS	AGENCIES	ESTIMATED COST ($1,000)	TIME FRAME 1975-1990	TIME FRAME 1990-2000
20-2	Regulate subsurface injection of wastewater to prevent contamination of basal fresh water aquifers and wetlands. • Strengthen design, licensing, and monitoring requirements for effluent injection wells, including treatment of injected wastes. • Allow wastewater injection only into confined saline aquifers. • Compile data on location and extent of underground wastewater disposal. • Conduct research on effects of underground waste disposal on ground water quality and on wetlands.	*DOH EPA DPW DLNR BWS/DWS USGS WRRC	100	x	
20-5	Reduce non-point source pollution of streams and coastal waters. • Develop coordinated programs within each county to improve control over non-point source pollutants. • Minimize erosion and floods by limiting soil-disturbing activities in urban areas and watersheds. • Maintain sanitary conditions in streams and drains by litter controls, street sweeping, and control of open storage in industrial and commercial areas. • Implement improved soil conservation practices on croplands and grazing lands. • Reclaim severely eroded areas. • Increase controlled hunting of pigs and grazing animals in kapu watersheds to reduce pollution of surface water. • Gather date on pollutant loads in urban runoff.	*DOH DPW EPA SWCD SCS DLNR	161,600	x	x
21-4	Preserve and enhance wetlands, shorelines, and submerged lands. • Ensure adequate water circulation in bays, estuaries, and wetlands by careful maintenance of channels and adequate streamflow levels. • Protect wetlands and submerged lands from excessive sedimentation and erosion. • Identify and protect wetlands of prime value as wildlife habitat.	*DLNR PD DOH	58,000	x	x
22-1	Preserve rare and endangered animals and plants. • Refine endangered species lists. • Improve delineation of critical habitat areas. • Improve data on fish and game species and habitat characteristics. • Establish natural area reserves where rare and endangered plants and animals are a significant part of the ecosystem.	*DLNR NARC FWS	22,500	x	x

REC. NO.	RECOMMENDATIONS & SPECIFIC ACTIONS	AGENCIES	ESTIMATED COST ($1,000)	TIME FRAME 1975-1990	TIME FRAME 1990-2000
	• Establish wildlife and plant sanctuaries in critical areas.				
	• Manage native forests to protect and preserve rare and endangered species.				
	• Create new habitat as part of water development and storage projects.				
22-2	Preserve unique coastal and terrestrial ecosystems.	*DLNR NARC DPED FWS DOH DPW	18,060	x	
	• Define and locate native ecosystems.				
	• Identify and protect unique natural ecosystems under the Natural Area Reserve or Marine Life Conservation District programs.				
	• Establish buffer zones around unique natural ecosystems to minimize potential harmful impacts.				
	• Study stream habitat changes and ecological affects of water control and development.				
	• Establish criteria for maintaining minimum flows in streams and preserving wetlands and nearshore areas.				
	• Maintain low flow in perennial streams where possible to protect relatively undisturbed ecosystems.				
	• Develop methodology for monitoring gradual adverse effects on coral reef ecosystems.				
	• Protect coastal ecosystems from excessive fresh water flood flows.				
	• Determine impacts of power generation on terrestrial and coastal water resources.				
24-3	Protect the beauty of waterfalls and other scenic water resources.	*LUC DLNR DGP OEQC	30	x	
	• Preserve visual access to scenic water resources.				
	• Acquire water rights to maintain adequate streamflow and water levels.				
	• Prevent unsightly and damaging encroachments on scenic water areas.				
	• Catalog pertinent on-site and off-site aesthetic values.				
	• Develop methods for quantifying relative values.				
25-4	Establish a central water resources data referral center to carry out the following functions:	*DLNR USGS DOH BWS/DWS Private			
	• Periodically publish an updated catalog of water related data sources.				
	• Identify gaps in the present water data base.				
	• Identify long-term basic data requirements to support water resources planning and decision making.				
	• Work with agencies concerned to make general data collection more useful for water resources planning and management.				

REC. NO.	RECOMMENDATIONS & SPECIFIC ACTIONS	AGENCIES	ESTIMATED COST ($1,000)	TIME FRAME 1975-1990	TIME FRAME 1990-2000
	• Participate in national data exchange programs as soon as feasible.				
27-1	Accelerate implementation of the National Water Assessment and Appraisal Program to establish priorities for federal funding of water and related land resources programs and projects.	*WRC DLNR DPED			
27-2	Use the Hawaii Water Resources Plan to guide authorization and appropriation of federal funds for water related agency programs and projects undertaken in the Hawaii Region.	*WRC			
27-3	Extend application of U.S. Water Resources Council's Principles and Standards for Planning Water and Related Land Resources to all federal agencies having substantial water and related land resources programs.	*WRC			
27-5	Establish a permanent water planning committee with membership from federal, state, county, and private agencies having substantial water resources programs in Hawaii (see Chapter 28) to carry out the following functions: • Implement and update the Hawaii Water Resources Plan within existing authorities, agency capabilities, and funding arrangements. • Serve as a planning and coordination group. • Recommend Hawaii's priorities for national planning and appraisal programs in the light of changing circumstances.	*WRC Governor Mayors			
27-8	Coordinate public meetings and establish formal, continuing community citizen groups on all islands for orderly public participation in all government programs.	*HWRIC			

APPENDIX E

LIST OF NECESSARY PERMITS AND APPROVALS

APPENDIX E

LIST OF NECESSARY PERMITS AND APPROVALS

1. City and County of Honolulu

   Special Management Area Permit
   Building Permit
   Grading Permit
   Grubbing Permit
   Stockpiling Permit

2. State of Hawaii

   Conservation District Land Use Permit (DLNR)
   Easements (DLNR)
   Noise Permit (DOH)
   State Coastal Zone Management Certification (DPED)

APPENDIX F

ORGANIZATIONS AND PERSONS CONSULTED

APPENDIX F

ORGANIZATIONS AND PERSONS CONSULTED

Hui O Kanani O Kahana
Kaawa Community Association
Koolauloa Neighborhood Board
Life of the Land*
Hawaiian Electric Company
University of Hawaii Environmental Center*
U. S. Fish and Wildlife Service, Division of Ecological Services*
Soil Conservation Service District Conservationist
State of Hawaii, Department of Land and Natural Resources*
State of Hawaii, Department of Transportation
State of Hawaii, Department of Agriculture*
City and County of Honolulu, Department of General Planning
City and County of Honolulu, Department of Land Utilization*

*Replies Received

APPENDIX G

COMMENTS AND RESPONSES TO THE EIS PREPARATION NOTICE

Comments - EIS Prep. Notice, Kahana Water Dev. Project

From: Life of the Land

1. The State Water Commission's report is referred to on p.3, especially its statements concerning promising supplies in Kahana. No mention is made in the EIS prep. notice, however, of the State Water Commission's recommendations concerning conservation and the Commissions finding that if maximum conservation presently achievable were practiced little if any additional water development would be necessary for Oahu till the year 2000. Any EIS for Kahana or any other water development project should include specific data concerning financial and social costs and benefits of converting to a maximum conservation system vs. proceeding as usual with primary reliance on new source development, of which the proposed Kahana water development is a part.

2. The fact that Kahana Valley has one of the few streams approaching natural quality remaining on Oahu should be given full consideration in EIS preparation. The fact that stream water and flow standards have not yet been adopted in the way of specifics is unfortunate, but this does not eclipse the fact that the State has taken a position that stream flows should be protected. There are few alternatives available for protecting remaining near natural stream flows. With conservation, however, there does seem to be an alternative available for supplying water needed for urban and municipal use.

3. Kahana has been designated for a "living" cultural park. Our opinion on this is that a living Hawaiian Park should and can be self-supporting on the basis of tradional Hawaiian agriculture and aquaculture. This would enhance planned tourist activities, provide foods for which there is currently a greater demand than supply, provide div, ag. jobs for which there are demands but suitable available land shortages, and prevent further drains on State funds. We feel that such a park will become a greater likelyhood in the near future. For any such park, however, large amounts of water will be needed.

G-1

We feel that these three issues of conservation xosts and benefits vs. costs and benefits of planned water developments over the next 20 years, protection of remaining near natural flow quality streams, and agricultural water requirements for Kahana if it is to be "living" in a tradional Hawaiian sense should be addressed in any Kahana water development EIS.

We also note that Kahuku has been left out as a proposed site for new source development. Given the abundant supplies in that area and the minimum effect development would have onstream flows, we can only ask "Why?"

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA
HONOLULU, HAWAII 96843

COPY

FRANK F. FASI, Mayor
YOSHIE H. FUJINAKA, Chairman
DAN QUON PANG, Vice Chairman
TOMOKICHI HIGASHIONNA
TERESITA R. JUBINSKY
WALLACE S. MIYAHIRA
ROBERT A. SOUZA
CLAUDE T. YAMAMOTO

KAZU HAYASHIDA
Manager and Chief Engineer

May 21, 1980

Life of the Land
Room 209
404 Piikoi Street
Honolulu, Hawaii 96814

Gentlemen:

Subject: Your Comments on the Environmental Impact Statement (EIS) Preparation Notice for the Kahana Valley Water Development Project

Thank you for your comments on our proposed project. Your letter will be appended to our EIS.

We also have the following reply to your comments:

1. *The State Water Commission's report is referred to on p. 3, especially its statements concerning promising supplies in Kahana. No mention is made in the EIS prep. notice, however, of the State Water Commission's recommendations concerning conservation and the Commissions finding that if maximum conservation presently achievable were practiced little if any additional water development would be necessary for Oahu till the year 2000. Any EIS for Kahana or any other water development project should include specific data concerning financial and social costs and benefits of converting to a maximum conservation system vs. proceeding as usual with primary reliance on new source development, of which the proposed Kahana water development is a part.*

The State Water Commission's recommendation on conservation is to "continue and intensify conservation programs undertaken by the Honolulu

Pure Water...man's greatest need – use it wisely

Board of Water Supply and military agencies to stabilize or reduce the per capita consumption of municipal water on Oahu."

The Department's water conservation program is an on-going program. We have adopted rules and regulations to control water usage during periods of low ground water levels. Amendments to these rules were adopted in May of this year to make them compatible with the State Department of Land and Natural Resources (DLNR) Regulation 9 administering the designation of ground water control areas.

The City's Plumbing Code has adopted a new section relating to water conservation. This ordinance, initiated through our efforts, became effective on November 10, 1979. It requires that newly purchased water supply faucets or valves be provided with an approved flow control device which limit flow to a maximum of three gallons per minute. New tank-type water closets shall be provided with volume limiting devices to limit discharge per flush to no more than 3.5 gallons. Also, any new installation using potable water for cooling equipment at a rate exceeding one gallon per minute, or operating more than ten hours in a twenty-four hour period, shall be designed to recirculate or reuse cooling water.

The projected water demand in the State Water Commission's report was 240 gpcd by the year 2000. Present projection is 220 gpcd by the year 2000 based on the best available data today.

Our gallons per day per capita served as reported in our Annual Report and Statistical Summary are as follows for the reported fiscal years:

1.	Fiscal 1975	200 gpcd
2.	Fiscal 1976	206 gpcd
3.	Fiscal 1977	216 gpcd
4.	Fiscal 1978	201 gpcd
5.	Fiscal 1979	198 gpcd

A review of such data should consider other factors which are not noted but play an important part in arriving at the fiscal figures. 1976 was a dry year in terms of rainfall with 1977 having even less rainfall than in 1976. 1978 and 1979 were years of higher rainfall. Another factor to consider is the figure for the estimated population served. However, even after considering these two factors, our water conservation program is showing some positive results, but we still need to develop additional sources before the year 2000. Population growth and redistribution of population will require the development of additional sources to meet these water demand requirements.

2. *The fact that Kahana Valley has one of the few streams approaching natural quality remaining on Oahu should be given full consideration in EIS preparation. The fact that stream water and flow standards have not yet been adopted in the way of specifics is unfortunate, but this does not eclipse the fact that the State has taken a position that stream flows should be protected. There are few alternatives available for protecting remaining near natural stream flows. With conservation, however, there does seem to be an alternative available for supplying water needed for urban and municipal use.*

Our proposed well field development in Kahana Valley calls for the incremental development of three well fields. We propose to drill exploratory wells for

the three well fields should our EIS be accepted. The first well field will then be made operational. We will then monitor stream flow until such time that we feel we can determine whether to go ahead with the next well field. We also plan to maintain stream flows in Kahana Stream in keeping with the State's plans for the development of Kahana Valley.

3. *Kahana has been designated for a "living" cultural park. Our opinion on this is that a living Hawaiian Park should and can be self-supporting on the basis of traditional Hawaiian agriculture and aquaculture. This would enhance planned tourist activities, provide foods for which there is currently a greater demand than supply, provide div, ag. jobs for which there are demands but suitable available land shortages, and prevent further drains on State funds. We feel that such a park will become a greater likelihood in the near future. For any such park, however, large amounts of water will be needed.*

The preparation of our EIS is being coordinated with DLNR and especially with its State Parks, Outdoor Recreation and Historic Sites Division. Therefore, any water development on our part will also consider the wishes and needs of the Kahana Valley "living" cultural park.

We also note that Kahuku has been left out as a proposed site for new source development. Given the abundant supplies in that area and the minimum effect development would have on stream flows, we can only ask "Why?"

We have not included any source development in the Kahuku area in our plans for development of the Windward water sources for two reasons:

1. There are no interconnections between our Pearl Harbor-Honolulu-Windward system and the Waialua-Kahuku system. Our ultimate goal is to have one island-wide interconnected system so that the sources can mutually support the system as required. We have no immediate plans to construct this interconnection.

2. Kahuku does not have abundant supplies for development. Past practice by the Kahuku Plantation was to overdraft the basin beyond the estimated recharge value of 12 mgd. Present agricultural usage of about 6 mgd plus that of Kahuku town leave only a few mgd of water in the area available for future development.

Should you have questions or require additional information, please call Lawrence Whang at 548-5221.

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: R. M. Towill Corp.

DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813 • (808) 523-4432

FRANK F. FASI
MAYOR

TYRONE T. KUSAO
DIRECTOR

LY
LU4/80-1833(SE)
80/EC-5

April 29, 1980

MEMORANDUM

TO : KAZU HAYASHIDA, MANAGER & CHIEF ENGINEER
BOARD OF WATER SUPPLY

FROM : TYRONE T. KUSAO, DIRECTOR OF LAND UTILIZATION

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE FOR THE KAHANA VALLEY WATER DEVELOPMENT PROJECT

We have reviewed the above Preparation Notice and offer the following comments:

1. Reference: Background, page 2

   Comment: The Preparatin Notice mentions that the Board of Water Supply (BWS) is expected to increase groundwater draft from 130.0 mgd in 1978 to about 192 mgd in 2000. Does this figure have relevance in light of the recent decision of the Board of Land and Natural Resources which restricts BWS draft from the Pearl Harbor District, and suggest the enlargement of groundwater control areas to the Honolulu and Leeward Districts?

2. Reference: Background, page 3

   Comment: The Preparatin Notice states that inter-district transmission of water will be necessary to supply the demand of each district. The EIS should outline the current status of projects integrating the inter-district transmission system.

3. Reference: Background, page 4

   Comment: The EIS should update the status of the proposed state park at Kahana Valley.

4. Reference: Description, page 6

   Comment: According to correspondence from BWS dated April 15, 1980, the estimated capacity of the Kahana Wells I is 10.0 mgd. How does this figure relate to the 6.0 mgd capacity of the proposed project?

5. Reference: Adverse Impacts, Page 26

   Comment: At what stage of the review process will the direct and secondary impacts of reduced stream flow be further investigated?

If you have any questions on these comments, please contact Mr. Scott Ezer of our staff at 523-4077.

TYRONE T. KUSAO
Director of Land Utilization

TTK:ey

G-4

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA
HONOLULU, HAWAII 96843

COPY

May 9, 1980

TO : MR. TYRONE T. KUSAO
DIRECTOR
DEPARTMENT OF LAND UTILIZATION

FROM : KAZU HAYASHIDA
BOARD OF WATER SUPPLY

SUBJECT: YOUR LETTER OF APRIL 29, 1980, COMMENTING ON THE ENVIRONMENTAL IMPACT STATEMENT (EIS) PREPARATION NOTICE FOR THE KAHANA VALLEY WATER DEVELOPMENT PROJECT

Thank you for your comments on the EIS preparation notice for the proposed water development project.

We have the following replies in response to them:

1. "Reference: Background, page 2

Comment: The Preparation Notice mentions that the Board of Water Supply (BWS) is expected to increase groundwater draft from 130.0 mgd in 1978 to about 192 mgd in 2000. Does this figure have relevance in light of the recent decision of the Board of Land and Natural Resources which restricts BWS draft from the Pearl Harbor District, and suggest the enlargement of groundwater control areas to the Honolulu and Leeward Districts?"

The expected increase in groundwater draft was based on grouth projections relevant to the Department of Planning and Economic Development's II-F projection figures and not on existing and pending groundwater control areas. We believe that designation may cause delays that will slow the rate of grouth but should not curtail grouth completely.

What designation has done, however, is to restrict additional draft from the Pearl Harbor Basin and accelerate our development of Windward water resources, of which the Kahana Water Development Project is a part, to meet projected demands.

2. "Reference: Background, page 3

Comment: The preparation Notice states that inter-district transmission of water will be necessary to supply the demand of each district. The EIS should outline the current status of projects integrating the inter-district transmission system."

The EIS will be revised to include a section explaining Board of Water Supply's inter-district transmission system and proposed plans for connecting all water districts.

3. "Reference: Background, page 4

Comment: The EIS should update the status of the proposed state park at Kahana Valley."

The revised EIS will update the section on the proposed state park at Kahana Valley.

4. "Reference: Description, page 6

Comment: According to correspondence from BWS dated April 15, 1980, the estimated capacity of the Kahana Wells I is 10.0 mgd. How does this figure relate to the 6.0 mgd capacity of the proposed project?"

There is no relation between the two figures. The 10 mgd was an optimistic figure used initially for preliminary planning. It was later revised after recent studies revealed that 6.0 mgd would be a more realistic figure for the proposed project.

5. "Reference: Adverse Impacts, page 26

Comment: At what stage of the review process will the direct and secondary impacts of reduced stream flow be further investigated?"

Direct and secondary impacts of reduced stream flow cannot be investigated during the review process. However, the impacts may be investigated during test pumping of the wells.

Should you have questions or require additional information, please call Lawrence Whang at 548-5221.

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

G16

cc: R. M. Towill Corporation

80-1460

United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 ALA MOANA BOULEVARD
P. O. BOX 50167
HONOLULU, HAWAII 96850

IN REPLY REFER TO:
ES
Room 6307

May 5, 1980

Mr. Kazu Hayashida
Manager and Chief Engineer
C&C Board of Water Supply
630 South Beretania St.
Honolulu, Hawaii 96843

Re: EIS-Preparation Notice
Kahana Valley Water
Development Project
Oahu, Hawaii

Dear Sir:

We have reviewed the subject Environmental Impact Statement (EIS) Preparation Notice and offer the following comments:

G-7

The Site Plan (Figure 2) indicates that the existing unimproved road on the north side of the valley crosses at least two stream channels. If the stream crossings will be modified to permit all-weather access and accommodate occasional flood flows, the EIS should state how this will be done, as well as how the transmission main and utilities will be routed at these crossings, and what measures will be taken to minimize the adverse impacts of erosion and downstream siltation.

The Service is also concerned with what impacts, if any, the removal of six million gallons per day (mgd) from groundwater sources in lower Kahana Valley will have on Kahana Stream, whose average discharge is only 23 mgd, with lows of 6.5 mgd. A hydrological evaluation of these potential impacts should be included in the EIS.

When a draft EIS has been prepared, we would appreciate the opportunity to make additional comments at that time.

Sincerely yours,

Maurice H. Taylor
Field Supervisor
Division of Ecological Services

cc: EPA, San Francisco
NMFS, Honolulu
HDF&G
OEQC

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

University of Hawaii at Manoa

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

Office of the Director

May 5, 1980

Mr. Kazu Hayashida
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96843

Dear Mr. Hayashida:

Kahana Valley Water Development Project
Kahana Valley, Oahu

Thank you for sending a copy of the Environmental Impact Statement Preparation Notice for the above cited project. We note that it has been determined that the project will have a significant environmental impact and that an EIS will be required for it. Among the impacts are "a possible reduction of stream flow and the resulting impact on the surrounding flora and fauna". The resulting biological impacts that should be of concern are not those on the flora and fauna surrounding the stream above but particularly the stream flora and fauna. Critical to the extent and spacial distribution of these impacts are the location of points of ground-water inflow to the stream. These are dependent upon the relationships of groung-water heads to low-water stream-surface elevations along the stream. These relationships, not discussed in the assessment, should be thoroughly addressed in the EIS. We look forward to reviewing the Draft EIS when it becomes available.

G-8

Sincerely,

Doak C. Cox
Director

DCC/cu

cc: R.M. Towill Corporation
John Sorensen

AN EQUAL OPPORTUNITY EMPLOYER

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

May 12, 1980

Dr. Doak C. Cox
Director
Environmental Center
Crawford 317
2550 Campus Road
Honolulu, Hawaii 96822

Dear Dr. Cox:

Subject: Your Letter of May 5, 1980, Commenting on the Environmental Impact Statement (EIS) Preparation Notice for Kahana Valley Water Development Project

Thank you for your comments on our proposed project.

We will have our engineering consultant discuss the project's impacts to stream flora and fauna as well as the relationship of groundwater heads to stream-surface elevations in the EIS.

Should you have questions or require additional information, please call Lawrence Whang at 548-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: R. M. Towill Corp.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA
HONOLULU, HAWAII 96843

COPY

May 9, 1980

Mr. Maurice H. Taylor
Division of Ecological Services
Fish and Wildlife Service
U. S. Department of the Interior
P. O. Box 50167
Honolulu, Hawaii 96850

Dear Mr. Taylor:

Subject: Your Letter of May 5, 1980, Commenting on the Environmental Impact Statement (EIS) Preparation Notice for the Kahana Valley Water Development Project, Oahu

Thank you for your comments on our proposed project.

We will direct our engineering consultant preparing the EIS to discuss the effects of flood flows on the access roadway at stream crossings, the design considerations for routing the transmission main and utilities at these crossings, and the impacts of erosion and downstream siltation. Also, a hydrological evaluation on the removal of six million gallons per day from the valley will be included in the EIS.

Should you have questions or require additional information, please call Lawrence Whang at 548-5221.

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: R. M. Towill Corp.

Pure Water...man's greatest need—use it wisely

GEORGE R. ARIYOSHI
Governor of Hawaii

SUSUMU ONO, CHAIRMAN
BOARD OF LAND & NATURAL RESOURCES

EDGAR A. HAMASU
DEPUTY TO THE CHAIRMAN

DIVISIONS:
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FISH AND GAME
FORESTRY
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

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

May 15, 1980

REF NO.: CPO-1652

Honorable Kazu Hayashida
Board of Water Supply
630 South Beretania
Honolulu, HI 96843

Dear Sir:

We have reviewed the EIS preparation notice for the proposed wells in Kahana Valley.

Inasmuch as the well fields are to be located on State-owned conservation land in Kahana Valley, a Conservation District permit will be required.

The notice provides a good overview of Oahu's water situation. The material is clearly written and tightly organized. However, we find some fault with Sections VI and VII.

Item A.1.b. (page 26) states that the wells will effect stream flow. It should be made clear how this high level water source will be disturbed by the basal water wells.

With respect to Item A2 (pages 26-29), evaluation of alternatives ought to include relative effects upon stream flow.

Regarding Items B1 and B2 (pages 29-31), any permanent roadways should be consistent with park design. Disruption by construction roads should be mitigated, and the areas restored to a natural condition as soon as possible. Fences and control structures should be as unobtrusive as possible. Impact might be mitigated by placing structures underground. Careful consideration should also be given to mitigation of the impact of utility lines.

Very truly yours,

SUSUMU ONO, Chairman
Board of Land and Natural Resources

C-10

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA
HONOLULU, HAWAII 96843

FRANK F. FASI, Mayor
YOSHIE H. FUJINAKA, Chairman
DAT QUON PANG, Vice Chairman
YOKICHI HIGASHIONNA
TERESITA R. JUBINSKY
WALLACE S. MIYAHIRA
ROBERT A. SOUZA
CLAUDE T. YAMAMOTO

KAZU HAYASHIDA
Manager and Chief Engineer

June 3, 1980

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

Dear Mr. Ono:

Subject: Your Letter of May 15, 1980, on the Environmental Impact Statement (EIS) Preparation Notice for the Kahana Valley Water Development Project, Kahana Valley, Oahu

Thank you for your comments on the EIS Preparation Notice for our proposed water development project.

We will file a Conservation District Use Permit Application with your department.

The EIS will include a description of the hydraulic mechanisms involved between the proposed wells and Kahana Stream. The effects on stream flow from each of the project's alternatives will also be included.

As mentioned on page 7 of the notice, we will use existing roadways, whenever possible, and will construct new roadways of compacted, crushed coral to comply with recommendations presented in the State Park EIS. Construction roads will be restored to a natural condition as soon as possible. All structures will be landscaped to make them as unobtrusive as possible. All electrical and telephone cables will be installed underground (page 8). Our consultant has been informed to work closely with your State Parks Division.

Should you have questions or require additional information, please call Lawrence Whang at 548-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: R. M. Towill Corp.

Pure Water...man's greatest need - use it wisely

STATE OF HAWAII
DEPARTMENT OF AGRICULTURE
1428 SO. KING STREET
HONOLULU, HAWAII 96814

JOHN FARIAS, JR.
CHAIRMAN, BOARD OF AGRICULTURE
YUKIO KITAGAWA
DEPUTY TO THE CHAIRMAN

RECEIVED
BD OF WATER SUPPLY
Oct 20 11 57 AM '80

October 15, 1930

MEMORANDUM

To: Mr. Kazu Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu

Subject: Kahana Valley Water Development Environmental Impact Statement Preparation Notice

The notice states, "the objective of the proposed project is to develop the water resources within Kahana Valley to meet the increasing domestic demand on Oahu." It is the Department's concern that the respective EIS prepared for the wells address the effects of the water source development on agricultural water use, as well as urban and domestic requirements.

We believe that the question of potential impacts on agricultural activities within Kahana Valley should specifically be addressed. The Environmental Impact Statement for Kahana Valley State Park envisions agricultural demonstration plots which will be small, but adds that "it would be best if fairly extensive areas of the Valley bottom could be planted in taro to create the desired effect." The EIS notes that, "Taro cultivation will require construction or reconstruction of irrigation ditches or auwai to supply the large amounts of water required for this crop." The EIS also suggests "the exploration of the feasibility of establishing an agricultural park within Kahana Valley." For these potential activities, adequate water should be assured.

Thank you for the opportunity to comment.

Yukio Kitagawa
for John Farias, Jr.
Chairman, Board of Agriculture

JF/ch

G-11

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA
HONOLULU, HAWAII 96843

FRANK F. FASI, Mayor
YOSHIE H. FUJINAKA, Chairman
DAT QUON PANG, Vice Chairman
RYOKICHI HIGASHIONNA
Donna H. Howard
WALLACE S. MIYAHIRA
ROBERT A. SOUZA
CLAUDE T. YAMAMOTO

KAZU HAYASHIDA
Manager and Chief Engineer

December 1, 1980

Mr. John Farias, Jr.
Chairman, Board of Agriculture
State Department of Agriculture
1428 South King Street
Honolulu, Hawaii 96814

Dear Mr. Farias:

Subject: Your Memorandum of October 15, 1980, on the Environmental Impact Statement (EIS) Preparation Notice for Kahana Valley Water Development

Thank you for your comments on the EIS preparation notice for our proposed project.

Our EIS is being closely coordinated with the State Department of Land and Natural Resources (DLNR). The water requirements for domestic and agricultural activities in the proposed park will be preserved and assured as indicated in our EIS.

Furthermore, since DLNR controls the valley, we are required to coordinate and comply with their plans for the valley.

Should you have questions or require additional information, please call Lawrence Whang at 548-5221.

Very truly yours,

Kazu Hayashida
KAZU HAYASHIDA
Manager and Chief Engineer

cc: R. M. Towill Corp.

Pure Water...man's greatest need—use it wisely

APPENDIX H

COMMENTS AND RESPONSES TO THE EIS

Dept. of Housing & Community Development
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 5th FLOOR
HONOLULU, HAWAII 96813

January 15, 1982

Mr. Roy N. Takemoto
Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

H-1

Dear Mr. Takemoto:

Subject: Kahana Valley Water Development Project
Kahana Valley, Koolauloa District, Oahu

We have reviewed the Environmental Impact Statement (EIS) for the subject project and have no comments.

We appreciate the opportunity to review this EIS and are retaining this copy for our files.

Sincerely,
JOSEPH K. CONANT
Original Signed
JOSEPH K. CONANT

/cc: Board of Water Supply

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

January 22, 1982

TO : MR. JOSEPH K. CONANT, DIRECTOR
DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT

FROM : KAZU HAYASHIDA
BOARD OF WATER SUPPLY

SUBJECT: YOUR LETTER OF JANUARY 15, 1982, ON THE ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR KAHANA VALLEY WATER DEVELOPMENT PROJECT, KOOLAULOA DISTRICT, OAHU

Thank you for reviewing the EIS for our proposed project. Your letter will be appended to the revised environmental document.

If you have any questions, please contact Lawrence Hhang at 548-5221.

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
R. M. Towill Corporation

RECEIVED
BD OF WATER SUPPLY
Dec 29 3 17 PM '81

DEC 28 1981

Office of Environmental
Quality Control
550 Halekauwila Street
Room 301
Honolulu, Hawaii 96813

H-2

Gentlemen:

Subject: Environmental Impact Statement
for the Kahana Valley Water
Development Project

Thank you for this opportunity to review and comment on the subject project.

The project will not have any adverse environmental effect on any existing or planned facilities serviced by our department.

Very truly yours,

RIKIO NISHIOKA
State Public Works Engineer

Hirja

cc: Board of Water Supply

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

(P)2062.1

February 11, 1982

Mr. Hideo Murakami, Comptroller
Department of Accounting and
General Services
State of Hawaii
P. O. Box 119
Honolulu, Hawaii 96810

Attention: Mr. Rikio Nishioka

Dear Mr. Murakami:

Subject: Your Letter of December 28, 1981,
on the Environmental Impact Statement
for Kahana Valley Water Development
Project

Thank you for reviewing the draft environmental impact statement for our proposed project. Your letter will be appended to the revised environmental document.

If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

For KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
M. Towill

H-3

STP 8.7950

January 4, 1982

MEMORANDUM

TO: Office of Environmental Quality Control

FROM: Director of Transportation

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT
KAHANA VALLEY, KOOLAULOA DISTRICT, OAHU

Thank you for the opportunity to comment on the subject EIS.

We have no substantive comments to offer to improve the document.

Ryokichi Higashionna
Ryokichi Higashionna

cc: Board of Water Supply

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

January 12, 1982

Dr. Ryokichi Higashionna
Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Dr. Higashionna:

Subject: Your Letter of January 4, 1982,
on the Environmental Impact
Statement for Kahana Valley
Water Development Project,
Kahana Valley, Koolauloa, Oahu

Thank you for reviewing the draft environmental document for our proposed water development project. Your letter will be appended to the revised environmental impact statement.

If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

Kazu Hayashida
KAZU HAYASHIDA
Manager and Chief Engineer

cc: R. M. Towill Corp.

GEORGE R. ARIYOSHI
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF SOCIAL SERVICES AND HOUSING

FRANKLIN Y. K. SUNN
DIRECTOR
RICHARD PAGLINAWAN
DEPUTY DIRECTOR
ALFRED K. SUGA
DEPUTY DIRECTOR

January 6, 1982

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Gentlemen:

Subject: Kahana Valley Water Development Project - Environmental Impact Statement

The Hawaii Housing Authority has reviewed the subject EIS and has no specific comments to offer relative to the proposed action. The Authority is highly supportive of this action as it will provide much needed water for the Windward, Honolulu and Pearl Harbor Water Use Districts. The development of these additional ground water sources in Kahana Valley will assist in the future plans of the Authority in providing affordable housing for Hawaii's people.

Thank you for allowing us to comment on this matter.

Sincerely,

Franklin Y. K. Sunn

FRANKLIN Y. K. SUNN
Director

cc: Board of Water Supply

H-4

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

January 19, 1982

Mr. Franklin Y. K. Sunn, Director
Department of Social Services and Housing
State of Hawaii
P.O. Box 339
Honolulu, Hawaii 96809

Dear Mr. Sunn:

Subject: Your Letter of January 6, 1982, On The Environmental Impact Statement for Kahana Valley Water Development Project, Koolauloa, Oahu

Thank you for reviewing the draft environmental impact statement (EIS) for our proposed project. Your letter will be appended to the revised environmental document.

If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
R. M. Towill Corporation

GEORGE R. ARIYOSHI
Governor of Hawaii

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

January 7, 1982

GEORGE A. L. YUEN
Director of Health

JOHN F. CHALMERS, M.D.
Deputy Director of Health

HENRY M. THOMPSON, M.A.
Deputy Director of Health

MELVIN K. KOIZUMI
Deputy Director of Health

ADELINA MORAD SHAW, M.A., J.D.
Deputy Director of Health

In reply, please refer to:
File: EPHS-55

MEMORANDUM

To: Office of Environmental Quality Control

From: Deputy Director for Environmental Health

Subject: Environmental Impact Statement (EIS) for Kahana Valley Water Development Project, Koolauloa District, Oahu

Thank you for allowing us to review and comment on the subject EIS.

Please be advised that Section 11-20-29 of Chapter 20, Title XI, Administrative Rules (formerly Chapter 49, Public Health Regulations) requires that all new sources of water serving public water systems be approved by the Director of Health prior to their use. Such approval is based primarily on the submission of an engineering report which adequately addresses all concerns set down in Section 11-20-29. The report must be prepared by a registered engineer and bear his or her seal upon submittal.

We note that no reference to this approval was made in Appendix C of the environmental impact statement entitled, "List of Necessary Permits and Approvals." We request that the aforementioned approval be included if appropriate.

If you should have any questions pertaining to the requirements of Chapter 20, Title XI, Administrative Rules, please contact the Drinking Water Program at 548-2235.

We realize that the statements are general in nature due to preliminary plans being the sole source of discussion. We, therefore, reserve the right to impose future environmental restrictions on the project at the time final plans are submitted to this office for review.

for MELVIN K. KOIZUMI

cc: Board of Water Supply ✓

H-5

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

January 19, 1982

Mr. Melvin K. Koizumi
Deputy Director
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, Hawaii 96801

Dear Mr. Koizumi:

Subject: Your Letter of January 7, 1982, On The Environmental Impact Statement for Kahana Valley Water Development Project, Koolauloa District, Oahu

Thank you for reviewing the draft environmental impact statement (EIS) for our proposed project. Your letter will be appended to the revised environmental document.

We will submit an engineering report for your approval in accordance with Chapter 20, Title XI, Administrative Rules.

If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
R. M. Towill Corporation

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

January 19, 1982

EnV 81-C

January 11, 1981

TO : DR. MICHAEL J. CHUN, DIRECTOR
DEPARTMENT OF PUBLIC WORKS

FROM : KAZU HAYASHIDA
BOARD OF WATER SUPPLY

SUBJECT: YOUR LETTER JANUARY 11, 1982, ON THE ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR THE KAHANA VALLEY WATER DEVELOPMENT PROJECT, KOOLAULOA DISTRICT, OAHU

Thank you for reviewing the EIS for our proposed project. Your letter will be appended to the revised environmental document.

The construction plans will be submitted to your Division of Engineering for review.

If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
R. M. Towill Corporation

9-H

Office of Environmental Quality Control
State of Hawaii
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Gentlemen:

Subject: EIS for the Kahana Valley Water Development Project, Koolauloa District, Oahu, Hawaii

The subject EIS is satisfactory with respect to our area of responsibility. Construction plans should be submitted to the Division of Engineering for review.

He ke aloha pumehana,

for MICHAEL J. CHUN
Director and Chief Engineer

cc: Board of Water Supply

RECEIVED RECEIVED
BD OF WATER SUPPLY
DEPARTMENT OF THE ARMY
JAN 15
HEADQUARTERS UNITED STATES ARMY SUPPORT COMMAND, HAWAII
FORT SHAFTER, HAWAII 96858

AFZV-EHE-E

Office of Environmental Quality Control
State of Hawaii
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Gentlemen:

H-7

The Environmental Impact Statement (EIS) for the Kahana Valley Water Development Project, Kahana Valley, Koolauloa District, Oahu has been reviewed and we have no comments to offer. It is anticipated that there will be no adverse impacts on Army installations or activities resulting from the proposed project.

Thank you for allowing us the opportunity to comment on the project.

Sincerely,

Original signed by

RAY H. JYO
Acting Director of Engineering and Housing

Copy Furnished:
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96843

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

January 25, 1982

Mr. Ray H. Jyo
Acting Director of Engineering
and Housing
Headquarters U. S. Army Support Command, Hawaii
Department of the Army
Fort Shafter, Hawaii 96858

Dear Mr. Jyo:

Subject: Your Letter of January 11, 1982, On The Environmental Impact Statement for Kahana Valley Water Development Project, Kahana, Oahu

Thank you for reviewing the draft environmental impact statement (EIS) for our proposed project. Your letter will be appended to the revised environmental document.

If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office Environmental Quality Control
K. M. Towill Corp.

RECEIVED
BD OF WATER SUPPLY
1 58 PM '82

HEADQUARTERS
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860

IN REPLY REFER TO:
002A:RLE:ci
Ser 114
12 JAN 1982

Environmental Quality Commission
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Gentlemen:

Environmental Impact Statement
Kahana Valley Water Development Project

The EIS for the Kahana Valley Water Development Project has been reviewed and the Navy has no comments to offer. As this command has no further use for the EIS, the EIS is being returned.

Thank you for the opportunity to review the EIS.

Sincerely,

R. L. ELSBERND
LCDR, CEC, USN
Deputy Facilities Engineer

Enclosure a/s

Copy to:
DHS C&C HONO

H-8

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

January 28, 1982

Lt. Commander R. L. Elsbernd
Deputy Facilities Engineer
Headquarters, Naval Base Pearl Harbor
Box 110
Pearl Harbor, Hawaii 96860

Dear Commander Elsbernd:

Subject: Your Letter of January 12, 1982, On The Environmental Impact Statement for Kahana Valley Water Development Project, Kahana Oahu

Thank you for reviewing the draft environmental impact statement for our proposed project. Your letter will be appended to the revised environmental document.

If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office Environmental Quality Control
R. M. Towill Corp.

United States Department of Agriculture

Soil Conservation Service

P. O. Box 50004
Honolulu, Hawaii
96850

January 12, 1982

Office of Environmental Quality Control
550 Halekauwila St., Room 301
Honolulu, HI 96813

Gentlemen:

Subject: EIS for Kahana Valley Water Development Project

We have reviewed the subject EIS and have no comments to make.

Thank you for the opportunity to review this document.

Sincerely,

JACK P. KANALZ
State Conservationist

cc: Board of Water Supply

H-9

The Soil Conservation Service is an agency of the Department of Agriculture

SCS-AS-1
10-79

JAN 18 9 53 AM '82

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

January 26, 1982

Mr. Jack P. Kanalz
State Conservationist
Soil Conservation Service
U. S. Department of Agriculture
Box 50001
Honolulu, Hawaii 96850

Dear Mr. Kanalz:

Subject: Your Letter of January 12, 1982, on the Environmental Impact Statement for Kahana Valley Water Development Project, Koolauloa District, Oahu

Thank you for reviewing the draft environmental impact statement (DEIS) for our proposed project. Your letter will be appended to the revised environmental document.

If you have any questions, please contact Lawrence Hnang at 548-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
A. M. Towill Corporation

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
FT. SHAFTER, HAWAII 96858

PODED-PV

13 January 1982

Mr. George Yuen
Office of Environmental Quality Control
550 Halekauwila Street
Honolulu, Hawaii 96813

Dear Mr. Yuen:

Thank you for the opportunity to review the Environmental Impact Statement (EIS) for the Kahana Valley Water Development Project, Oahu, Hawaii, sent to us on 17 December 1981. Based on our review, we provide the following comments.

a. The EIS does not provide sufficient information for the US Army Corps of Engineers to make a determination of whether or not a permit is required for the project. A Department of the Army (DA) permit will be required for any fill in Kahana Stream.

b. The proposed Well Site II is not situated in a designated flood plain but rather in an area of minimal flooding, or Zone C classification. Proposed Well Sites III, IV, and V are situated in areas of undetermined, but possible flood hazards, or Zone D classification. A portion of the proposed water main alignment which follows the access road is situated in the Kahana Stream flood plain, more specifically in the floodway, and flood fringe areas with flood zone designations A4, A5, and A3. The water surface elevations in the area are 8 to 11.5 feet above Mean Sea Level. The information is taken from the Flood Insurance Study for Oahu prepared by the Federal Insurance Administration (see Incl 1). We recommend that public facilities such as water systems be located outside of the floodway, which is defined as the channel of a river or watercourse and adjacent land areas that must be reserved to discharge the base flood. We recommend that water supply systems within flood-prone areas be constructed and designed to minimize or eliminate flood damage and the infiltration of flood waters into the system.

c. Page III-4, item 4, para 1, and Page V-8, para 2. The EIS quotes extensively from Timbol's 1979 study which was sponsored by the Corps. Timbol, in the "Limnological Survey of Kahana Stream, 1979" came to the conclusion that

H-10

JAN 18 9 52 AM '82

PODED-PV
Mr. George Yuen

13 January 1982

if 60 percent of the average flow of Kahana Stream is saved, there would be no adverse biologic effects. The EIS instead concludes there would be no problem if 60 percent of the Q90 flow is retained. The text on these pages should be corrected to reflect Timbol's statements.

Sincerely,

1 Incl
As stated

KISUK CHEUNG
Chief, Engineering Division

CF: w/o incl
Board of Water Supply
City & County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96843

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

February 3, 1982

Mr. Kisuk Chaung
Chief, Engineering Division
U. S. Army Engineer District, Honolulu
Department of The Army
Fort Shafter, Hawaii 96858

Dear Mr. Chaung:

Subject: Your Letter of January 13, 1982, On The Environmental Impact Statement For The Kahana Valley Water Development Project, Koolauloa District, Oahu

H-11

Thank you for reviewing the environmental impact statement (EIS) for our proposed project. Your letter will be appended to the revised environmental document.

We shall coordinate the preparation of the construction plans with you to determine if a Department of Army permit is required. Although sections of the transmission main will be within flood prone areas, the main will be designed to minimize or eliminate flood damage and infiltration of flood waters. We shall also incorporate into the document the flood zone designations mentioned in your letter.

The EIS will be corrected to indicate that there will be no adverse biologic effects if 60 percent of the average flow of Kahana Stream is preserved as stated in Timbol's survey.

If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineering

cc: Office of Environmental Quality Control
R. M. Towill Corp.

DEPARTMENT OF PARKS AND RECREATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

EILEEN R. ANDERSON
MAYOR

ROBERT K. MASUDA
DIRECTOR

January 15, 1982

H-12

Mr. Mel Koizumi
Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Mr. Koizumi:

SUBJECT: REVIEW OF EIS FOR THE KAHANA VALLEY WATER DEVELOPMENT PROJECT

We have reviewed the EIS as prepared by R. M. Towill Corp. and would like to express our concern about the quality of the "AA rated" waters of Kahana Bay.

Kahana Bay Beach Park is one of our prime swimming-camping parks on the windward area. We look forward to reviewing the precautionary measures that will be taken to minimize erosion-runoff during and immediately after the construction period.

Sincerely yours,

ROBERT K. MASUDA, Director

RKM:vc

cc: BWS

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

January 27, 1982

TO : MR. ROBERT K. MASUDA, DIRECTOR
DEPARTMENT OF PARKS AND RECREATION

FROM : KAZU HAYASHIDA
BOARD OF WATER SUPPLY

SUBJECT: YOUR MEMORANDUM OF JANUARY 15, 1982, ON THE ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR KAHANA VALLEY WATER DEVELOPMENT PROJECT

Thank you for reviewing the EIS for our proposed project. Your memorandum will be appended to the revised environmental document.

Although we anticipate no erosion-runoff impacts, we will coordinate our construction plans with your department. All grading work will be in accordance with the Soil Erosion Standards and Guidelines of the Department of Public Works (Grading, Grubbing and Stockpiling Permit).

If you have any questions, please contact Lawrence Whang at 548-5221.

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
R. M. Towill Corporation

820116

LIFE of the LAND

January 15, 1982

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96843

Gentlemen:

Subject: EIS for the Kahana Valley Water Development Project

H-13

A proposal by the BWS to reduce the flow of Kahana Stream is almost tantamount to saying that there is not one stream on Oahu which is of sufficient natural quality to warrant preservation in its existing state. If this is the BWS position, then it should be stated in the subject EIS. If this is not the BWS position, then the BWS should indicate which Oahu streams deserve to be protected from further reduction in flow. And the BWS should justify whichever position it takes by including relevant limnological survey data. The brief allusions to "forage fish" in the subject EIS are not an adequate basis for deciding whether to protect Kahana Stream.

The 1981 National Rivers Inventory lists 18 Hawaiian streams which Federal and State officials agreed were still of high natural quality. Only two Oahu streams are listed: Kahana and Kaluanui. The 1979 Limnological Survey of Kahana Stream, Oahu, which was prepared for the Corps of Engineers, states that "On Oahu, Kahana Stream is one of the few remaining high-quality streams." The 1979 Hawaii Water Resources Regional Plan, which is intended to guide Federal, State, and County actions which affect Hawaii's water resources, lists Kahana Stream and estuary as a scenic resource to be protected and identifies Kahana Valley wetlands as a proposed wildlife refuge. The 1977 Hawaiian Waterbirds Recovery Plan, which was jointly prepared by Federal and State biologists, classifies Kahana Marsh and Stream as a "Secondary Habitat Area" for two species of endangered Hawaiian waterbirds. Such areas are defined to be "... important to the species in conjunction with other areas to which they fly on a daily or seasonal basis." The 1977 Ornithological Survey of Hawaiian Wetlands, which was prepared for the Corps of Engineers, indicates that Kahana Valley pasturelands have "... considerable potential for improvement as waterbird habitat...." It would seem to Life of the Land that these are re-

250 S. Hotel St. Rm. 211, Honolulu, Hawaii 96813. Tel 521-1300

levant facts which should be prominently mentioned in an EIS addressing the environmental tradeoffs and potential impacts of reducing the flow of Kahana Stream.

Mitigation measures proposed in the EIS will not be sufficient to protect stream biota. According to the 1980 USGS Water-Data Report HI-80-1, there is a gage on Kahana Stream at an elevation of 30 feet, immediately mauka of inflow from Kawa Stream. Over a 21 year period, this gage recorded an average discharge of approximately 23.1 mgd. By comparison, the BWS EIS indicates that proposed "... wells will be pumped only when the average stream flow will not be reduced to less than 6.7 mgd." The previously mentioned Limnological Survey of Kahana Stream, Oahu contains an analysis of the potential impacts of reducing the instantaneous Kahana Stream flow to "... 10%, 30%, and 50% ... of the average discharge...." This report concluded "... that a 30% minimum instantaneous flow will sustain a short-term survival of the present resident species and their habitat; however, such a low permanent rate of flow will eventually lead to the loss of species and habitat. If a permanent change of flow is instigated, a reduction to much less than 60% minimum flow will, over time, have a negative effect on the macrobiota as well as lead to a degradation of economic, intrinsic and aesthetic qualities of Kahana Stream." In addition, "Thirty percent minimum stream flow could lead to the eventual disappearance of the o'opu nakea, a threatened endemic goby that is also a food fish.... This study suggests that 60% is the base flow needed to sustain good survival conditions for Kahana's macrobiota, and to maintain economic and intrinsic values, and general recreational values."

Although the BWS EIS neglected to discuss project compliance with Hawaii's Coastal Zone Management (CZM) Program, Environmental Quality Commission EIS Regulations require "Discussion of how the proposed action may conform or conflict with objectives and specific terms of approved or proposed land use plans, policies, and controls, if any, for the area affected...." Based on the foregoing, the BWS apparently intends to pump its new well fields to an extent which could produce significant adverse environmental effects as defined in Section 205A-26, HRS. This clearly would not be in compliance with Hawaii's CZM Program.

Environmental Quality Commission EIS Regulations also require that "The interrelationships and cumulative environmental impacts of the proposed action and other related projects shall be discussed in the EIS." Unfortunately, the BWS EIS neglects to address potential cumulative impacts resulting from existing and proposed BWS wells and proposed water development for Kahana State Park. A Negative Declaration filed by the BWS in March 1975 refers to four exploratory BWS wells in Kahana Valley. EQC correspondance files also contain a June 12, 1975 letter by the BWS to the UH Environmental Cen-

ter attempting to justify the Negative Declaration. This letter reads in part, "Water levels in ... two wells are similar and stand approximately 100 feet above sea level.... We recognize that to confirm our stand of essentially non-contribution of underflow to the main stream would require extensive and costly gaging." Since the USGS gage at 30 foot elevation has recorded Kahana stream flow both before and after the BWS put two (?) of its exploratory Kahana wells into production, there is ample data for the subject EIS to address the impact of existing BWS wells. (It also would be useful to show the locations of existing wells and proposed Kahana Park stream diversions as part of EIS graphics.)

At best, the BWS EIS discussion of Kahana Stream flow can only be described as highly confused. To begin with, the EIS authors do not seem to know the difference between average (i.e. mean) discharge and Q_{90} (i.e. flow exceeded 90% of the time) discharge. The EIS identifies the "long-term discharge (Q_{90})" as 11.2 mgd but incorrectly states that this estimate of flow at the mouth of Kahana Stream was actually recorded by the USGS gage at 30 foot elevation. By comparison, the 1973 UH Water Resources Research Center Technical Report No. 77 mentions an observed Q_{90} of 9.5 mgd at the USGS gage. The EIS authors do not seem to understand that Kahana Stream gains water throughout its entire length and that Kawa Stream contributes additional stream flow below the USGS gage. Although proposed BWS wells potentially might intercept most or all stream gain below an elevation of 300 feet, the EIS does not bother to estimate the amount of stream gain which occurs below 300 feet. Instead, the EIS only includes an unintelligible out-of-context figure from the 1973 UH Technical Report No. 77.

The BWS EIS contains an unsubstantiated claim that it is cheaper to use water from Kahana Valley to meet leeward Oahu water needs than to exchange brackish water or sewage effluent for the 40 to 50 mgd of potable water used to irrigate Oahu Sugar Co. fields. Out-of-date estimates of the cost of water exchanges are included in the EIS, and no estimates are included of the total cost of delivering Kahana well water to Hawaii Kai. We believe that the EIS should contain an up-to-date cost estimate for both approaches in terms of price of delivered water per million gallons. Since a water exchange program would eliminate the necessity for developing all proposed windward Oahu wells (such as the Kahana wells), the subject EIS should give this alternative the attention that it deserves.

Sincerely,

Arthur Mori
President

cc: Ron Albu

H-14

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

August 16, 1982

Mr. Arthur Mori
President
Life of the Land
250 South Hotel Street
Room 211
Honolulu, Hawaii 96813

Dear Mr. Mori:

Subject: Environmental Impact Statement for the Kahana Valley Water Development Project, Kahana Valley, Koolauloa District, Oahu
TMK: 5-2-01, 02, 03 & 05

Thank you for your letter of January 15, 1982, regarding the Kahana Valley Water Development Project. The following is offered in response to your comments on the Environmental Impact Statement (EIS):

1. We understand Life of the Land's desire to preserve Kahana Stream in its existing state because of its natural quality. However, the Board of Water Supply (BWS) is constantly looking for new sources to meet the water demand for all land uses allowed under the City's Development Plans. Groundwater is presently the purest and most economically developable source of supply.

   We will be pursuing the development of potential groundwater sources and will abide with all current regulations. We plan to drill exploratory wells first. As we proceed to the development stage, we will also follow the State Department of Land and Natural Resources (DLNR) minimum streamflow or in-stream use regulations which we expect will be adopted before we are ready to develop our wells in Kahana.

2. The EIS has been revised to include a detailed list of the Kahana Stream biota. It now also describes the studies which you reference and the importance of Kahana Stream as well as the marshes and pasture lands in Kahana Valley.

3. The EIS has been revised and now states that the BWS will maintain a streamflow of 13.9 mgd, a figure equal to 60 percent of the average flow measured at the U.S. Geological Survey (USGS) gage. This streamflow of 13.9 mgd will be maintained until the DLNR determines the minimum streamflows for Windward Oahu using more advanced techniques. The BWS will comply with the findings of the DLNR.

4. The EIS has been revised to provide a discussion of the project's compliance with Hawaii's Coastal Zone Management (CZM) Program.

5. The EIS has been revised in Section V to provide a discussion on the cumulative impacts of the Kahana Wells, State Park and proposed reservoir. The existing wells are down gradient from the USGS gage so no effects from the existing wells would be measured at the gage. The EIS graphics have been revised to include the existing wells (Attachment No. 1).

6. We thank you for pointing out inconsistencies in the use of base flow, average flow and Q_{90}. The revised hydrologic discussion of Kahana Stream and excerpts from the U.H. Water Resources Research Center (WRRC) Technical Report No. 77 added to the appendix will remove the inconsistency stemming from the use of Q_{90}, average flow and base flow. The reference to a Q_{90} flow of 11.2 mgd at the mouth of Kahana Stream is from U.H. WRRC Technical Report No. 77 which includes a compilation of USGS, BWS and other miscellaneous data gathered by other researchers.

   The EIS hydrologic discussion now refers only to the flows at the USGS gage as the wells should not affect groundwater gains to the stream below the gage due to the impermeable sediments under the stream. The stream gains a substantial amount of the USGS Q_{90} of 9.5 mgd between elevation 300 ft. and elevation 30 ft., and the excerpts from the U.H. WRRC Technical Report No. 77 indicate how the stream gains flow from the dike complex and the marginal dike zone. The report will also clarify the hydrologic budget figure used in the EIS. The EIS has been revised to provide a more complete hydrologic discussion of the Kahana Stream flow and the possible effects of the proposed wells upon the stream.

7. The BWS cost estimates for water exchange are up-to-date but do not include the cost the sugar companies will incur should the conversion from potable to brackish water or sewage effluent affect their drip irrigation systems. There are no cost data available for delivering Kahana Well water to Hawaii Kai. Additional information prepared by the BWS for brackish water exchange at the Ewa Shaft has been added to Appendix A (Attachment No. 2).

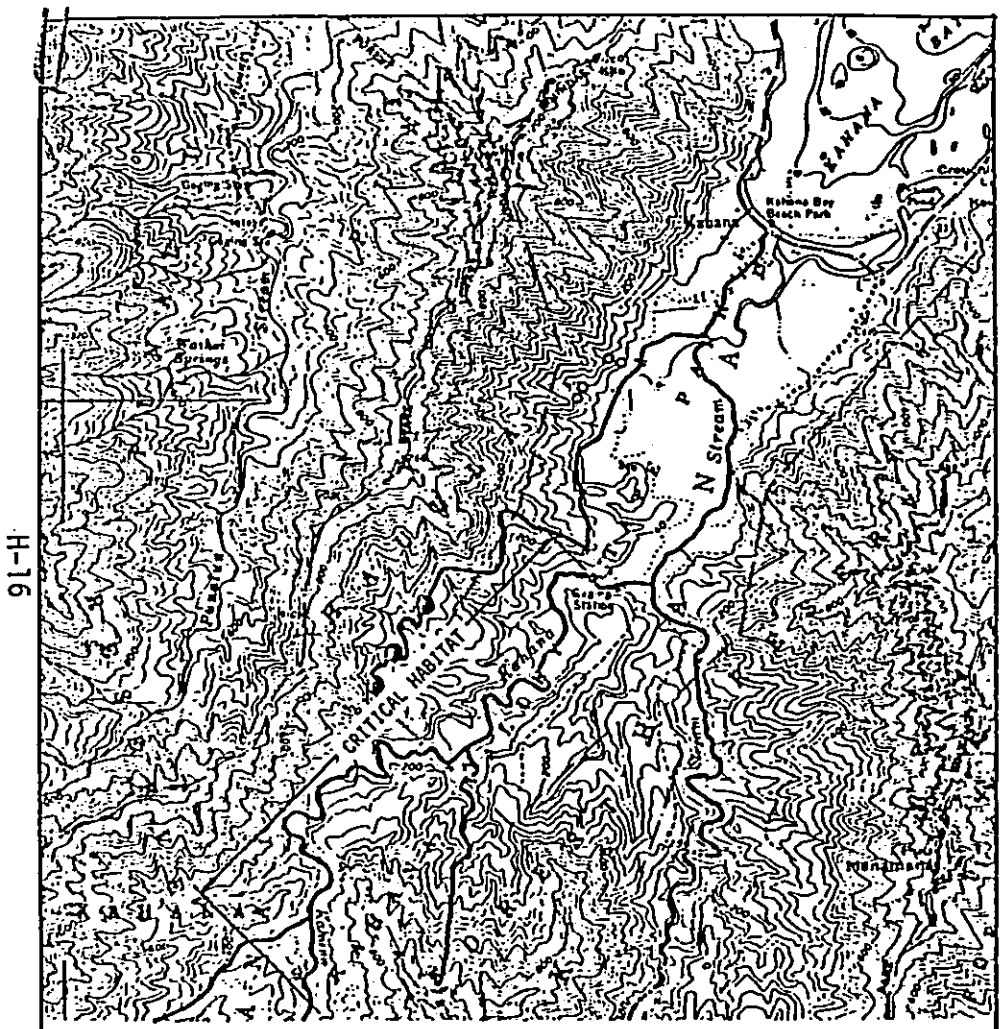
We appreciate the time you spent in reviewing our document. If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

Attach.

cc: R. M. Towill



Attachment A-1

APPENDIX A
FUTURE ALTERNATIVE SOURCES OF WATER[1]

A. WATER EXCHANGE PROGRAM

This program would consist of an exchange of water between Oahu Sugar Co. and the Board of Water Supply. Presently, Oahu Sugar is using approximately 40 to 50 mgd of domestic quality water for sugarcane irrigation. The BWS would trade water of lower quality for this potable water on a one-to-one basis. The lower quality water for exchange would come from any of the potential sources listed below. In addition, another 20 mgd could be converted to domestic use if this water were to be blended with water of lower mineral content; thus, from 40 to 70 mgd would be available for exchange.

1. Sewage Effluent [6.1]

It is estimated that approximately 33 mgd of sewage effluent would be available for use in the exchange program. About 25 mgd could be supplied by the Honouliuli WWTP, and about 8 mgd by the Mililani STP. It would be mixed with higher quality water on a ratio of one part effluent to three parts water and then used for drip irrigation.

The existing Mililani Sewage Treatment Plant is located on the West Bank of Kipapa Gulch, 15,000 feet north of the Oahu Sugar Co. mill in Waipahu. The effluent is presently discharged into Kipapa Stream and flows down to Pearl Harbor. The most feasible way to use this effluent for sugarcane irrigation is to pump it from the plant to the Waiahole Ditch, about 8,000 feet mauka.

The Honouliuli WWTP is the other sewage treatment plant in this cane growing area that can furnish cane irrigation water. It will be located outside the east boundary of Barbers Point Naval Air Station, about 4,000 feet north of the Ewa Plantation mill. To make this effluent available for cane irrigation, it is necessary to pipe it about 20,000 feet toward the present location of Ewa shaft, although it may be applied to the cane fields on

[1]SOURCE: City and County of Honolulu, 1979, Board of Water Supply, Honouliuli Wells Environmental Impact Statement, Notice of Preparation.

Attachment A-1

the plain surrounding the WWTP. However, piping the effluent to Ewa shaft will make its application more widespread, affording opportunities for selective applications and dilution.

The cost of supplying the sewage effluent has been estimated at $0.09 per thousand gallons for the Hililani STP and $0.13 per thousand gallons for the Honouliuli WWTP [6.2].* Studies by the University of Hawaii Water Resources Research Center indicate that the 1-3 mixture ratio is adequate to meet State Department of Health standards and sugar needs as well [6.3].

2. Pearl Harbor Springs [6.4]
The average discharge of water from the Pearl Harbor Springs is about 55 mgd. About 13 mgd of this is pumped to sugarcane fields, and the remaining 42 mgd discharges into the sea after flowing through water cress or other wetland crops [6.5]. Thus, spring water could be captured and used for additional cane irrigation, or possibly mixed with effluent and then applied.

Three major springs are located at Kalauao, Waiau, and Waiawa. They were used in the past for irrigation, and redevelopment of the springs would be feasible. To regain the use of the springs for sugarcane irrigation, these waters must be collected and pumped westward to the cane growing areas overlying the caprock. A more feasible scheme would also encompass an integrated pipeline pumping system involving all three spring areas and two surface streams -- Waikele and Waiawa. Assuming that the pumping installations are sized to accommodate the lower flows expected during the summer months, up to 40 mgd of water suitable for cane irrigation can be delivered to cane growing areas from the three spring areas and the two surface streams. It is estimated that the cost of supplying water from the springs will be approximately 12 cents per thousand gallons [6.6].*

3. West Loch Reservoir [6.7]
Another alternative which has been suggested is to dam West Loch to create a reservoir to capture flood flows from Waikele Stream.

*Additional information provided by the BWS is shown in Figure A-1.

Although the dry weather flow is presently being used for irrigation, flood flows rush into West Loch unused because there is no large storage basin to capture them.

A large storage reservoir in West Loch would make it possible to store the high flows during the rainy months for use during the drier summer months. A dam extending 2,700 feet on a bearing of north 75° east from Nichol's Point to Waipio Peninsula can form a 2.3 billion gallon reservoir. Using existing hydrographic data, the proposed reservoir would be able to sustain a flow of about 10 mgd.

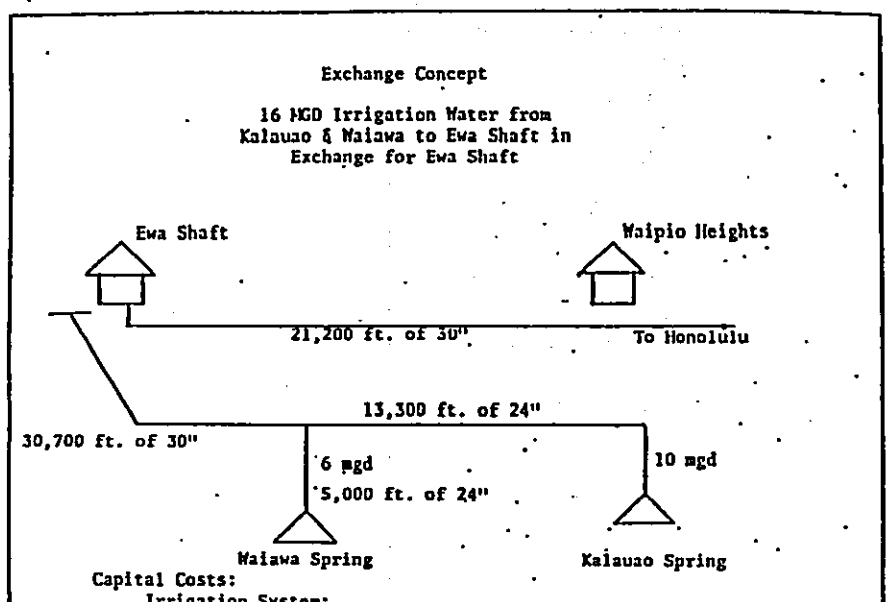
To deliver the stored flood water, an intake structure pumping station and pipeline would have to be constructed. Delivery of this source of water to the Waikele area would require a pipeline of 16,500 feet long. Consequently, this would be a relatively expensive source, at $0.68 per thousand gallons [6.8], and the environmental impacts would need to be studied in some detail before proceeding.* Trapping of sediments in the reservoir would shorten the useful life span of the reservoir unless periodic dredgings were performed.

4. Brackish Water*
Brackish water wells are another potential source of irrigation water. These could be developed in the caprock of the Ewa plain or Waianae coast. As long as the chloride content is below 1,000 ppm, the water would be suitable for this use. Some 20 mgd is presently being drafted from this area for irrigation.

B. BRACKISH WATER DEMINERALIZATION
Brackish water in the caprock and transition zone comprises a large potential water source presently unused due to excessive mineral content. Caprock water occurs in the Ewa plain and Waianae coastal areas. In the Ewa area, chloride content of the water ranges up to 2,000 ppm and total dissolved solids (TDS) up to 4,000. Transition zone wells are located along the shoreline of Pearl Harbor and in the Metropolitan area

*Additional information provided by the BWS is shown in Figure A-1.

Figure A-1



Capital Costs:

Irrigation System:	
Station:	$ 1,800,000
Pipeline:	
18,300 ft. of 24"	2,470,000
30,700 ft. of 30"	5,066,000
Total	$ 9,336,000
Domestic System:	
Stations: (Renovate Ewa Shaft or	$ 3,000,000
Pipeline: develop new source)	
21,200 ft. of 30"	3,816,000
Total	$16,152,000
Grand Total - Irrigation + Domestic	$16,152,000

Annual Domestic Water Production @ 90% load factor:
16 x 365 x 0.9 = 5,256 mil gal

Annual Costs:

Irrigation System:	
Operating Cost: - 5,256 x 410 x 0.21 =	$ 453,000
Amortization: - 9,336,000 x 0.07265 =	680,000
Domestic System:	
Operating Cost: - 5,256 x 250 x 0.21 =	275,000
Amortization: - 6,816,000 x 0.07265	495,000
Total	$1,910,000

Cost Per Million Gallons:
1,910,000 ÷ 5,256 = $364

SOURCE: BWS Planning Department

H-19

State of Hawaii
DEPARTMENT OF DEFENSE
OFFICE OF THE ADJUTANT GENERAL
3949 Diamond Head Road
Honolulu, Hawaii 96816

HIENG

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Gentlemen:

Kahana Valley Water Development Project

Thank you for providing us the opportunity to review your proposed project, Kahana Valley Water Development Environmental Impact Statement.

We have completed our review and have no comments to offer at this time.

Yours truly,

JERRY M. MATSUDA
Captain, HANG
Contr & Engr Officer

cc: Board of Water Supply
OEQ Comission w/EIS

RD OF WATER SUPPLY
IND COUNTY OF HONOLULU

COPY

January 27, 1982

Captain Jerry M. Matsuda
Contract and Engineering
Officer
Office of the Adjutant General
Department of Defense
State of Hawaii
3949 Diamond Head Road
Honolulu, Hawaii 96816

Dear Captain Matsuda:

Subject: Your Letter of January 19, 1982, on the Environmental Impact Statement for Kahana Valley Water Development Project

Thank you for reviewing the draft environmental impact statement for our proposed project. Your letter will be appended to the revised environmental document.

If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
R. M. Towill Corporation

University of Hawaii at Manoa

Water Resources Research Center
Holmes Hall 283 • 2540 Dole Street
Honolulu, Hawaii 96822

20 January 1982

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Gentlemen:

SUBJECT: EIS for Kahana Valley Water Development Project, Board of Water Supply, October 1981

We have reviewed the subject EIS and offer the following comments:

1. The most significant impact will undoubtedly be the effect of the wells on minimum stream flow. However, the EIS does not seem to address this adequately or in sufficient detail.

   a. The discussion centers primarily on water already being withdrawn (Waiahole Ditch System) but does not say what effects the wells will have on Kahana Valley and adjoining areas.

   b. Pp. V-748. Is 60 percent of the base flow equivalent to Q_{50}?

   This discussion is not clear, possibly because the terms are not defined initially or they are used inconsistently.

   c. It is not made clear that Q_{50} is the base flow. Consequently, the last paragraph on p. V-7 is confusing until it is realized that the sentence is probably written incorrectly. The sentence should read:

   "Thus, this study suggests that 60 percent of the base flow in needed to..."

   instead of:

   "Thus, this study suggests that 60 percent in the base flow needed to..."

   as printed.

   The wells possible effect on reducing streamflow needs more elaboration and detailed discussion. A more detailed hydrogeologic presentation would probably help.

2. The maps are inadequate.

   a. P. III-5. There is no indication of where Well No. 405 is located; therefore, it is impossible to follow the discussion.

   b. Similarly, none of the maps show where Kahana Wells I, discussed on p. III-14, is located.

3. Under "Section VI, Probable Adverse Environmental Impacts Which Cannot be Avoided", some mention should be made of the possible effect on reduced streamflow. It would be ill-advised not to do so.

4. In Appendix A, the sources for references 6.15 to 6.22 are missing from the list on p. A-13.

Thank you for the opportunity to comment. This material was reviewed by WRRC personnel.

Sincerely,

Edwin T. Murabayashi
EIS Coordinator

ETM:ja

cc: Y.S. Fok
H. Gee
Env. Center, UH
EMS

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

July 6, 1982

Dr. L. Stephen Lau, Director
University of Hawaii at Manoa
Water Resources Research Center
Holmes Hall 283
2540 Dole Street
Honolulu, Hawaii 96822

Attention: Mr. Edwin T. Murabayashi:

H-21

Dear Dr. Lau:

Subject: Environmental Impact Statement for the Kahana Valley Water Development Project Kahana Valley, Koolauloa District, Oahu
TMK: 5-2-01, 02, 03, & 05

Thank you for your letter dated January 20, 1982 regarding the Kahana Valley Water Development Project. The following is offered in response to your comments on the Environmental Impact Statement:

1a. The EIS has been revised to include an expanded discussion on the effects of the wells minimum streamflow, Kahana Valley and adjoining areas.

b. The EIS has been revised to include a more complete discussion of the streamflow reduction. Q_{90} is the flow exceeded 90 percent of the time and is not equivalent to 60 percent of the base flow. The revised EIS provides a hydrologic discussion to clarify the terms and remove any inconsistencies (Attachment #1).

c. The sentence in the last paragraph on page V-7 is a quote from the Timbol Report. The Q_{90} is used to determine the dry weather flow contributions to Kahana stream by groundwater sources and was incorrectly used as the base flow for applying the "Tenant Method." The EIS has been revised to correct this inconsistency. A more detailed hydrogeologic discussion has been provided (Excerpt from WRRC Technical Report No. 77).

2a. Well No. 405 has now been located on the EIS graphics (Attachment #2).

b. Kahana Wells I has now been located on the EIS graphics.

3. The EIS has been revised to discuss streamflow reduction in Section VI (Attachment #3).

4. The sources for references 6.15 to 6.22 have been included in the revised EIS.

We appreciate the time you spent in reviewing our document. If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: R. M. Towill

c. Kahana Stream

The withdrawal of 6 million gallons a day by Kahana Wells III, IV and V from the high level dike water will have an effect on Kahana Stream because the dike system is the source of most of the water that flows in Kahana Stream during the dry season. Although some dikes are partially visible, the number, size and shape of the dike compartments of the area are not known, so it is not possible to develop a water budget for the dike compartments to be tapped by the wells. The proposed wells are located near the transition between the dike complex and the marginal dike zone and will withdraw dike water moving parallel to the predominant dike trend toward Kahana Stream. Well Fields III, IV and V are in a position to tap dike compartments that provide water to the reach where the greatest gain in groundwater occurs. This is the reach between elevations 115 and 300 feet where 52 percent of the Q_{90} (dry weather base flow) is gained. Thus, the well pumping will have an effect upon Kahana Stream which will be measurable during the dry season if the ultimate development is obtained.

The overall geology and hydrology of Kahana Valley is well documented but there is little known about the individual well field sites. While much can be inferred from the overall knowledge of the area, more knowledge of the well field sites will be obtained during well testing and later during well development. This is the reason for the incremental development of the well fields.

During well testing, the groundwater head drawdown will be measured until a steady state is reached. This will probably withdraw some of the water that flows preferentially parallel to the dike trend towards Kahana Stream, not only from the dike compartment which the well taps but also from the compartments around it. Depending upon the weather prior to and during the test, the USGS may detect an effect upon Kahana Stream due to the well testing. In any case, the USGS will monitor the stream during well tests for the three well fields. Well test monitoring may require the installation of temporary gages at selected sites along the stream. Should a well field provide an inadequate amount of water, a new well field will be chosen. Only after all three well fields have been completely tested and proven will the first well field be developed and integrated into the water system.

After the first well field is put into service, there will be time to study the effects of pumping upon Kahana Stream before the next field is put into service. The USGS continually monitors Kahana Stream and the BWS will monitor the groundwater heads at the individual well sites so there will be a considerable volume of information available from which to draw conclusions about the effect of the wells upon the stream. As the rest of the well fields are put into service, any effect upon the stream will probably be more noticeable, requiring quick response by the BWS. The BWS has all of its wells tied into a central control station so curtailment of pumping can be done immediately in response to any adverse findings of the USGS stream monitoring or BWS well pumping data.

The BWS controls all of its well pumping from its Beretania Pump Station and will curtail pumping should the groundwater head at the well begin to go down below the equilibrium level. A drop below this level would mean that the pumping rate has exceeded the recharge rate of the dike compartment and pumping must be curtailed to prevent excessive drawdown of the head of the compartment. Decreasing the pumping rate protects the integrity of the water source during times of low recharge and will also protect Kahana Stream.

Groundwater stored in the dike complex and marginal dike zone moves toward the ocean or Kahana Stream because of the difference in elevation of the water surface elevations or head. Thus, the lowering of the groundwater head in the dike compartments tapped reduces the hydraulic gradient that drives the stored groundwater through the permeable rock, cracks, fissures, and dikes toward Kahana Stream from these and surrounding compartments. A maintainable equilibrium of groundwater head does not mean that the groundwater will not be diverted from Kahana Stream. For this reason, the USGS stream data is of great importance in the maintenance of the integrity of Kahana Stream. Should a decrease in stream flow occur that is deemed detrimental to Kahana Stream, pumping will also be curtailed.

Close monitoring of the stream should prevent any adverse effects upon the "secondary habitat" for endangered species.

In a recent report by Amadeo S. Timbol for the U. S. Army Corps of Engineers, entitled Limnological Survey of Kahana Stream, Oahu, the minimum stream flows are discussed in the report summary:

"Minimum instream flow at 10, 30 and 60 percent, based on methods developed by Tenant (1976), of the average discharge are discussed. It is suggested that 10 percent minimum flow is not adequate for the maintenance of desirable macrobiota in Kahana Stream. The stream will suffer serious degradation, with the definite loss of the critical habitat in the main stream.

"Thirty percent minimum stream flow could lead to the eventual disappearance of the o'opu nakea, a threatened endemic goby that is also a food fish. The most obvious detrimental effect is on the critical habitat caused by the decrease in water velocity and other changes that go with it.

"Sixty percent minimum stream flow had no significant detrimental effect both the biota and physical features of Punaluu

Stream (Timbol herein refers to a similar study recently completed on a stream diversion on Punaluu Stream in the adjacent Punaluu Valley). Some form of degradation must have taken place upstream of the diversion, but not below.

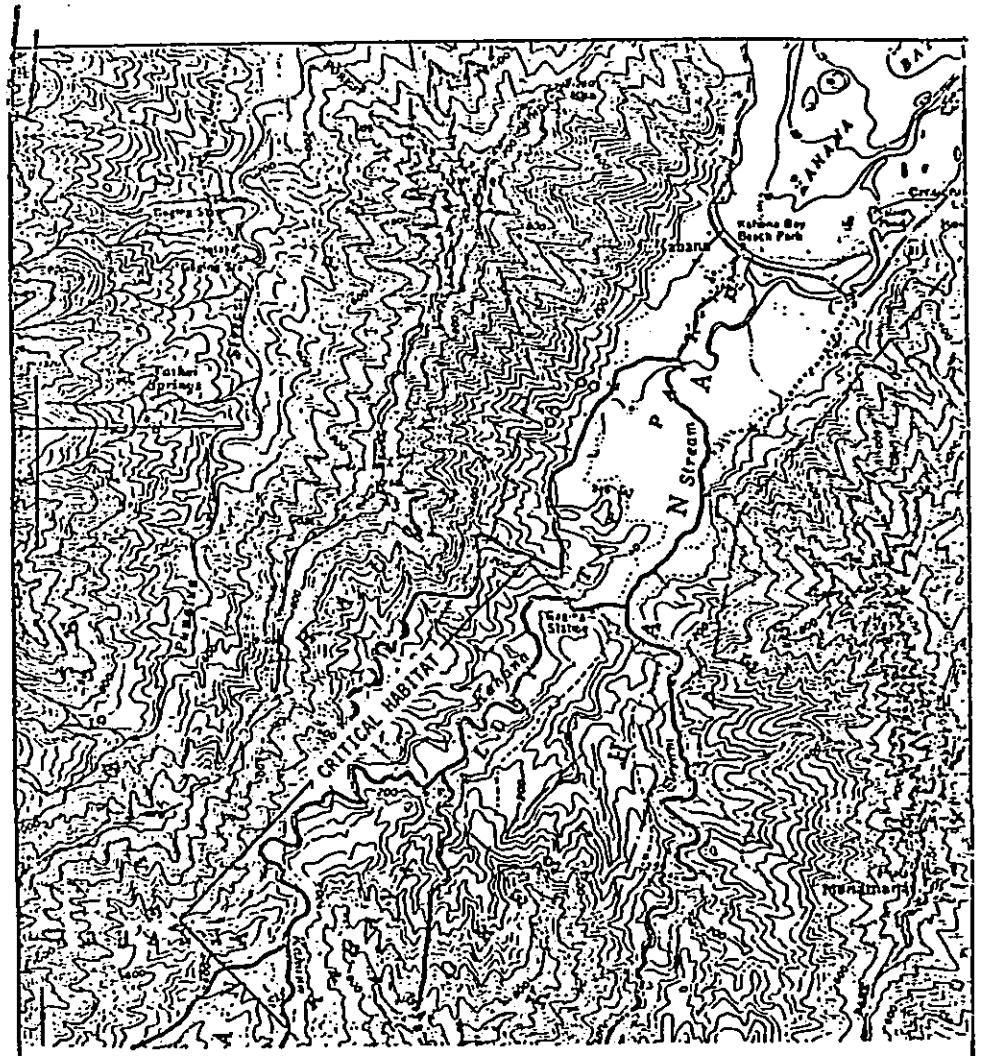
"Thus, this study suggests that 60 percent is the base flow needed to sustain good survival conditions for Kahana macrobiota, and to maintain economic and intrinsic values, and general recreational qualities."

The value suggested is 60 percent of the average flow measured by the USGS gage or 13.9 mgd. While this gage is not at the mouth of Kahana Stream, no measureable effects below the gage are anticipated because the sediments of the valley retards the movement of groundwater into the stream.

Some precautionary statements on the minimum stream flow recommendations are also provided by Timbol:

"Some precautionary statements are needed at this point. Hawaii streams are minute when compared with continental rivers (e.g., the discharge of the Sacramento-San Joaquin River is 80 times more than that of Wailuku River in Hilo, Hawaii's largest). Climate also makes streams in Hawaii different from U. S. mainland streams because the high mean annual temperature and lack of greater seasonal changes here give these streams a much milder external environment than streams of temperature regions. The methods of Tenant (1976) are based on continental stream ecosystems and have not been tested in Hawaii. Thus, even the 10, 30, 60 percent values may be not appropriate for Kahana Stream."

An approximate value of 13.9 mgd for a minimum stream flow has been suggested by Timbol. The critical habitat he refers to is shown in Figure 13. This is the basis upon which the BWS will initially set its minimum stream flow reduction. This basis suggested by Timbol will be modified by the findings of State, and Federal agencies on the effects of the wells upon the flora and fauna of Kahana Valley and by the proposed minimum stream flows yet to be determined by the DLNR. The DLNR will use one of many "state of the art" techniques to determine the minimum stream flow such as the Instream Flow Group Method developed by the United States Department



KAHANA VALLEY WATER DEVELOPMENT PROJECT
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 13

CRITICAL HABITAT

CITY AND COUNTY OF HONOLULU
BOARD OF WATER SUPPLY

H-24

Attachment 3

SECTION VI

PROBABLE ADVERSE ENVIRONMENTAL IMPACTS WHICH CANNOT BE AVOIDED

The unavoidable short term adverse impacts are those related to construction activities. Temporary air pollution from dust, vehicular emissions, noise from construction equipment and inconvenience to resident and visitor traffic will occur. Particular care will be taken to avoid any damage to the archaeological sites near Kahana Wells II and excess trubidity in Kahana Stream during construction to the extent practicable.

The long term adverse impacts, which are unavoidable because of the nature of the project, will be the visual impact and physical land changes caused by the well fields and the access road and the potential adverse effect on the flow of Kahana Stream and the endangered species secondary habitat in the lower valley. The stream flow will be reduced but to a signficant level only during the dry season when water withdrawal may have to be curtailed. Should the reduction in stream flow show signs of impacting adversely the stream or the waterbird habitat, water withdrawal will be curtailed until the Federal and State agencies find increased withdrawal acceptable. Due to the dependence of the stream and the marsh lands upon both rainfall and groundwater, the adverse impacts from groundwater withdrawal will have a seasonal dependence. For this reason, the BWS will be flexible in its pumping operations in Kahana Valley.

Improvements to the access road will again signal man's intrusion into the valley as will the wells and their associated control buildings. It should be noted that the well field areas and the valley at higher elevations were used extensively for jungle warfare training by Army troops during World War II. Still, the affected area is relatively small and only those traveling along the access roads will be able to see the effects of construction. The access road on the opposite side of the valley from Kahana Wells III, IV and V is available as an alternate route for visitors on foot to avoid the visual intrusion of the well sites. The noise generated at the individual well sites will be greatly reduced by sound attenuators. Proper landscaping will blend the individual wells and control buildings into their surroundings.

Attachment 3

KAHALU'U NEIGHBORHOOD BOARD NO. 29
c/o KAHALU'U COMMUNITY CENTER
47-232 WAIHEE ROAD
KANEOHE, HAWAII 96744
NUKOLA KEA · KAHALU'U · WAIHE'E · WAIAHOLE · WAIKANE · HEMPUU AND KUALOA

"Let us not ever have an unhappy minority"

January 20, 1982

Office of Environmental Quality Control
State of Hawaii
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Environmental Impact Statement
Kahana Valley Water Development Project, Kahana, Ko'olaupoko, O'ahu

Gentlemen:

The Kahalu'u Neighborhood Board No. 29 considers the Kahana Valley Water Development Project premature and recommends that it not proceed at this time.

Because stream flow monitoring systems have not yet been put in place, necessary comprehensive studies have not yet been undertaken and minimum stream flow standards have not yet been established, we must repeat our positions on Windward water resources development and diversion.

Furthermore, it is our understanding that there may be a legal question as to whether any additional Windward exploratory or production well development can be allowed to proceed until the Hawaii Supreme Court decides the minimum stream flow dispute between Waiho'e farmers and the Board of Water Supply.

Specific comments relating to the Kahana Valley Water Development Project are as follows:

1) No Kahana water development until interim Windward Water District stream flow standards are adopted, a Windward Water District stream flow monitoring system is in place and comprehensive Windward Water District water resources studies are completed. Excerpts from our Board's Water Resources Position Statement:

   - "The Department of Land and Natural Resources immediately establish interim stream flow standards on all Windward streams."
   - "The Department of Land and Natural Resources immediately commence monitoring in-stream flows of all Windward streams-gauging stations to be installed at strategic locations along each stream."
   - "The Department of Land and Natural Resources initiate a comprehensive study of all Windward water resources encompassing the sources and amounts of impounded high level dike water, underlying basal water, ground water, in-stream water, surface run-off & ground recharge

and the hydrologic relationships of the various types of water resources and their further inter-relationships with watersheds, shoreline and Kane'ohe Bay."

2) No Kahana water development for diversion outside the Windward Water District. This environmental impact statement says that "Planning for the development of the Kahana source has been accelerated to meet projected water demands in the Windward and Honolulu Districts." and the Board of Water Supply has previously stated that it estimates that, by the year 2000, it will produce windward water at the rate of 43 mgd of which it intends to transport 21 mgd to urban Honolulu. We fully support the 1977 City General Plan which directs that urban growth occur in the Primary (Honolulu) and Secondary (Ewa) Urban Centers and which designates the Windward Coast from Kahuku to Kahalu'u as Rural and Agricultural. However, the Board of Water Supply must cease to assume that there will be "excess" windward water available for diversion to these urban centers from the Windward Water District. Excerpts from our Board's Water Resources Position Statement:

   - "Development of any additional windward water resources be limited by interim or permanent stream flow standards and be reserved first for windward agricultural use and next for windward suburban use."
   - "A moratorium be established on any additional diversion of windward water outside Ko'olaupoko & Ko'olauloa until establishment of permanent stream flow standards that will assure fulfillment of the policy of the State of Hawai'i to achieve ever increasing agricultural self-sufficiency."

We trust that you will give our concerns your serious attention.

Sincerely yours,

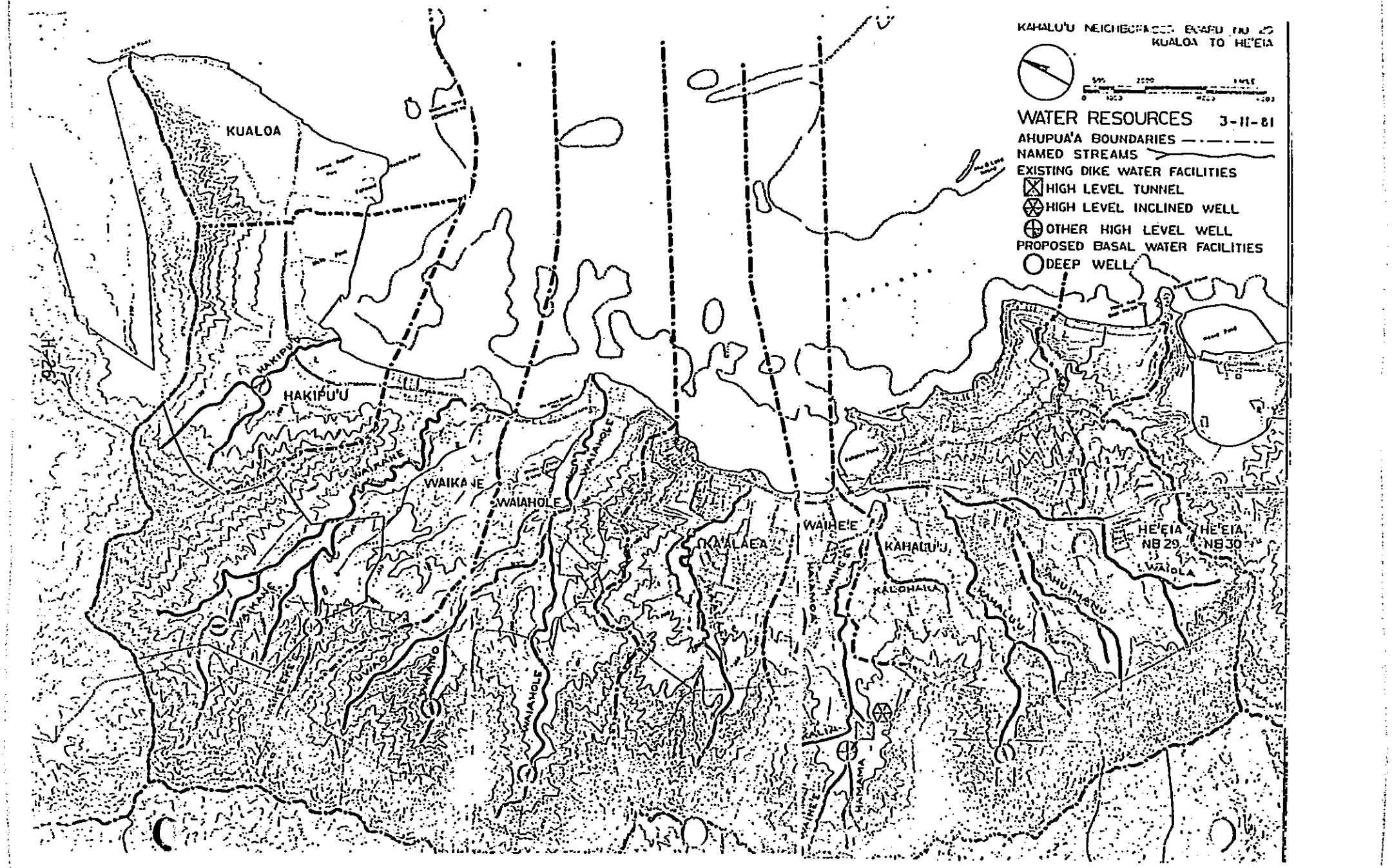
Edwin B. Stevens

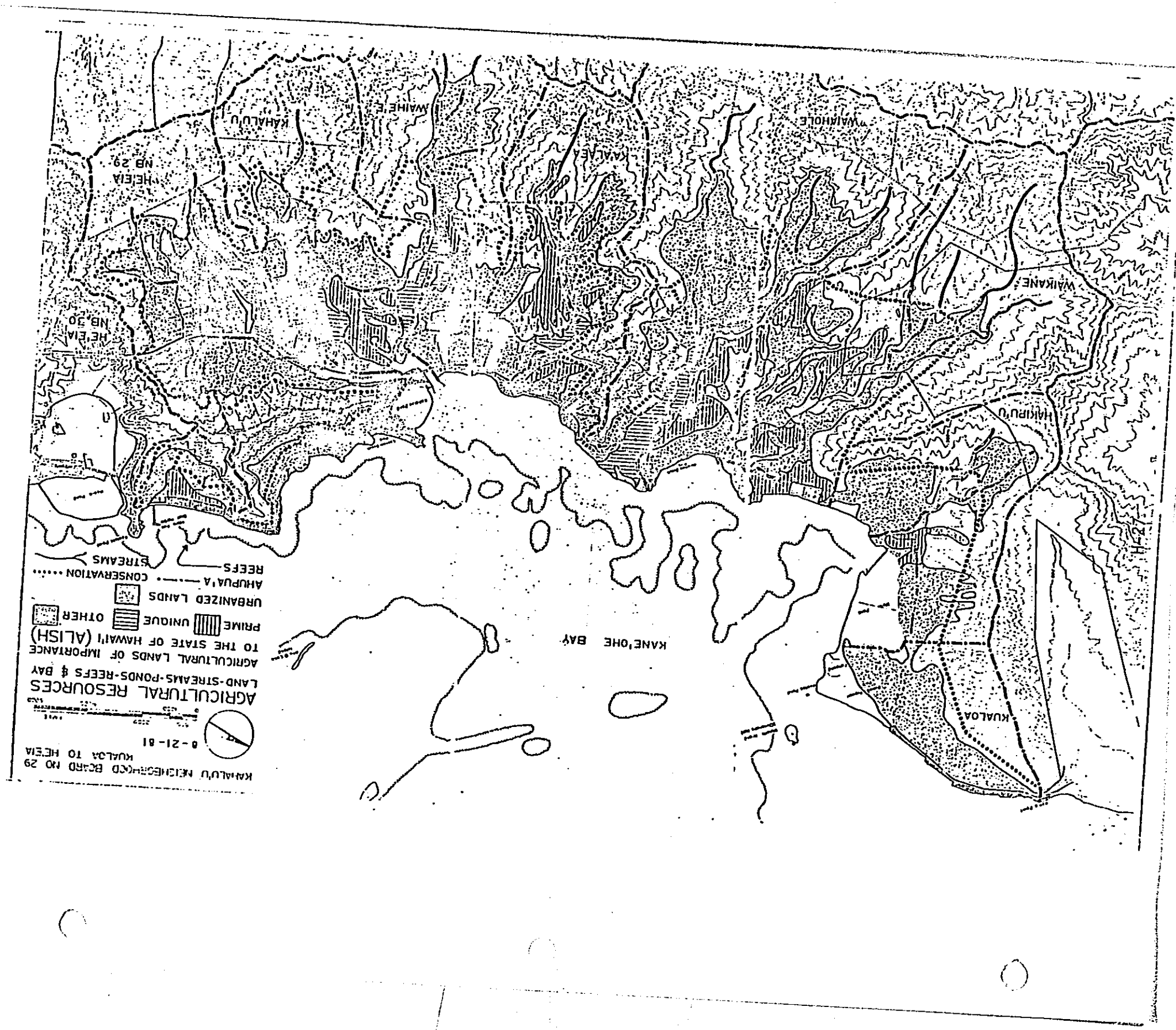
Edwin B. Stevens, Chairman
Kahalu'u Neighborhood Board No. 29

Attachments: N.B.#29 Water Resources Map dtd. 3-11-81
N.B.#29 Agricultural Resources Map dtd. 8-21-81

References: N.B.#29 Water Resources Position Statement dtd. 3-11-81
N.B.#29 letter to DLNR Monitoring Stream Flows dtd. 11-3-80
DLNR letter to N.B.#29 re In-stream Use Study dtd. 8-4-81

Copies: Board of Water Supply
Department of Land and Natural Resources
Ko'olaupoko N.B.#28
Kahalu'u N.B.#29 - Chairman & Water Resources Committee
Kahalu'u Community Resource Center
Neighborhood Commission


KAHALU'U NEIGHBORHOOD BOARD NO. 29
KUALOA TO HE'EIA
WATER RESOURCES 3-11-81
AHUPUA'A BOUNDARIES
NAMED STREAMS
EXISTING DIKE WATER FACILITIES
HIGH LEVEL TUNNEL
HIGH LEVEL INCLINED WELL
OTHER HIGH LEVEL WELL
PROPOSED BASAL WATER FACILITIES
DEEP WELL
KUALOA
HAKIPU'U
WAIKANE
WAIAHOLE
KA'ALAE'A
WAIHE'E
KAHALU'U
KALOHAIKA
HE'EIA NB 29
HE'EIA NB 30
WAIOLA
H-26


KAHALU'U NEIGHBORHOOD BOARD NO 29
KUALOA TO HE'EIA
8-21-81
AGRICULTURAL RESOURCES
LAND-STREAMS-PONDS-REEFS & BAY
AGRICULTURAL LANDS OF IMPORTANCE
TO THE STATE OF HAWAI'I (ALISH)
PRIME
UNIQUE
OTHER
URBANIZED LANDS
AHUPUA'A
CONSERVATION
STREAMS
REEFS
KANE'OHE BAY
KUALOA
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WAIKANE
WAIAHOLE
KAALAEA
WAIHE'E
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HE'EIA
NB 29
HE'EIA
NB 30

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

July 28, 1982

Mr. Edwin B. Stevens, Chairman
Kahaluu Neighborhood Board No. 29
Kahaluu Neighborhood Community Center
47-232 Waihee Road
Kaneohe, Hawaii 96744

Dear Mr. Stevens:

Subject: Environmental Impact Statement (EIS) for the Kahana Valley Water Development Project Kahana Valley, Koolauloa District, Oahu
TMK: 5-2-01, 02, 03 & 05

Thank you for your letter dated January 20, 1982 regarding the Kahana Valley Water Development Project. The following is offered in response to your comments on the EIS:

1. The proposed water development at Kahana Valley is one of several Windward projects that is necessary to meet the future water requirements of this island. The Department of Land and Natural Resources (DLNR) will be developing standards for minimum streamflows. Since our well development projects already consider minimum streamflows, we foresee no problem in complying with any standards adopted by DLNR.

2. There are no pending legal questions affecting the project due to the dispute between the Board of Water Supply and the Waihe'e Farmers.

   a. It is our intention to develop groundwater sources only to safe levels before turning to more costly sources of potable water. The EIS has been revised to reflect this.

   b. The water from the proposed wells would serve the Windward district. Any water in excess of the needs of the Windward district would be transmitted to Honolulu via Hawaii Kai.

We appreciate the time you spent in reviewing our document. If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: R. M. Towill Corp.

H-28

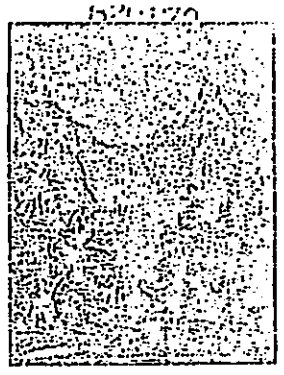
The Sierra Club, Hawaii Chapter
Post Office Box 22897, Honolulu, HI 96822
Telephone: (808) 946-8494

RECEIVED
BOARD OF WATER SUPPLY
JAN 27 11 10 AM '82

January 21, 1982

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96843



Nuuanu Pali, by Fisquet, 1837

Re: EIS for the Kahana Valley Water Development Project

The Honolulu Group of the Hawaii Chapter of the Sierra Club have the following concerns in regards to the Kahana Valley Water Development Project:

H-29

1. The preservation of one of the two remaining streams on Oahu that is still of high natural quality.
2. The impact on an important cultural and recreational valley.
3. The realization of the Kahana State Park's goals in establishing a unique "living park", whose activities will be very dependent upon preserving the stream flow.
4. Conservation on a more intense level as a way to eliminate the necessity of developing all of Oahu's potential ground water for many years.

1. The EIS states that: "The withdrawal of 6 million gallons in Kahana Wells III, IV, and V from the high level dike water will have an effect on Kahana Stream because the dike system is the source of most of the water that flows in Kahana Stream during the dry season". Since the Board of Water Supply in its EIS does not mention the priority of the stream as a natural resource of high quality left in its natural state, we would assume that this has not been a consideration. Sierra Club values Kahana as a place for hiking because of the stream. Except in the very back of the valley, the botany represents the period of Hawaiian and later occupation and is not outstanding as far as native species is concerned. However, in hiking on Oahu, we find nothing like the beauty of the stream in its present state. We do not feel that this stream should be tampered with at all. To us it represents a more valuable resource than using its waters, tapped at the source, to provide for more questionable development. The 1979 Hawaii Water Resources Regional Plan, which is intended to guide Federal, State, and County actions which affect Hawaii's water resources, lists Kahana Stream and estuary as a scenic resource to be protected and identifies Kahana Valley wetlands as a proposed wildlife refuge. The 1977 Hawaiian Waterbirds Recovery Plan, which was jointly prepared by Federal and State biologists, classifies Kahana Marsh and Stream as a "Secondary Habitat Area" for two species of endangered Hawaiian waterbirds. In the EIS, we do not see a concern for water in its natural state as a valuable resource, only as a developal resource. In this case, we would favor the development of surface water first rather than the potential of groundwater development as a first priority. From a conservationist's point of view, when there comes a decision between retaining the integrity of the land (or of the stream), the decision must go to the land, because economics will recover but land changes will not. It is obvious that Oahu cannot continue to enjoy the luxury of inexpensive water. If water is priced at its real worth, (which is impossible, since it is equivalent to life itself), a greater degree of conservation will automatically take place.

2. The EIS description of the work and machinery necessary to provide the infrastructure for the wells does not adequately deal with the resulting impact. Road improvement alone will change the atmosphere of the Valley, as evidenced presently by the change in flora from the point where the present road becomes a trail. When we hike in the Valley, we feel as if we have returned to "civilization" once we reach the present road. In effect, the hike into a natural area has ended. Vegetation around the sites will not do much to mitigate this same impact. The EIS does not assure us that it is even possible to "retain the integrity of the land", if this project goes forward. The natural wetness of the Valley will increase the impacts, even though the provision is for the work to be done in the dry season.

3. We do not feel that the EIS gives adequate assurance that there will remain a sufficient water supply for the proposed "living park" agricultural activitie This Valley was obviously important in taro cultivation, with its ample supply of cool fresh water. We feel that it is an important fact that taro growing recycles water rather than using it. It cannot be justified that the water needed for this agricultural activity be taken for non-recycling uses and again brings up the question of philosophy and priorities for water uses. This whole water question has yet to be decided in the courts. We share the concerns of the Board of Agriculture and of the Kahana State Park committee.

4. Finally, we believe that if conservation were given the same priority as development, it would be possible to elect the alternative of, "no project". We do not find that conservation as an alternative is adequately dealt with.

Sincerely,
Kate Marsh
Acting Conservation Chair

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

July 30, 1982

Ms. Lola Mench
Acting Conservation Chairman
The Sierra Club, Hawaii Chapter
P. O. Box 22897
Honolulu, Hawaii 96822

Dear Ms. Mench:

Subject: Environmental Impact Statement for the Kahana Valley Water Development Project, Kahana Valley, Koolauloa District, Oahu
TMK: 5-2-01, 02, 03 & 05

Thank you for your letter of January 21, 1982 relating to the Kahana Valley Water Development Project. We submit the following in response to your comments on the Environmental Impact Statement (EIS):

1. The EIS has been revised to provide for a discussion of the stream as a natural resource of considerable value as a habitat for native flora and fauna, and for its aesthetic quality for hiking and other recreational activities. The EIS has also been revised to indicate that the decision to develop the groundwater sources in Kahana Valley was made with priority consideration for providing water in the most economical way for the people of Oahu while minimizing environmental impacts.

2. The EIS has been revised to provide for a more detailed discussion of the impacts due to well and appurtenant construction. We will make every effort to minimize the impact of the project during its construction so as to retain the cultural and recreational features of the valley. We are working with the State Parks Division in developing our project.

H-30

3. The agricultural needs of Kahana Valley are being considered in the planning of the project. The EIS has been revised to indicate that a sufficient water supply will be ensured for the valley.

4. The BWS has a program for water conservation, and installation of water-saving devices is now required by the building code. Water conservation is a continuous ongoing program which is being carried out in conjunction with a progressive water development program to provide for the water needs of the Island.

We appreciate the time you spent in reviewing the document. If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: R. M. Towill

820169

Office of Environmental Control
550 Halekauwila St. Rm. 301
Honolulu, Hi. 96813

22 January 1982

Board of Water Supply
630 South Beretania St.
Honolulu, Hawaii 96843

To whom it may concern:

Subject ; EIS for Kahana Valley Water Development Project

I would like to point out some errors in the BWS's estimate of the effect its wells will have on Kahana stream. It states on page III-4 that the Q-90 of the stream is 11.2mgd and the average flow is 30mgd,k Then on page V-7 there is a quotation from a report by the USGS which suggests that 60% of the average stream flow is an acceptable minimum stream flow. This may or may not be true, but if 60% were an acceptable figure then the minimum stream flow for Kahana should be 18mgd. (60% x 30mgd average flow) However, the BWS says that 60% of the Q-90, or 6.7mgd is the acceptable minimum stream flow. This is in direct conflict with the recommendation which they themselves propose to use as a minimum stream flow guide.

Sincerely,

Charles F. Reppun
47-410 Iulani St.
Kaneohe, Hi. 96744

H-31

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

June 21, 1982

Mr. Charles F. Reppun
47-410 Lulani Street
Kaneohe, Hawaii 96744

Dear Mr. Reppun:

Subject: Environmental Impact Statement for the Kahana Valley Water Development Project
Kahana Valley, Koolauloa District, Oahu
TMK: 5-2-01, 02, 03 & 05

Thank you for your letter dated January 22, 1982 regarding the Kahana Valley Water Development Project. The following is offered in response to your comments on the Environmental Impact Statement (EIS):

The 30 mgd value cited is for the entire watershed of which Kahana stream is a part. The EIS is inconsistent in using the Q_{90} value in applying the "Tenant Method". This inconsistency has been corrected and the revised hydrologic discussion will use the average flow at the USGS gage as the base flow. The average flow at the USGS gage is 23.2 mgd, which includes storm runoff.

The EIS has been revised to state that the "Tenant Method" recommending no more than a 40 percent reduction in the average streamflow of 23.2 mgd will be one of the methods used to determine the groundwater withdrawal from Kahana Valley. In addition, groundwater heads at the well sites will be monitored in an effort to anticipate the effect on Kahana Stream. Before any permanent water development operations can begin, the BWS must explore for developable groundwater sources in Kahana Valley. In the meantime, the Department of Land and Natural Resources will determine interim and permanent minimum streamflow standards.

We foresee no problems in complying with the new standards.

We appreciate the time you spent in reviewing our document. If you have any questions, please contact Lawrence Whang at 546-5221.

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: R.M. Towill Corporations

United States Department of the Interior

GEOLOGICAL SURVEY
Water Resources Division
P.O. Box 50166
Honolulu, Hawaii 96850

January 22, 1982

Environmental Quality Commission
Office of the Governor
550 Halekauwila Street Rm. 301
Honolulu, Hawaii 96813

Subject: Environmental Impact Statement for the
Kahana Valley Water Development Project
TMK: 5-2-01, 02, 03 and 06

We have reviewed the above Environmental Impact Statement and we have no comments to offer.

Hereafter, will you please include the U.S. Geological Survey in your list of organizations consulted for the EIS Preparation Notices on any major water-development projects. We feel that this procedure will enhance our ability to comment on the subsequent EIS.

Yours truly,

Benjamin L. Jones
District Chief

cc: Board of Water Supply, City and County of Honolulu

H-33

ARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

February 10, 1982

Mr. Benjamin L. Jones
District Chief
Water Resources Division
Geological Survey
U.S. Dept. of the Interior
P.O. Box 50166
Honolulu, Hawaii 96850

Dear Mr. Jones:

Subject: Your Letter of January 22, 1982, on the Environmental Impact Statement for Kahana Valley Water Development Project

Thank you for reviewing the draft environmental impact statement for our proposed project. Your letter will be appended to the revised environmental document.

We will include your agency in our list of organizations consulted for all future EIS Preparation Notices.

If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

For KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
R.M. Towill

GEORGE R. ARIYOSHI
GOVERNOR

BD OF WATER SUPPLY
JAN 27 11 10 AM

JACK K. SUWA
CHAIRMAN, BOARD OF AGRICULTURE

820171

STATE OF HAWAII
DEPARTMENT OF AGRICULTURE
1428 SO. KING STREET
HONOLULU, HAWAII 96814

January 22, 1982

RESPONSIBLE

To: Office of Environmental Quality Control

Subject: Environmental Impact Statement
Kahana Valley Water Development Project
Kahana Valley, Koolauloa District, Oahu
TMK: 5-2-01, 02, 03 & 05

The Department of Agriculture has reviewed the subject Environmental Impact Statement and offers the following comments.

We were unable to find where the EIS directly indicates that "water requirements for domestic and agricultural activities in the proposed park will be preserved and assured" (December 1, 1980, letter from Kazu Hayashida to John Farias, Jr.). We understand from discussion with Board of Water Supply staff that Kahana Valley residents will have the first chance for the water they need, but that water cannot be promised for several years in the future due to current Board of Water Supply policy. However, since it would be three to five years before the wells could be put into production if water is found, the development of the park should be at a stage where water requirements will be known. We believe that it would be helpful for the EIS to state this more clearly.

Thank you for the opportunity to comment.

JACK K. SUWA
Chairman, Board of Agriculture

cc: Board of Water Supply
City & County of Honolulu

H-34

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

June 18, 1982

Mr. Jack K. Suwa
Chairman, Board of Agriculture
State of Hawaii
Department of Agriculture
1428 South King Street
Honolulu, Hawaii 96814

Dear Mr. Suwa:

Subject: Environmental Impact Statement for the Kahana Valley Water Development Project, Kahana Valley, Koolauloa District, Oahu TMK: 5-2-01,02,03 and 05

Thank you for your letter dated January 22, 1982 regarding the Kahana Valley Water Development Project. In response to your comment on the Environmental Impact Statement, we have included a statement on page II-4 of the Revised EIS that the water requirements for domestic and agricultural activities in the parks will be preserved and assured.

We appreciate the time you spent in reviewing our document. If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

Kazu Hayashida
KAZU HAYASHIDA
Manager and Chief Engineer

cc: R. M. Towill

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BD OF WATER SUPPLY
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22 January 1982

Mr. Kazu Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96813

Dear Mr. Hayashida:

We have reviewed the enviromental impact statement for the Kahana Valley Water Development. There are several things which concern us.

Our primary concern, as you well know, is the taking of water from Windward Oahu on such a large scale (22.8 mgd more) for urban development elsewhere. This will preclude the expansion of diversified agriculture in Windward, and may mean its eventual demise. The BWS continues to give priority to urban uses of water over agricultural use. The policy of the BWS seems to be to develop water for urban uses right up to the ability of the island to supply water (470 mgd), without consideration for farming, at least any expansion of agricultural use of water.

No consideration seems to be given to leaving a margin for periods of severe drought if water development will reach 470 mgd. That leaves a margin of 10 mgd from the 480 mgd which is the lover estimated limit of sustainable yeild for the island

The Kahana Stream is one of the few major streams left on Oahu with its natural flow still nearly intact. Beacuse it is in a living park which covers most of the valley, it should be left alone. This may be the one place on Oahu where the traditional Hawaiian ahupuaa concept can be restored. That possibility should not be lost, and the reduction of the stream flow from 11.2 mgd to 6.7 mgd could threaten it.

This 40% reduction in stream flow will aggravate flooding problems in times of heavy rain. Vegetation growth along the stream banks will be increased because the stream will be smaller. Therefore the stream will be far more subject to blockages and overflows, or changes in course.

Another effect of reduced streamflow will be increased salinity of Kahana Bay and possible ecological changes affecting the aquactic life of the Bay. Kahana is a good source of fish. No mention is made of this possible effect in the EIS.

Thank you for this opportunity to comment on the EIS.

Sincerely,

John Lewis Reppun

John Reppun
Vice President,
Hui Malama Aina O Ko'olau

H-35

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA
HONOLULU, HAWAII 96843

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KAZU HAYASHIDA
Manager and Chief Engineer

July 21, 1982

Mr. John Reppun, Vice President
Hui Malama Aina O Ko'olau
47-178B Pulama Place
Kaneohe, Hawaii 96744

Dear Mr. Reppun:

Subject: Environmental Impact Statement for the Kahana Valley Water Development Project Kahana Valley, Koolauloa District, Oahu
TMK: 5-2-01, 02, 03, & 05

Thank you for your letter dated January 22, 1982 regarding the Kahana Valley Water Development Project. The following is offered in response to your comments on the Environmental Impact Statement (EIS):

1. Proposed development of Windward Oahu sources is part of our overall plan to meet the future demands of the Island. The water needs of Windward Oahu will be satisfied first, and any excess water will be exported to Honolulu. The water will be available for both urban and agricultural uses. Our projections of future water requirements for the Island take into account the agricultural needs of the windward area.

2. We plan to develop groundwater on Oahu only up to the sustainable yield that can be withdrawn without depleting or harming our groundwater resources. Groundwater withdrawal will be limited to insure the integrity of Oahu's groundwater source.

3. Our plan takes into consideration the value of Kahana Valley as a natural resource. The preservation of the natural beauty of the valley is a priority consideration. The EIS has been revised to indicate that existing streamflow of up to 13.9 mgd will be

July 21, 1982

maintained. This flow is equal to 60 percent of the average flow measured at the U. S. Geological Survey (USGS) gage. This 13.9 mgd flow will be maintained until minimum streamflow standards are developed by the State.

4. Although we have set a minimum flow of 13.9 mgd to be maintained in the stream, we do not foresee any significant reduction in streamflow due to our wells because every effort will be made to maintain existing streamflows.

We appreciate the time you spent in reviewing our document. If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: R. M. Towill Corporation

BD OF WATER SUPPLY

United States Department of the Interior

JAN 27 11 10 AM '82

FISH AND WILDLIFE SERVICE
300 ALA MOANA BOULEVARD
P.O. BOX 50167
HONOLULU, HAWAII 96850

IN REPLY REFER TO:
ES
Room 6307

JAN 22 1982

Office of Environmental Quality Control
Office of the Governor
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Re: Environmental Impact Statement (EIS) for Kahana Valley Water Development Project.

Dear Sir:

We have reviewed the subject Environmental Impact Statement (EIS). The EIS omits important information which is necessary to provide a clear understanding of the environmental impacts that may result from implementation of the proposed wells. Specific portions of the EIS, which lack substantive information and contain discrepancies or inaccurate statements, are discussed in the following review comments.

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Page I-3. Paragraph 4. There is a possibility that withdrawal of groundwater will reduce discharge of Kahana Stream year-round.

Page II-4. Paragraph 4. This paragraph implies that it is the intention of the Board of Water Supply (BWS) to fully utilize all available groundwater resources before any large scale development of alternative water sources is pursued. Based upon currently proposed water developments on Oahu, it is apparent that this policy will ultimately result in a significant reduction of surface water discharge. Therefore, we encourage the BWS to seriously evaluate the cumulative impacts of this and other ongoing water developments upon stream and coastal water quality, instream uses, and the biological productivity of Oahu's streams and nearshore waters.

Page II-6. Table 2. Should the Waiahole-Waikane wells illustrated in Figure 2 also appear in this table?

Page II-9. Paragraph 4. It may not be appropriate to reference a specific minimum instream flow value at this point in the text since the derivation of this value is not presented until later chapters. Furthermore, the 6.7 mgd value cited in the EIS is not the correct minimum instream flow value for Kahana Stream (refer to our subsequent comments).

Page III-8. Paragraph 2. This paragraph should indicate that Kahana marshlands, Stream, and pasturelands were identified as areas of secondary importance to

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endangered species in the "Hawaiian Waterbirds Recovery Plan" prepared by the U.S. Fish and Wildlife Service (August 1977) in conjunction with state and federal wildlife biologists. This plan recommends that these downstream habitats be preserved or protected for populations of endangered coot and gallinule. The stream and pastures further up in the valley also have enhancement potential for these waterbirds.

Page III-8. Paragraph 3. The EIS would be greatly enhanced by citing the results of the "Limnological Survey of Kahana Stream, Oahu" by Dr. Assadeo S. Timbol (1979) (a report prepared for the Army Corps of Engineers, in anticipation of future water development projects within Kahana Valley). Further information about Kahana's estuarine and bay resources may be cited from Timbol's report "Trophic ecology and macrofauna of Kahana estuary, Oahu" (Ph.D Dissertation, University of Hawaii, 1972).

Page IV-1. Section IV. This section would be enhanced by evaluating the relationship of the proposed water development project to Hawaii's 208 Water Quality Plan, and to the Hawaiian Waterbird Recovery Plan.

Page V-3. Paragraph f. We anticipate that the construction of access road stream crossings will generate substantial suspended sediment which will lead to temporary degradation of aquatic habitat. Of greater concern, however, is that road crossings (fords, causeways, and culverts) may restrict or impede the movement of indigenous aquatic species within the stream. Long-term impacts may include a gradual defaunation of the upper stream reaches (which we have witnessed within the Wailua River basin on Kauai, due in part to natural migration barriers). An excellent discussion on potential impacts of water development and related activities upon stream resources is presented in Timbol's 1979 limnological survey report.

Page V-3. Paragraph f. This paragraph should also discuss the potential degradation of secondary endangered waterbird habitat due to stream flow reduction.

Page V-8. Paragraph 2. 60% of the base flow (Q_{90}) used in the EIS is not the minimum sustained flow recommended by Timbol (1979). Timbol refers to the "Tenant method" of assigning instream flows for the protection of aquatic resources. This method utilizes a percentage of the average discharge, NOT of the base discharge (refer again to Timbol 1979, page 35, paragraph 3). Therefore, 60% of the average discharge for Kahana Stream equals 21.5 cfs, or 13.9 mgd. (Average discharge for a 21-year period at gaging station no 2965 = 35.8 cfs. Source is U.S. Geological Survey Surface Water Records for Hawaii and Pacific, 1980, page 123.)

Page VIII-1. Paragraph 2. Careful monitoring of drawdown impacts on stream-flow alone will not avoid detrimental effects to stream biota unless specific commitments are made by the BWS to refrain from any further water pumping in Kahana should state and federal biologists identify significant impacts to fish and wildlife resources.

Kahana Stream has been included in the Department of the Interior, National Park Service's Nationwide Rivers Inventory in recognition of its important scenic and historic values. Kahana is also one of a few streams on Oahu which supports significant populations of indigenous freshwater species. Because the proposed water development poses a significant threat to these resources and to other popular instream uses at Kahana, we recommend that this EIS be revised to present an accurate evaluation of project-related resource losses.

Sincerely yours,

Derral Herbst
Acting Project Leader
Office of Environmental Services

cc: Board of Water Supply

H-38

June 21, 1982

Mr. Derral Herbst
Acting Project Leader
Office of Environmental Services
United States Department of the Interior
Fish and Wildlife Service
300 Ala Moana Boulevard
Honolulu, Hawaii 96850

Dear Mr. Herbst:

Subject: Environmental Impact Statement for the Kahana Valley Water Development Project Kahana Valley, Koolauloa District, Oahu TMK: 5-2-01, 02, 03 & 05

Thank you for your letter dated January 22, 1982, regarding the Kahana Valley Water Development Project. The following is offered in response to your comments on the Environmental Impact Statement (EIS):

Page I-3, Paragraph 4, of the EIS has been revised to state:

"The withdrawal of groundwater from the high level dike system will reduce the dry weather flows of Kahana Stream although the extent will not be known until the well fields are put into service. We therefore plan to incrementally develop the well fields." Streamflow will be permanently monitored during the operation of the wells.

Page II-4, Paragraph 4

It is our intention to develop groundwater resources up to the determined safe level of withdrawal from Oahu's groundwater sources. Because the wells are widely spaced a cumulative effect upon stream and coastal water quality should be minimal. The effects upon the individual streams affected by these wells are of importance and therefore, as stated, streamflow will be continuously monitored during the operation of the wells.

Page II-6, table 2

The EIS has been revised to delete the Waiahole-Waikane wells from Figure 2. These wells have been deleted from our development plans.

Page II-9, Paragraph 4

Reference to a specific minimum instream flow on page II-9, paragraph 4, has been removed from the text.

Page III-8, Paragraph 2

The EIS has been revised to identify the Kahana Marshlands, stream and pasturelands as areas of secondary importance to endangered species. The effects upon these and the upper valley areas have also been discussed.

Page III-8, Paragraph 3

The EIS has been revised to include results of the report by Dr. Timbol: Limnological Survey of Kahana Stream. Dr. Timbol's report on "Trophic ecology and macrofauna of Kahana estuary, Oahu" was not used as all of the relevant information was contained in his limnological survey.

Page IV-1, Section IV

The relationship of the project to Hawaii's 208 Water Quality Plan and the Hawaiian Waterbird Recovery Plan has been evaluated in the Revised EIS.

Page V-3, Paragraph f

Construction-caused turbidity will be mitigated through careful construction practice. Kahana Stream will not be crossed by the access road so there will be no adverse impacts due to restricted movement of indigenous aquatic species. Road crossings will be made over intermittent tributaries to Kahana Stream.

Page V-3, Paragraph f

The EIS has been revised to include a discussion on

the potential degradation of the secondary endangered waterbird habitat on page VI-1 (Attachment #1).

Page V-8, Paragraph 2

The EIS has been revised to state that 60% of the average flow or 13.9 mgd will be the minimum sustained flow until the DLNR establishes its recommendations on minimum streamflows for Windward Oahu. We will comply with the recommendations of the DLNR.

Page VIII-1, Paragraph 2

We will comply with the recommendations of the State and Federal biologists should water pumping show indications of significant impacts to the fish and wildlife resources of Kahana Stream. The EIS has been revised to discuss the possibility of project related resource losses in Section IX (Attachment #2).

We appreciate the time you spent in reviewing our document. If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

Attach.

JY:cs
cc: K. Hayashida
G. Hiu
L. Whang
82-175

820153

University of Hawaii at Manoa

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

Office of the Director

January 22, 1982
RE:0345

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Sir:

Draft Environmental Impact Statement
Kahana Valley Water Development Project
Kahana Valley, Koolauloa District, Oahu

The Environmental Center has reviewed the above cited document with the assistance of J.D. Parrish, Hawaii Cooperative Fishery Research Unit; Doak Cox and Robert Rowland, Environmental Center. The discussion of impacts resulting from development of the four well fields has been carefully examined and we have several comments.

The most critical of the possible environmental impacts of the project to which this draft EIS relates are the diminution of the dry-weather flow of Kahana Stream and the effects of the diminution on the biota. Unfortunately, the draft EIS:

1) Is internally inconsistent in its statements concerning the possibility of the diminution of the dry-weather flow;

2) Does not provide an estimate of the extent of the diminution;

3) Proposes a plan for draft limitation on the basis of probably inadequate monitoring;

4) Does not conform to the recommendation it cites as to the minimum stream flow to be assured;

5) Accepts uncritically the basis for the recommended minimum stream flow standard;

6) Neglects the critical duration aspect of the minimum.

In addition there are a number of other deficiencies.

Possibility of diminution of dry weather flow

On page I-3 the reduction of dry-weather flow of the stream is stated merely as a possible outcome of the withdrawal of ground water from Well Systems II, III, IV and V. However, on page V-6 it is stated that: "The withdrawal of 6 million gallons in Kahana Wells III, IV, and V from the high level dike water will have an effect on Kahana Stream because the dike system is the source of most of the water that flows in Kahana Stream during the dry seasons." (The emphasis is added. Surely 6 mgd, not merely 6 mg is intended.)

We should have [illegible] [illegible] some of the [illegible], since they [illegible]

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The EIS should be consistent as to the probability that the reduction in dry-weather stream flow will occur. In what follows, we assume that there will be a reduction.

Extent of diminution of flow

The responses of the Board of Water Supply to previous comments from us, from the Department of Land and Natural Resources, and from the U.S. Fish and Wildlife Service, and (Appendix E) indicate the intent to discuss in the EIS "the relationship of groundwater heads to stream-surface elevation", "a description of the hydraulic mechanisms between the proposed wells and Kahana Stream," "the effects on stream flow of each of the project's alternative," and specifically "a hydrological evaluation on the removal of six million gallons per day from the valley." This intent is not in the slightest accomplished in the EIS.

Admittedly, estimation in advance of the effects of the proposed 6 mgd. groundwater draft on the streamflow will be inexact. There is, however, no discussion of: i) the size and shape of the dike compartments that supply the dry weather flow of the stream and those that will be tapped by the wells; ii) the reaches of the stream in which there are gains from groundwater discharge; iii) the positions of those reaches and of the proposed wellfields in relation to the predominant dike trend; or iv) the probable water budget of the dike compartments in the vicinity. Without considering these factors, it is impossible even to guess intelligently whether the proposed 6 mgd draft will or will not exceed the recharge of the draft compartments to be tapped, or will or will not result in a significant or major diversion from the dry-weather streamflow.

If analysis considering these factors suggests that the proposed draft cannot be accomodated without a major reduction of the dry-weather streamflow, it would seem extremely doubtful that the investment should be made in the proposed wells, roads, etc.

Detection of diminution and limitation of draft

The draft EIS suggests a plan for incremental development, streamflow monitoring, and limitations of draft that is in general sensible, at least in theory. It states that: "As the well fields are each put into service, the stream will be closely monitored to ensure that there is no significant adverse effect." In itself the monitoring will not, of course, ensure that there is no reduction in stream flow. What is intended is that the streamflow will be monitored to detect any reduction, and if a reduction materializes, the draft from the well fields will be curtailed as indicated on page V-8.

In practice, one must question whether the Board of Water Supply will be willing to limit the draft as necessary after the investment has been made in the roads, pipeline, powerline, and initial wellfield. Will some other agency have the power to enforce the limitations?

In any case, there is no indication in the EIS how long the effects of each wellfield will be monitored before the decision is reached to develop the next wellfield, and questions must be raised as to the adequacy of the intended monitoring.

It seems intended that the monitoring will be performed at the USGS gaging station which is located on Kahana Stream downstream from the proposed sites of wellfields VII, IV, and V, but upstream from the junction of Kawa Stream and from the proposed site of wellfield II. The predominant dike trend (not indicated in Figure 3 and not discussed in the geology section, page III-3-4) is such as to encourage the assumption that part of the stream flow influence of draft from wellfields III, IV, and V will be manifest above the gaging station. However, the possibility that significant influence will be manifest only below the gaging station should be discussed in the EIS.

A more serious limitation of the proposed monitoring scheme is indicated by temporal considerations. The draft from the wells cannot represent a direct diversion from the stream at the gaging station but will result in the reduction of the streamflow through reduction of head first in the vicinity of the wells and then in the vicinity of the springs feeding the stream. There may be considerable lag between a change in well draft rate and the resulting change in stream flow. By the time the streamflow is reduced to the proposed minimum standard, there may already have been sufficient draft to cause a significant further reduction.

If the proposed draft limitation is to have the desired result, it would seem necessary to base it directly on groundwater heads monitored in the vicinity of the wells, rather than on the stream gage record.

H-41

Minimum stream flow standard

In the draft EIS, a minimum streamflow of 6.7 mgd is proposed on the claimed basis of a recommendation by Timbol (1979). However, internally in the draft EIS, and between the draft EIS and Timbol's report, there are inconsistencies in streamflow terminology that appear to make the 6.7 mgd standard inconsistent with Timbol's recommendation.

Timbol's report is quoted (page V-7) to the effect that: "60 percent is the base flow needed to sustain good survival conditions for Kahana macrobiota, and to maintain economic and intrinsic values, and general recreational qualities." Timbol (1979, page 45) indicates that this "base flow" (proposed minimum stream flow standard) is 60 percent of the average discharge of the stream.

Neither Timbol nor the draft EIS indicate what the average flow of the stream is, but the average at the gaging stating is 23 mgd (35.3 ft^3/sec) (Water Resource Data, Hawaii, 1977). Sixty percent of that would be about 14 mgd.

In the draft EIS (page V-8) the standard seems defined as 60 percent of the "long-term stream discharge" (11.2 mgd). By "long-term stream discharge" the average flow might be meant. However, on page III-4, the draft EIS indicates that the 11.2 mgd is the Q_{90} of the stream at the USGS gaging station (18-year record). Q_{90} is not defined in the document, but presumably means the flow equalled or exceeded 90 percent of the time. The 6.7 mgd proposed standard is 60 percent of the 11.2 mgd Q_{90}.

Basis for minimum-stream-flow standard

The basis for the 60 percent (of whatever) provisional minimum mean flow value in the EIS appears to be entirely the Timbol paper cited. Timbol's conclusions/recommendations appear to be based on the case of Punaluu and the general recommendations of Tennant (1976, see attached list) which are based on a series of continental U.S. streams. These streams appear to be rather different from Kahana and Hawaiian streams generally.

Timbol (page 36) cautions that Tennant's recommendations "may not be appropriate for Kahana Stream." Minimum stream flows have never been properly defined in Hawaii, largely because of lack of the necessary data relevant to local conditions. The EIS does not address the state of this art. There is a considerable body of recent literature (since the brief, summary paper by Tennant) on the subject; references to some relevant Instream Flow Group material are attached. In reviewing Timbol's evaluation of the effects of diversion on Punaluu stream (based on work by another researcher), we find the data cited somewhat ambiguous and inconclusive. The "recent" Punaluu study referenced on page V-7 was published in 1969 (no criticism of its use implied).

Some concerns expressed in the cited paper by Timbol are not fully addressed. Timbol refers to a certain "critical habitat," giving one example (page 29). He states that "no water should be diverted upstream of the critical habitat" (page 44). If the reference is only to the example on page 29, it seems that the proposed Kahana wellfields III, IV and V are probably below it. However, the issue seems worth addressing in the EIS. The idea of critical habitat is based on requirements of certain stream species. One species of concern in Timbol's paper is the native Hawaiian oopu nakea (Awaous stamineus). Timbol's paper seems to suggest that even at 60 percent minimum stream flow, this species may be affected. It is about the only native fish at higher elevations in the stream.

The EIS does not identify stream biota at all and certainly does not address the question of what fauna might be sensitive to what effects. Field survey should not be required; it has been done adequately, recently, and over several years' time as well. I can provide the references if desired. Most sources are cited in Timbol's paper, but nothing enters the EIS except comments on percent minimum stream flows. This seems inconsistent with the terrestrial botanical information provided. The last paragraph of B, page III-8 fails to mention Kuhlia sandvicensis (the aholehole) and the native Hawaiian stream fishes of the freshwater reaches; all the latter are relatively rare and of genuine biological concern. One of the results of studies at Kahana over the years is that a few stream species have disappeared, become rare or missing from certain reaches/tributaries. Causes are uncertain, but the result suggests the system is fragile.

Supplementary information pertinent to standard

There is actually one piece of information in the draft EIS that suggests that a flow at least as small as 6.7 mgd might be an acceptable standard at Kahana. This is the minimum flow of the 18-year record, stated (page III-4) to be 6.3 mgd, but according to the USGS actually 6.5 mgd (10 ft^3/sec). Presumably a reduction in flow at the gaging station to 6.5 mgd would have effects in the biota no more serious than the effects of the natural reduction to that rate if the duration of the period of minimum flow were no greater than that of the natural minimum flow and occurred during the same season. Timbol seems not to have recognized the implication of this recorded minimum flow.

There is no information in the draft EIS which indicates the durations of flows between the 6.5 mgd minimum and the 11.2 mgd Q_{90}, or the seasons during which the low flows occurred, nor on the biological implications of the low-flow record. There is also no information on the duration of low-flows approximating the standard that would be permitted in the future, nor the seasons in which these might occur. Without such information it cannot be estimated whether the effects of the adoption of the proposed standard would be no more serious than the effects of the historic minimum flow.

Alternatives

Table 2 (page II-6) lists a number of possible "Windward" ground water developments that are being considered by the BWS, with estimated capacities totaling 22.8 mgd. That the sustainable yield of the aquifers that would be tapped by these developments is as much as 22.8 mgd more than the present average draft from item 4 is questionable particularly if the minimum flow requirements of the streams they feed are taken into account. There seems to be no mention in the EIS of the Kahuku area groundwater that is probably not now fully developed, apparently just because the latter is in the "Waialua-Kahuku" district that is considered distinct from the "Windward" district (Figure 1).

Turbidity effects

Turbidity resulting from road improvement and other constructions is a potentially serious problem for stream biota. Timbol's report refers to the effect on limpets (hihiwai). A recent case of serious biological damage to native fauna due to siltation of a stream, apparently caused by upstream road work, occurred at Mililli on Kauai. The EIS refers to the problem (e.g. page V-6). The important point is that conventional contractor "precautio will not be adequate, and there must be assurance that turbidity will be monitored and controlled.

Culvert design

Culverts for road improvements are referred to in the EIS (e.g. page V-6). It seems unlikely that any perennial tributaries will be crossed by access roads. If they are, culverts and other construction must be such as to insure easy passage by diadromous fauna that must transit the stream as part of their life cycle.

Reservoir impact

A proposed reservoir is mentioned a number of times; no comment is made on its potential ecological impacts. Are these beyond the scope of this EIS?

Irreversible impacts

It is stated (page IX-1) that no irreversible effect is expected in Kahana Stream or the groundwater system. If the stream groundwater of any of the native Hawaiian species, with their delicate habitats, is destroyed, the effect may be irreversible. If the dry-weather streamflow is reduced by the proposed draft, even if the Board of Water Supply actually limits the draft so that the streamflow is not reduced below whatever standard is adopted, there is some possibility that the population of some native species will be destroyed.

Sincerely,

Doak Cox
Director

cc: Board of Water Supply
J.D. Parrish
Robert Rowland
Jacquelin Miller

H-42

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

June 21, 1982

Dr. Doak Cox, Director
University of Hawaii at Manoa
Environmental Center
Crawford 317, 2550 Campus Road
Honolulu, Hawaii 96822

Dear Dr. Cox:

Subject: Environmental Impact Statement for the Kahana Valley Water Development Project Kahana Valley, Koolauloa District, Oahu
TMK: 5-2-01, 02, 03 & 05

Thank you for your letter dated January 22, 1982 regarding the Kahana Valley Water Development Project. The following is offered in response to your comments on the Environmental Impact Statement (EIS):

1. Possibility of diminution of dry weather flow

Page V-6 of the EIS has been corrected to say 6 million gallons per day instead of 6 million gallons. The EIS has been revised to state that the wells will have an effect on Kahana Stream.

2. Extent of diminution of flow

The EIS has been revised to provide a better hydrogeologic description of Kahana Valley and a hydrologic evaluation of the removal of 6 mgd from the valley. The additional hydrologic description is an excerpt from the U.H. WRRC Technical Report No. 77 which provides the information you have requested for Kahana Valley. The description of the hydrology of the dike compartments tapped by the wells cannot be provided because there is very little data available from which to develop the analysis. The decision to explore for and to develop groundwater in Kahana Valley was made with the knowledge that streamflow reduction may prevent the ultimate withdrawal of 6 mgd from Kahana Valley.

3. Detection of diminution and limitation of draft

The BWS will comply with the recommendations of the DLNR on minimum streamflows. While the criteria have not yet been determined, interim or permanent standards should be determined by the time the wells are ready for development into production wells. The incremental development plan is set up to give adequate time for City, State, and Federal scientists to evaluate the effect of the wells upon the dike structure and upon Kahana Stream. The DLNR has the power to enforce the limitation of draft from Kahana Valley at any time.

The EIS has been revised to state that the BWS will comply with the recommendations of the DLNR on minimum streamflow as well as the recommendations of State and Federal scientists should the groundwater withdrawal show signs of threatening Kahana Stream. Also, stream monitoring will be augmented by the recording and monitoring of groundwater heads in the vicinity of the well fields. The data from the initial well field will provide hydrologic data which may be helpful in determining the cumulative effects of the subsequent well fields. Monitoring will be performed as long as the wells are operable.

A discussion of the possible effects upon streamflow below the USGS gage has been added to the revised EIS. The U.H. Water Resources Research Center Technical Report No. 77 cites a report by Hink (1964) which states that below the 30-foot elevation the stream flows over marine deltaic caprock sediments and does not receive any of its Q_{90} flows from the marginal dike zone. An excerpt from the revised document is attached (Attachment #1).

The BWS will monitor the groundwater head drawdown at the well sites and will curtail withdrawal should the head go below the equilibrium level set during well testing. Thus, a consistent head drawdown can be achieved making stream monitoring an important part of the BWS efforts to minimize the impact upon Kahana Stream. While the geology of the area is such that effects at the well site will not manifest itself at the stream immediately, any noticeable trend in streamflow reduction will be evaluated along with the well pumping and groundwater head data. In this way the BWS plans to prevent any reduction below

the proposed minimum standard. The proposed minimum standard is 13.9 mgd, which is higher than the naturally occurring minimum streamflows.

4. Minimum streamflow standard

The EIS has been revised to clarify the minimum streamflow standard. Timbol's stream flow recommendation of 60 percent of the average flow (23 mgd) will be the criteria the BWS will follow until the DLNR determines what the minimum streamflow should be in their study of Windward streams. The excerpt from the U.H. Technical Report No. 77 and the revised hydrologic discussion remove the inconsistencies between long term stream discharge, average discharge, and Q_{90}.

5. Basis of minimum streamflow standard

The EIS has been revised to provide a discussion on the state of the art of minimum streamflow determinations and the concerns expressed by Timbol have been addressed. A more complete list of stream biota has been added to the EIS as well as the sensitivities of the fauna to the possible effects of the wells. The critical habitat section of Kahana Stream has been included in the EIS graphics (Attachment #1, #2).

6. Supplementary information pertinent to standard

The supplementary information which you provide has now been incorporated into the EIS in Section XI (Attachment #3).

7. Alternatives

The BWS well construction program takes into consideration the problem of minimum streamflow. Any stream that may be affected by our well construction program is monitored during the test pumping of the exploratory well. Streamflow monitoring is then continued if the production station is constructed and placed into service. The EIS addresses the question of minimum streamflow and the Board is committed to abide with the minimum streamflow standards when they are adopted.

As for the groundwater in the Kahuku area, the existing BWS well withdraws 1.0 mgd to serve the domestic need of Kahuku town. Existing quaculture and agriculture and the proposed State sponsored Kahuku Agriculture Park may utilize the remaining available supply in the area.

8. Turbidity effects

The EIS has been revised to state that exceptional precautions will be provided to insure that there will be no significant impacts due to turbidity caused by construction. Monitoring by the BWS will be done to control turbidity from construction.

9. Culvert design

Culverts will be provided for the intermittent streams that the access road will cross. The main stream will not be crossed by the access road.

10. Reservoir Impact

The EIS has been revised in Section V to include the potential effects of the proposed reservoir.

11. Irreversible Impact

Section IX has been revised to provide a more detailed discussion of the irreversible effects upon Kahana Valley (Attachment #4).

We appreciate the time you spent in reviewing our document. If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

Attach.
cc: R. M. Towill

c. Kahana Stream

The withdrawal of 6 million gallons a day by Kahana Wells III, IV and V from the high level dike water will have an effect on Kahana Stream because the dike system is the source of most of the water that flows in Kahana Stream during the dry season. Although some dikes are partially visible, the number, size and shape of the dike compartments of the area are not known, so it is not possible to develop a water budget for the dike compartments to be tapped by the wells. The proposed wells are located near the transition between the dike complex and the marginal dike zone and will withdraw dike water moving parallel to the predominant dike trend toward Kahana Stream. Well Fields III, IV and V are in a position to tap dike compartments that provide water to the reach where the greatest gain in groundwater occurs. This is the reach between elevations 115 and 300 feet where 52 percent of the Q_{90} (dry weather base flow) is gained. Thus, the well pumping will have an effect upon Kahana Stream which will be measurable during the dry season if the ultimate development is obtained.

The overall geology and hydrology of Kahana Valley is well documented but there is little known about the individual well field sites. While much can be inferred from the overall knowledge of the area, more knowledge of the well field sites will be obtained during well testing and later during well development. This is the reason for the incremental development of the well fields.

During well testing, the groundwater head drawdown will be measured until a steady state is reached. This will probably withdraw some of the water that flows preferentially parallel to the dike trend towards Kahana Stream, not only from the dike compartment which the well taps but also from the compartments around it. Depending upon the weather prior to and during the test, the USGS may detect an effect upon Kahana

Stream due to the well testing. In any case, the USGS will monitor the stream during well tests for the three well fields. Well test monitoring may require the installation of temporary gages at selected sites along the stream. Should a well field provide an inadequate amount of water, a new well field will be chosen. Only after all three well fields have been completely tested and proven will the first well field be developed and integrated into the water system.

After the first well field is put into service, there will be time to study the effects of pumping upon Kahana Stream before the next field is put into service. The USGS continually monitors Kahana Stream and the BWS will monitor the groundwater heads at the individual well sites so there will be a considerable volume of information available from which to draw conclusions about the effect of the wells upon the stream. As the rest of the well fields are put into service, any effect upon the stream will probably be more noticeable, requiring quick response by the BWS. The BWS has all of its wells tied into a central control station so curtailment of pumping can be done immediately in response to any adverse findings of the USGS stream monitoring or BWS well pumping data.

The BWS controls all of its well pumping from its Beretania Pump Station and will curtail pumping should the groundwater head at the well begin to go down below the equilibrium level. A drop below this level would mean that the pumping rate has exceeded the recharge rate of the dike compartment and pumping must be curtailed to prevent excessive drawdown of the head of the compartment. Decreasing the pumping rate protects the integrity of the water source during times of low recharge and will also protect Kahana Stream.

Groundwater stored in the dike complex and marginal dike zone moves toward the ocean or Kahana Stream because of the difference in elevation of the water surface elevations or head. Thus, the lowering of the groundwater head in the dike compartments tapped reduces the hydraulic gradient that drives the stored groundwater through the permeable rock, cracks, fissures, and dikes toward Kahana Stream from these and surrounding compartments. A maintainable equilibrium of groundwater head does not mean that the groundwater will not be diverted from Kahana Stream. For this reason, the USGS stream data is of great importance in the maintenance of the integrity of Kahana Stream. Should a decrease in stream flow occur that is deemed detrimental to Kahana Stream, pumping will also be curtailed.

Close monitoring of the stream should prevent any adverse effects upon the "secondary habitat" for endangered species. In a recent report by Amadeo S. Timbol for the U. S. Army Corps of Engineers, entitled Limnological Survey of Kahana Stream, Oahu, the minimum stream flows are discussed in the report summary:

"Minimum instream flow at 10, 30 and 60 percent, based on methods developed by Tenant (1976), of the average discharge are discussed. It is suggested that 10 percent minimum flow is not adequate for the maintenance of desirable macrobiota in Kahana Stream. The stream will suffer serious degradation, with the definite loss of the critical habitat in the main stream.

"Thirty percent minimum stream flow could lead to the eventual disappearance of the o'opu nakea, a threatened endemic goby that is also a food fish. The most obvious detrimental effect is on the critical habitat caused by the decrease in water velocity and other changes that go with it.

"Sixty percent minimum stream flow had no significant detrimental effect both the biota and physical features of Punaluu

Stream (Timbol herein refers to a similar study recently completed on a stream diversion on Punaluu Stream in the adjacent Punaluu Valley). Some form of degradation must have taken place upstream of the diversion, but not below.

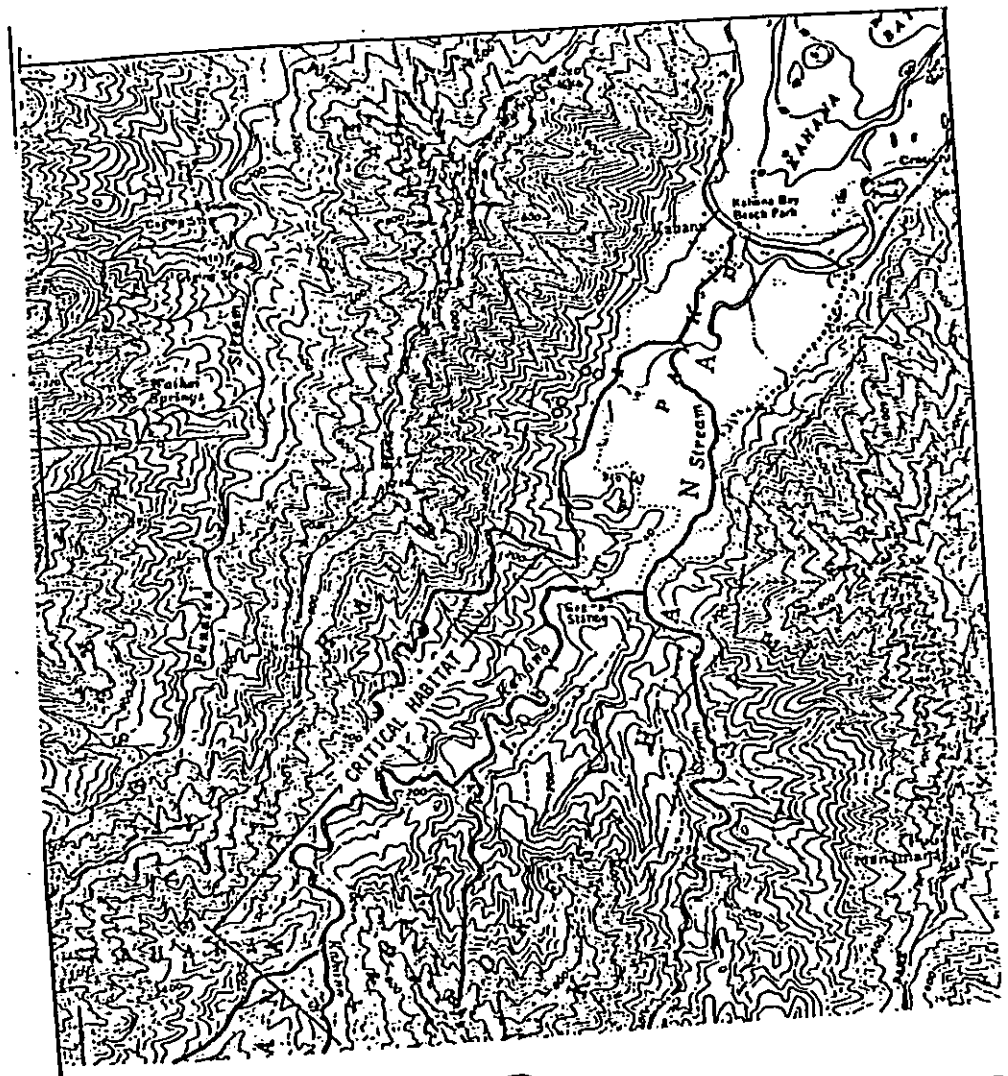
"Thus, this study suggests that 60 percent is the base flow needed to sustain good survival conditions for Kahana macrobiota, and to maintain economic and intrinsic values, and general recreational qualities."

The value suggested is 60 percent of the average flow measured by the USGS gage or 13.9 mgd. While this gage is not at the mouth of Kahana Stream, no measureable effects below the gage are anticipated because the sediments of the valley retards the movement of groundwater into the stream.

Some precautionary statements on the minimum stream flow recommendations are also provided by Timbol:

"Some precautionary statements are needed at this point. Hawaii streams are minute when compared with continental rivers (e.g., the discharge of the Sacramento-San Joaquin River is 80 times more than that of Wailuku River in Hilo, Hawaii's largest). Climate also makes streams in Hawaii different from U. S. mainland streams because the high mean annual temperature and lack of greater seasonal changes here give these streams a much milder external environment than streams of temperature regions. The methods of Tenant (1976) are based on continental stream ecosystems and have not been tested in Hawaii. Thus, even the 10, 30, 60 percent values may be not appropriate for Kahana Stream."

An approximate value of 13.9 mgd for a minimum stream flow has been suggested by Timbol. The critical habitat he refers to is shown in Figure 13. This is the basis upon which the BHS will initially set its minimum stream flow reduction. This basis suggested by Timbol will be modified by the findings of State, and Federal agencies on the effects of the wells upon the flora and fauna of Kahana Valley and by the proposed minimum stream flows yet to be determined by the DLNR. The DLNR will use one of many "state of the art" techniques to determine the minimum stream flow such as the Instream Flow Group Method developed by the United States Department



REF: USGS QUAD.

2000' 0' 2000'
Graphic Scale

KAHANA VALLEY WATER DEVELOPMENT PROJECT
ENVIRONMENTAL IMPACT STATEMENT

FIGURE 13

CRITICAL HABITAT
CITY AND COUNTY OF HONOLULU
BOARD OF WATER SUPPLY

of the Interior. These methods use much more detailed analysis and will be tailored for Hawaiian streams whereas the "Tenant Method" proposed by Timbol is not. For this reason, the BWS water development project in Kahana will be flexible and responsive to the on-going studies of water withdrawal in Kahana Valley.

d. Water Mains

A 20-inch water main will carry the well water from Kahana Wells III, IV and V down the valley to the proposed Kahana Reservoir or into the transmission main along Kamehameha Highway. A smaller line will take water from the Kahana Wells II site to the transmission main along Kamehameha Highway. The trench excavation will be along the road and no adverse long term impacts are expected to be generated.

e. Kahana Bay

The withdrawal of 6 million gallons a day from Kahana Valley is not expected to affect the water quality of Kahana Bay. The Water Resources Research Center Technical Report No. 77, The Quality of Coastal Waters: Second Annual Progress Report, September 1973, had these findings:

"The study produced evidence that during times of heavy rainfall the turbidity of the nearshore water of the bay increases and a measurable loss of clarity occurs. A lowering of the salinity of this water at such times also indicates that dilution with fresh water is sometimes appreciable, perhaps sufficient to make the nearshore waters marginal for some types of coral found there.

"Studies of biota in Kahana Bay--sea urchins, coral, and miscellaneous invertebrates as well as micromolluscs--show variations within the bay environment which are more related evidently to the oceanography and other characteristics of the bay than to the quality of water and sediments dicharged from the stream. There was no evidence that the diversity of life in Kahana Bay was limited by quality factors originating on the land. The biological data presented are therefore subject to little interpretation in terms of responseof living organisms to discharges from Kahana Stream. They do, however, give some

baseline data, as do the results of chemical analyses, against which to compare the results of similar observations in other land use situations--urban, industrial, and agricultural."

f. Other Areas

Groundwater flows generally from the adjacent Punaluu Valley eastward toward Kahana Valley and also flows down the upper valley to the leeward side of the Koolau Range and possibly to Waikane Valley. The wells are located in the mid valley and are most likely to affect the groundwater flowing from Punaluu toward Kahana Valley. It is not expected to affect Punaluu Valley in any way as this flow exists at present and is not expected to be increased due to the groundwater withdrawal.

g. Long Term Benefits

There are benefits to be gained by the well fields that are believed to outweigh the adverse visual and physical impacts on the land. The water gained is valuable and necessary to meet the immediate projected water demands for Windward Oahu. The Kahana Wells will feed into the water system that supplies the Windward, Honolulu and Pearl Harbor Water Use Districts. The BWS hopes to one day have its six water use districts integrated into just one island-wide water system. Kahana Wells II, III, IV and V will then become part of a system that supplies water to the entire island.

The access roads will also provide an easier access into the deeper reaches of the valley, benefiting visitors, scientists, hikers, emergency rescue groups and others.

h. Long Term Adverse Effects

The development of groundwater in Kahana Valley, while necessitated by population growth, will also enable population growth in the Windward area. This growth will change the lifestyle of the residents to a faster pace and increase the stresses related to overcrowding. Growth will also increase the

demands upon the other public services such as sewage treatment, police protection, hospitals and schools. Only the orderly planning of the City and County of Honolulu can mitigate these adverse effects.

i. Cumulative Effects of the Water Development, Water Reservoir and State Park Projects

The three projects now planned for Kahana Valley will have a cumulative short term effect due to construction activities unless these activities are coordinated so that the effects can be mitigated. This is the reason that the BWS is working closely with the DLNR's Division of State Parks, Outdoor Recreation and Historic Sites, to insure the orderly development of the resources of the Valley and preserve its natural beauty. The sensitivity of some of the Kahana Stream biota to excess turbidity is of continuing concern and will require careful construction techniques to mitigate this problem.

The wells and control buildings will impact visually upon the visitors that hike the old jeep trail and will require careful landscaping to decrease the adverse effect. This is a problem that cannot be mitigated completely. The proposed 6 million gallon water reservoir will also have a visual impact because it may not be possible to completely shield it from views from other parts of the valley.

The combined activities of water recreation, fishing, agriculture and water development will be coordinated by the State Department of Land and Natural Resources to assure that these activities are compatible and do not affect the environment adversely.

Table 5. List of Macrofauna in Kahana Stream and its Tributaries, Hanalele and Kawa (August 1979).[1]

Scientific Names	Common, Local Names	Origin[a]	Listing[b]
Annelids (worms)			
Hirudinea	Leech	Unknown	None
Nemalycastis abiuma	Polychaete worm	Endemic	None
Oligochaeta	Earthworm	Unknown	None
Insects			
Diptera: Chironomidae	Midge larva	Endemic	None
Odonata: Zygoptera	Damselfly naiad	Unknown	
Trichoptera:			
Cheumatopsyche analis	Caddisfly larva	Exotic	None
Oxyethira maya	Microcaddisfly larva	Exotic	None
Mollusks (Snails)			
Melania sp.	Pond snail	Indigenous	
Crustaceans (Prawns and Shrimp)			
Atya bisulcata	Mountain shrimp Opae kala'ole	Endemic	None
Macrobrachium grandimanus	Hawaiian prawn Opae oeha'a	Indigenous	None
Macrobrachium lar	Tahitian prawn	Exotic	None
Fishes			
Awaous genivittatus	Goby, o'opu naniha	Indigenous	None
Awaous stamineus	Goby, o'opu nakea	Indigenous	Depleted[c]
Clarias fuscus	Chinese catfish	Exotic	None
Eleotris sandvicensis	O'opu okuhe	Endemic	None
Kuhlia sandvicensis	Aholehole	Endemic	None
Mugil cephalus[d]	Mullet, ama'ama	Indigenous	None
Poecilia reticulata	Wild guppy	Exotic	None
Xiphophorus helleri	Swordtail	Exotic	None
Xiphophorus maculatus	Moonfish	Exotic	None

[a] Terms used in this column:
Endemic-occurring naturally in Hawaii only.
Indigenous-occurring naturally in Hawaii and also elsewhere.
Exotic-brought to Hawaii either intentionally or accidentially by man.

[b] Considered as endangered or threatened in official register or scientific publications. The following definitions are from Hiller (1972). Endangered (threatened)-facing extinction, needs special protective measures. Depleted-still occurs in numbers adequate for survival but heavily depleted and continues to decline at a rate substantially greater than can be sustained.

[c] Depleted on Oahu (Hiller, 1972).

[d] Two other mullet species may be present; *Neomyxus chaptali* (uoa'uoa, indigenous) and *Chelon engeli* (mullet, exotic).

[1] SOURCE: U. S. Army Corps of Engineers, Limnological Survey of Kahana Stream. by Amadeo S. Timbol, 1979.

SECTION XI
SUMMARY OF UNRESOLVED ISSUES

The proposed project could affect the dry weather flow of Kahana Stream to some extent. The hydrogeologic complexity of the groundwater system in Kahana Valley makes the estimation of the extent of flow reduction difficult. For this reason, stream monitoring must be done to insure no adverse impacts upon Kahana Stream although the minimum stream flow reduction is unresolved. While a minimum stream flow reduction has been recommended by Timbol using the "Tenant Method," the method has certain deficiencies. This is because the method was based upon continental United States rivers and streams which are much different from Hawaiian streams and some of Timbol's recommendations are inferred from Punaluu Stream which may not completely apply to Kahana Stream. Timbol also did not take into account the fact that the USGS has recorded a minimum stream flow of 6.5 mgd in his assessment of the effect of stream flow reduction. This low flow was recorded for three days in 1961 so only short-term flow reduction conclusions can be inferred from this piece of information. Still, the fact that the average flow of Kahana Stream is equaled or exceeded about three to four months out of the year, may be important in the determination of the minimum flow required.

The DLNR is conducting a study to determine minimum stream flows for Windward streams using one of the "state of the art" methods (e.g., the Instream Flow Group Method. The method chosen will be much more accurate and will be tailored for Hawaiian streams. Until the results of this study are made available to the BWS, the minimum stream flow ~~reduction~~ will be 50 percent of the average flow or 13.9 mgd. When the DLNR study of Kahana Stream is complete, the BWS will comply with their findings.

SECTION IX
IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

City and County funds, labor, and materials, will be irreversibly committed to the project. More funds will be required for operation and maintenance. No other commitment of resources is considered irreversible or irretrievable. The land can be reclaimed if it becomes desirable to do so and no significant irreversible effect is expected on Kahana Stream or the groundwater system.

It is possible that construction activities and reduced flows to Kahana Stream could irretrievably affect the fauna of the stream. Construction activities could cause increased turbidity in Kahana Stream which will affect the stream inhabitants. Excess turbidity is one of the causes for the disappearance of the limpet hihiwai. Turbidity and reduced flows could change the streambed environment, affecting the migration of the o'opu nakea, mountain shrimp and the Tahitian prawn. Reduced flows and the subsequent diminution of the riffle areas from Kawa Stream caused the disappearance of the o'opu napili from the stream. Reduced flows, if excessive, could affect the riffle areas of Kahana Stream causing a reduction in the o'opu napili population and possibly their disappearance from the stream. The BWS priorities of preserving the "Critical Habitat" portion of Kahana Stream and of compliance with present and future DLNR requirements for protecting Kahana Stream should prevent this irretrievable loss from occurring.

GEORGE R. ARIYOSHI
GOVERNOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
550 HALEKAUWILA ST.
ROOM 301
HONOLULU, HAWAII 96813

George Yuen
Director
TELEPHONE NO.
548-6915

January 27, 1982

Kazu Hayashida, Director
Board of Water Supply
City and County of Honolulu
Honolulu, Hawaii 96813

SUBJECT: Environmental Impact Statement for Kahana Valley Water Development Project, Kahana, Oahu

H-50

Dear Mr. Hayashida:

This Office has reviewed the subject statement and offer the following comments for your consideration:

INCONSISTENCIES

On page II-1, the EIS indicates 134 mgd was drafted by the Board of Water Supply. On page II-2, the EIS indicates 130.0 mgd was drafted by BWS. The discrepancy should be clarified.

On page II-2, the projections for water usage are 130.0 mgd in 1978 and 192 mgd for the year 2000. Table 5 on page III-1 indicates a different amount. Therefore, the differences in projection need to be clarified. In addition, the EIS should discuss the relationship of population projections and the water demand.

On page II-1, the EIS indicates that 222 mgd is used for sugar irrigation and 52 mgd is used for military purposes which totals 274 mgd. However, on page II-2, the EIS assumes that the quantity consumed by other users will remain constant at 280 mgd. The basis for omitting 6 mgd should be discussed.

OAHU WATER PLAN (p. II-2)

The EIS states, "In order to meet the projected water demands within the Island of Oahu, the BWS has proposed the installation (Figure 2) of a variety of water development facilities (generally wells) in the Windward District as summarized in the Oahu Water Plan, July 1975." It should be pointed out that in 1975,

much of the population projections were based on the Department of Planning and Economic Development's population projection, E-2. However, DPED has revised its population projections to II-F which results in a lower future population figure. Therefore, the EIS should clarify how the water demand was computed and on what population projections was the water demand based. The General Plan for Oahu is also outdated in terms of population figures because the general plan was also based on the E-2 population projections.

PAGE II-3

Reference to the report, "Honolulu and Windward Water District's Water Supply Status, December 1977," is misleading because the report cites that potential sources include groundwater development at Hawaiian Electric's Waiau tunnel which has since been included as the Pearl Harbor Groundwater Control District. We recommend a discussion to clarify the use of the Waiau tunnel.

WATER DEMAND

Throughout the EIS there has been constant reference to the projected water demand. However, the EIS does not adequately discuss the water demand, what population projection it is based on, and what is the overall plan for water development in the future for the island of Oahu. We strongly recommend an in-depth discussion on the matter.

PAGE II-9

The EIS states, "The possible effects of well water withdrawal on the water in Kahana Stream will be monitored per each increment." The EIS should also discuss the impacts of the existing well on the stream flow.

PAGE III-8

The scientific names for the species cited should be underlined.

PAGE II-11

The resident population including the projected population on Table 5 differs from the 1981 Data Book. The reference for the population figures should be given to clarify the discrepancy.

PAGE IV-5

The EIS should also consider the State Environmental Policies as stated in Chapter 343, Hawaii Revised Statutes.

PAGE V-8

The data from Timbol's report has been interpreted incorrectly. We refer you to the comments by the U.S. Fish and Wildlife Service and the Corps of Engineers. We recommend that the EIS be revised to reflect their comments.

The EIS should also be expanded to include measures that will assure the protection of endemic wildlife in the stream during times of drought.

Further, it is important to note that Kahana Stream has been placed on the list of Nationwide Rivers Inventory which recognizes the stream as a valuable scenic and historic resource. Therefore, such designation warrants careful consideration of the proposed action and its effect on that status.

PAGE V-9

The EIS should recognize that water development is one of the contributory factors toward growth. The EIS should discuss the impacts associated with growth. Further guidance may be found in EIS Regulation 1:42 c., which states,

> It should be realized that several actions, in particular those that involve the construction of public facilities or structures (e.g., highways, airports, sewer systems, water resource projects, etc.) may well stimulate or induce secondary effects. Such secondary effects may be equally important as, or more important than, primary effects, and shall be thoroughly discussed to fully describe the probable impact of the proposed action on the environment. The population and growth impacts of an action shall be estimated if expected to be significant, and an evaluation made of the effects of any possible change in population patterns or growth upon the resources of the area in question. (Emphasis added.)

In addition, the EIS should reflect the negative impacts associated with growth and not in addition to the benefits.

PAGE VII-1

Another alternative that should be mentioned is water use conservation.

H-151

We trust that these comments will be helpful to you in preparing the revised environmental impact statement. For your convenience we have listed the commentors on a separate page.

We thank you for the opportunity to review the subject EIS. If you should have any questions in this matter, please do not hesitate to contact us.

Yours truly,

George Yuen, Director
Office of Environmental Quality Control

Attachments

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

June 18, 1982

Mr. Charles Clark, Director
Office of Environmental Quality Control
State of Hawaii
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Mr. Clark:

Subject: Environmental Impact Statement for the Kahana Valley Water Development Project Kahana Valley, Koolauloa District, Oahu TMK: 5-2-01, 02, 03 & 05

Thank you for your letter dated January 27, 1982 regarding the Kahana Valley Water Development Project. The following is offered in response to your comments on the Environmental Impact Statement:

Inconsistencies

Page II-1

The discrepancy between the 134 mgd on page II-1 and the 130 mgd on page II-2 is due to the calendar years for which these values are given. The value of 130 mgd is for 1978 and 134 mgd is for 1979. The EIS now includes only the 134 mgd value.

Page II-2

The water demand projections have been corrected and a discussion of BWS water demand estimates has been included (Attachment).

Page II-1

Page II-2 has been corrected to read:
"Assuming that the quantity consumed by others (sugar, military, industry) does not exceed 280 mgd,..."

H-52

Oahu Water Plan (Page II-2)

The EIS has been revised to indicate the change from E-2 to II-F population projections. The basis for water demand predictions has also now been included.

Page II-3

The water presently discharged by Hawaiian Electric's Waiau Tunnel has been classified as leakage by the DLNR and is developable as long as the tunnel is not changed to extract additional water. There is approximately 10 mgd of Waiau tunnel water. It is not counted as Pearl Harbor Basin water. The DWS is planning for its use.

Water Demand

The EIS has been revised to include a discussion on water demand, population projection and the overall water development plan for Oahu.

Page II-9

The existing wells are down gradient of the USGS gage so no effects are measurable at the gage. There are no known impacts of the existing well on the stream-flow.

Page III-8

The EIS has been revised to provide a more complete list of the fauna of Kahana Stream and all scientific names have been underlined.

Page III-11

Table 5 (now Table 6) is the City and County Department of General Planning Distribution No. 4 and is now cited on page III-11.

Page IV-5

The EIS has been revised to include considerations of the State Environmental policies as stated in Chapter 343, Hawaii Revised Statutes.

Page V-8

The EIS has been revised to reflect the comments of the U.S. Fish and Wildlife Service and a more complete discussion of the protection of Kahana Stream's endemic wildlife has been included. The Kahana Stream listing on the Nationwide Rivers Inventory has been included in the EIS.

Page V-9

The EIS has been revised to reflect the adverse impact of growth stimulated by water resource projects.

Page VII-1

The BWS has instituted several water conservation measures which have been included in the Building Code and further conservation plans are under consideration. The EIS has been revised to include the alternative of water use conservation.

We appreciate the time you spent in reviewing our document. If you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: R.M. Towill Corporation

SECTION II
PROJECT DESCRIPTION

A. INTRODUCTION

The proposed project will consist of the incremental development of four well fields (Kahana Wells II, III, IV and V), each with a control building, connected by an access road and a transmission main to tie into the proposed Kahana Reservoir or into the water main carrying water to Kaneohe along Kamehameha Highway. The project is part of the Oahu Water Plan, City and County of Honolulu, 1975. The new wells will assist in meeting the future needs of the water system that serves the Windward, Honolulu, and Pearl Harbor Water Use Districts, shown on Figure 1.

B. PROJECT OBJECTIVES

The objectives of the proposed project are to develop the water resources within Kahana Valley to assist in meeting the increasing domestic water demand on Oahu and to minimize any adverse impact of the development upon Kahana Valley.

C. BACKGROUND

Nearly all fresh water on Oahu is presently obtained from groundwater sources. Oahu has a geological structure which results in locally complex hydrologic conditions. Impervious dikes, caprock and basaltic aquifers allow a large quantity of fresh groundwater to be stored. It has been computed by the BWS that an average of 650 mgd of rain water infiltrates into the ground to recharge this source.

Of the 700 mgd (including return irrigation) that does infiltrate into the ground, hydrologists estimate the dependable yield of our groundwater resources is between 480 and 630 mgd, assuming a greater recovery factor than 75 percent for the latter quantity. This is the amount of groundwater that can be withdrawn daily without depleting or harming the system.

During the 1979 calendar year, the total pumped from groundwater resources of Oahu was approximately 408 mgd of which 134 mgd was drafted by the BWS, 222 mgd was used for sugar irrigation, and 52 mgd was consumed by predominantly military and private industrial users. The groundwater drafted

by the BWS is expected to increase from 134.0 mgd in 1979 to about 205 mgd in 2000. Assuming that the quantity consumed by other users (sugar, military, industry) does not exceed 280 mgd, the "limit" (480 - 280 = 200 mgd) on the amount of groundwater that can be safely extracted by the BWS will be reached around the turn of the century.

Due to the island's geological structure, terrain, and population distribution, there are water use districts with more developable groundwater sources than the demand within the area and vice versa. With the projected growth of the population, the total island-wide water demand will approach the total amount of groundwater that can be safely extracted. Thus, the full development of groundwater within each district is necessary to meet the island's needs. Although the island is divided according to water use districts, it is the water system that determines what area a given source will serve. A water system can join two or more Water Use Districts and the water extracted from each district goes into its associated water system to provide for the needs of that system. Presently, the Windward District is connected to the same system that services Honolulu and the Pearl Harbor Districts. Future BWS plans call for the joining of all the water systems into a single, integrated and island-wide system which will effectively interconnect each water use district.

In order to meet the projected water demands within the Island of Oahu, the BWS has proposed the installation (Figure 2) of a variety of water development facilities (generally wells) in the Windward District as summarized in the Oahu Water Plan, July 1975. Although recent developments have made revisions to the Plan necessary, the basic priorities will be retained.

In the State Water Commission's report entitled, "Hawaii's Water Resources: Directions for the Future," January 1979, priority recommendations were outlined (Appendix B) for State administrative and legislative implementation. The report emphasizes the importance of the development of new and alternate water sources on Oahu. Kahana Valley, among other areas, has been cited in the report as an area with available water supplies: "Large groundwater supplies are available

in the Windward Oahu areas of Kahuku, Kahana, and Koolaupoko. Streams in Windward Oahu, especially Kahana and Punaluu, appear most promising for development of large supplies."

Recent court decisions on water rights in Waihee Valley, Windward District, have caused the BWS to reevaluate its proposed schedule for source development. Realizing that it would not be able to develop as much groundwater in Waihee Valley, the BWS has made a reevaluation of their source development plans for the Honolulu and Windward Districts. Recommendations on Source Development, published by the BWS, are given in a report entitled "Honolulu and Windward Water District's Water Supply Status, December 1977." In this report, the BWS lists a number of potential sources that could be developed to meet the Honolulu demand. These potential sources include groundwater development of Hawaiian Electric Company's Waiau tunnel water (10.0 mgd), windward surplus, sugarcane irrigation water exchange, and other more complex brackish water conversion schemes. The report recommends the development of groundwater sources in the Windward District as the most viable plan. It cites that if the State approves the development of water in Kahana Valley and if Punaluu groundwater is also developed, additional water may be available for transport to the Honolulu District. New BWS water requirement projections have necessitated revisions to the 1977 report. The water to be developed in Kahana will now be used by the Windward Water District which has a shortage of developed sources.

Planning for the development of the Kahana source has been accelerated to meet projected water demands in the Windward District. Development of other sources, as outlined in the Oahu Water Plan and the capital improvements program, will also be undertaken to meet the projected demand in the future. The proposed Kahana Valley water development is a significant portion of the overall facilities required to meet the projected demand on the Windward side.

The Oahu Water Plan, published in 1975, was based upon the State Department of Planning and Economic Development's population projection E-2 which results in higher future population figures than their new population projection II-F. All BWS water demand projections, which

are essentially based upon per capita demand with commercial and agricultural requirements included, have been revised to conform to the new II-F population projection.

At present the new Kahana Wells I field is in service. These wells tap the basal groundwater. The proposed fields of Kahana Wells III, IV, and V will withdraw high level dike water. Kahana Wells II is in the eastern part of the valley and will draw water from basal groundwater. A 6.0 mg reservoir near well site IV is also proposed in Kahana Valley to improve the water transmission from the Punaluu Wells to Kaneohe.

The State Department of Land and Natural Resources (DLNR) has developed plans to create a "living park" out of the State-owned Kahana Valley. Items planned for the park development include a visitor's center in the lower valley near Kamehameha Highway, new houses for the valley residents, and hiking trails. The concept requires that everyone living in the valley take part in maintaining and operating the park as a requirement for residency there. The BWS is coordinating the proposed water development of Kahana Valley with the Division of State Parks, Outdoor Recreation and Historic Sites, of the DLNR. The water requirements for domestic and agricultural activities in the proposed park will be preserved and assured. Final plans for water development must be approved by DLNR in terms of land management, compatibility with the planned State Park and construction in Conservation District lands.

The Board of Water Supply is expediting the development of potential water sources along the Windward coast. EIS Preparation Notices have already been filed for the proposed Haiku, Kahaluu, Kaluanui, and Luluku Wells. Table 1 indicates the existing water development facilities in the Windward District. Table 2 lists 22 additional proposed sources. These are mainly small sources ranging from 0.5 to 2.0 mgd per well. The Board of Water Supply is also interested in developing some larger alternate sources of supply, which are also listed, to sustain growing demand while exploration and development of the smaller sources continues. Kahana Valley is the first of two areas to be considered, Punaluu being the second.

H-56

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Conservation Council for Hawaii
Post Office Box 2923
Honolulu, Hawaii 96802

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

11 February 1982

Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96813

Gentlemen:

Subject: EIS for the Kahana Valley Water Development Project

Todate Kahana Stream is the only stream on Oahu that is in almost pristine condition. The proposal to export water from the stream's drainage basin will certainly result in the deterioration of the stream's natural quality.

Proposed well fields III, IV and V (Fig. 3 of EIS) will most probably result in the loss all strongly, permanently flowing stream channels above 200 ft (61 m) elevation on Kahana mainstream and its two unnamed tributaries. The stream channels will become intermittent, flowing only during winter freshets. Kahana mainstream alone stands to lose at least 2.4 km (29.6%) out of a total of only 8.1 km (excluding 1.5 km estuary) of permanently flowing channels. The two unnamed permanently flowing tributaries that join the mainstream at about 200 ft elevation will be total losses.

Proposed well field II in the vicinity of Kawa tributary will draw water from the water table that would supply Kawa tributary. It has already been determined that between 1972 and 1978, Kawa tributary waters which were once mostly fast riffle, had slowed down for undetermined reasons. This has resulted in the disappearance of Sicydium stimpsoni ('o'opu nopili), once a common resident, from Kawa tributary. Any significant withdrawal of water from the Kawa tributary drainage basin will probably reduce further the surface flow. The now small but continuously flowing channels will be downgraded to isolated pools of water. Kawa tributary (1.7 km of channel) may well be written off as habitat for any native macrofauna.

Kahana mainstream at between 200 ft and 120 ft elevations (below proposed well sites III, IV, and V) has channels which approximate as nearly as possible, a physically pristine stream. These stretches of channel are strong flowing, bubbling brooks which also harbor good complements of native fish and crustaceans which have economic value. These

need preservation both for the resident animals and for aesthetic values. The withdrawal of water above these stetches of pristine channels will lower the water level and slow down flow velocity. Therefore, water loss in these areas will result in their degradation.

In a recent report by Amadeo S. Timbol for the U. S. Army Corps of Engineers, entitled "Limnological Survey of Kahana Stream, Oahu, recommended 60% of minimum instantaneous flow for the long-term survival of the present resident species and general recreational values. There is a strong possibility that the above minimum cannot be maintained once the wells become operational. There is a question of who monitors stream conditions and authority to stop pumping when stream conditions reach critical levels.

The EIS minimizes the impact of riparian clearing and additional road building in connection with the access roads. Any riparian clearing ultimately leads to changes in stream macrofauna. In addition, studies on the mainland report turbidities greater than 3,000 ppm resulting from such constructions. This additional source of silt and the silt resulting from the slowing of stream flow due to water withdrawal will lead to the destruction of the native macrobiota. These points are adequately taken up by the Timbol report mentioned in the preceding paragraph.

The decrease in volume and reduction in velocity in turn will also lead to low dissolved oxygen content and elevated temperatures. Such deteriorated conditions will result in the loss of desirable aquatic animals now found in Kahana (e.g. 'o'opu nakea (Awaous stamineus), a native goby that still supports an ethnic fishery on Kauai, and the Tahitian prawn (Macrobrachium lar) which is harvested for local consumption.)

For the above reasons, we submit that loss of the last pristine stream on Oahu is too high a cost to pay. It is the last remaining spot on the island where students can gain experience in freshwater biology and other nature studies under pristine conditions. We strongly urge the BWS to explore alternate ways to supply water to leeward areas.

Sincerely,

Wayne Gagne
President

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

April 2, 1982

Mr. Wayne Gagne'
President
Conservation Council
for Hawaii
P. O. Box 2923
Honolulu, Hawaii 96802

Dear Mr. Gagne':

Subject: Your Letter of February 11, 1982, on the Environmental Impact Statement (EIS) for the Kahana Valley Water Development Project

H-57

Thank you for reviewing the draft EIS for our proposed water development project. Your letter will be appended to the revised environmental document.

In response to your comments, we offer the following:

1. We do not anticipate disrupting flow upstream of the 200 foot elevation.

   It is possible that the tributory stream west of the well field may be affected. Because of the complexity of the dike system, the effects of withdrawal on streamflow cannot be determined accurately without monitoring of stream flow during the test pumping.

2. It is improbable that the operation of Kahana II will reduce the surface flow of Kawa Stream. Because of the seaward location of the wells and the geology of the wells (dike-free lava flows), it is improbable that the stream will be affected. Kawa Stream receives its water from the overflow of dike compartments inland of Kahana Well II.

3. As mentioned previously, we do not anticipate affecting streamflow above the 200 foot elevation.

4. Monitoring of the stream will be done by the U. S. Geological Survey, and we shall control pumpage to keep conditions from reaching critical levels. We are committed to meet any minimum streamflow standards that may be promulgated in the future.

5. Construction activities will be guided by City and County Ordinances. Mitigating requirements are installing silting ponds during the construction phase and replanting scarified areas at the end of the project.

6. We are aware of the existence of the native goby and Tahitian prawn in Kahana Stream. Streamflow will be monitored to determine any long term effects from the cumulative pumpage from all the proposed wells in the valley. Should there be any significant reduction to streamflow, we shall contact and coordinate proposed mitigative measures with the U. S. Fish and Wildlife Service and the Division of Fish and Game (DLNR).

   We concur that the degradation of Kahana Valley will be a detriment to the island of Oahu. It is with this mutual concern that all the environmental aspects will be addressed before the project is implemented.

Should you have any questions, please contact Lawrence Whang at 548-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental
Quality Control
R. M. Towill