November 19, 1982

TO: HONORABLE EILEEN R. ANDERSON, MAYOR

VIA: ANDREW I. T. CHANG, MANAGING DIRECTOR

FROM: KAZU HAYASHIDA, BOARD OF WATER SUPPLY

SUBJECT: FINAL ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR HONOUILI WELLS

We recommend your acceptance of the EIS for our proposed water development project. The EIS complies with all the requirements of Chapter 343, Hawaii Revised Statutes.

According to Chapter 343, your acceptance is a formal determination that the EIS adequately describes identifiable environmental impacts and satisfactorily responds to comments received during the review of the statement.

The Honouili Wells project could add up to 9.0 million gallons of water to the Ewa-Waianae Water District. The project will be deferred until a water exchange with sewage effluent can be arranged with Oahu Sugar Company and the exchange approved by the Department of Land and Natural Resources.

We enclose a copy of the environmental document for your information.

If you have any questions, please contact me at 548-6180.

[Signature]

For KAZU HAYASHIDA
Manager and Chief Engineer

Enc.

CONCUR:

[Signature]
Andrew I. T. Chang
Managing Director

ACCEPTED:

[Signature]
Eileen R. Anderson
City and County of Honolulu

LHYW:cs
cc: K. Hayashida, L. Whang
REVISED
ENVIRONMENTAL IMPACT STATEMENT

HOUNOULIULI WELLS

BOARD OF WATER SUPPLY · CITY AND COUNTY OF HONOLULU
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CITY AND COUNTY OF HONOLULU
BOARD OF WATER SUPPLY

REVISED
ENVIRONMENTAL IMPACT STATEMENT
FOR
HONOLIULI Wells
HONOLULU, OAHU, HAWAII

TAX MAP KEY: 9-2-01: PORTION OF PARCEL 1

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: Mayor, City and County of Honolulu

Board Members: [Signatures and dates]

PREPARED BY: Environment Impact Study Corp.
770 Kapiolani Blvd., Suite 605
Honolulu, Hawaii 96813

September, 1982
Proposed Project: Honouliuli Wells
Applicant: City and County of Honolulu
Board of Water Supply
Accepting Authority: Mayor, City and County of Honolulu
Contact: Mr. Lawrence Whang
Board of Water Supply
630 South Beretania Street
Honolulu, Hawaii 96843
548-5221

September, 1982
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Summary
SUMMARY
HOUNULULU WELLS
REVISED
ENVIRONMENTAL IMPACT STATEMENT
Honouliuli, Oahu, Hawaii

PROPOSING AGENCY: Board of Water Supply
City and County of Honolulu

ACCEPTING AUTHORITY: Mayor
City and County of Honolulu

The Board of Water Supply proposes to construct six wells and approximately 6,100 linear feet of 24-inch pipe, linking the proposed wells with the existing Honouliuli Line Booster Station. The wells and transmission line will be located within a parcel used for sugar cane production, approximately 1.3 miles northwest of Waipahu, Oahu.

The primary objective of the proposed project is to meet increasing demands for water in the leeward region of Oahu. Specific objectives include the following:

1. Provide water for the planned growth, directed by the General Plan, of the leeward area where water demands are expected to rise from the 1978 consumption rate of 19.30 mgd to 43.20 mgd by the year 2000;

2. Provide for existing and future fire flow requirements; and

3. Provide for water distribution flexibility to insure a reliable water supply to communities to reduce the threat of shortages during droughts.

S-1
The proposed project will be funded by the Board of Water Supply, City and County of Honolulu and private users. Construction will be phased. Two wells will be constructed initially, with the other wells phased in as required. Construction costs for the first phase (2 wells) are estimated at $2,179,000 and for the following phases at $1,560,000, for a total project cost of $3,739,000, at 1979 dollars.

The project will proceed only after a water exchange agreement is settled with Oahu Sugar Company and a permit for the proposed development and water exchange is approved by the State according to Department of Land and Natural Resources' (DLNR) Chapter 166 of Title 13. The water exchange would assure that there would be no net increase in pumpage from the Pearl Harbor aquifer.

The climate in the project vicinity is generally hot and dry. The site is located on the lower western slopes of the Koolau Range at an elevation of approximately 380 feet above sea level. Situated on a gentle slope (3.7%), the site is approximately 500 feet west of a tributary to Honoali'i Stream.

Soils on the project site are Molokai silty clay loam. Permeability is moderate, runoff is slow, and the erosion hazard is slight to moderate. The site is underlain by
the Koolau Volcanic Series and the Waianae Volcanic Series. Ground water beneath the site consists of potable basal ground water.

No rare or endangered species of plants or animals were observed on the project site. No historical or archaeological sites are known to exist on the project site, which is an area previously disturbed by sugar cane cultivation.

An existing cane haul road provides access to the site. Electrical and telephone service will be provided. Liquid waste will be disposed of in a water-tight container, which will be periodically pumped out. Emergency services serve the urban areas in the general vicinity of the site.

According to the Honolulu General Plan Distribution of Residential Population for the year 2000, the total population of the Ewa, Waipahu, and Waianae areas would be approximately 168,000 ± 5%. The Board of Water Supply planning population for these areas, on which water demand is based, totals 168,400 for the year 2000.

The proposed project is located in an area designated Agriculture by the State and designated Agricultural by the City and County's Development Plan Map. The City and County's Interim Zoning Control Map designates the site as Agriculture-1 (AG-1).
Due to its utility nature, the proposed project is a permitted use according to City Zoning controls. However, a State Special Permit will be required, as well as DLNR approval per Chapter 166 of Title 13.

The proposed development will generate short-term primary impacts affecting air quality, noise levels, and erosion. These construction-related impacts will be mitigated by appropriate measures.

Long-term primary impacts resulting from the project include removal of up to 2 acres of sugar cane from production, removal of up to 2 acres of Prime Agricultural Land from production, a possible drop in head levels at water sources close to the project site, a potential increase in population in the Ewa-Makakilo area, and a potential increase in jobs in the Ewa-Makakilo area.

Secondary impacts include indirect impacts on population growth and the infrastructure to serve that growth.

Several alternatives have been investigated. They include "no action," postponing the project, alternative sites, an alternative transmission line alignment, and alternative water sources. Present BWS policy favors optimization of groundwater development.

The construction materials, capital, energy, and labor involved in this project will be irreversibly and irrevocably committed. Water resources will be committed
to specific uses which will be difficult to reverse in the future. There will be no net increase in ground water withdrawal from the Pearl Harbor aquifer. The wells and pumpage will be controlled by applicable governmental regulations.
Proposed Project
SECTION 1
DESCRIPTION OF THE PROPOSED PROJECT

I. INTRODUCTION

A. General

The increasing demand for water in the Leeward District of Oahu necessitates the development of additional water sources to meet current and future water needs. After years of studies, the Board of Water Supply, City and County of Honolulu, proposes development of the Honouliuli Wells as one of many ongoing projects to provide water for portions of the Ewa-Waianae and the Pearl Harbor water districts.

The Honouliuli Wells project is one of the actions proposed in the Oahu Water Plan developed in 1975 for the City and County of Honolulu to meet existing and future water needs of the Ewa and Waipahu areas.

B. Project Description

The proposed project will require the development of a well field to tap the underground Pearl Harbor aquifer. Six wells will be drilled with each having electrical pumps rated at 2 million gallons per day (mgd) capacity. Also, the construction of a control building and a connecting water transmission line from the wells to the existing Honouliuli line booster...
station will be required. Approximately two acres of land will be required for the well field and control station. Other sections of this report will provide information on the impact on the Pearl Harbor aquifer, water demand and pumpage, and other relevant information.

C. Project Location

The proposed Honouliuli Wells field (TMK 9-2-01: portion of parcel 1) is surrounded by cane fields and located approximately 1.3 miles northwest of Waipahu, Oahu and 1/2 mile west of Kunia Road. The only access to the well field is from an existing cane haul road. Please refer to Figures 1-1, 1-2 and 1-3.

II. PROJECT OBJECTIVES

The primary purpose of the project is to meet increasing demands for water in the leeward region of Oahu. Specific objectives include the following:

1. Provide water for the planned growth of the leeward area, directed by the General Plan, where water demands are expected to rise from the 1978 consumption rate of 19.30 mgd to 43.20 mgd by the year 2000;
2. Provide for existing and future fire flow requirements; and
3. Provide for water distribution flexibility to insure a reliable water supply to communities to reduce the threat of shortages during droughts.

1-2
LOCATION MAP

FIGURE 1-1
III. EXISTING WATER SYSTEM

A. General Background

The proposed wells will draw from the new State-designated Pearl Harbor Ground Water Control Area (PHGWCA), which includes the Ewa and Wahiawa Judicial Districts and which has been designated for specific control. Refer to Figure 1-4. Existing wells in this area were conditionally certified by July 3, 1980 and new projects must be approved by the State Department of Land and Natural Resources, Division of Water and Land Development. The resident population within the PHGWCA was 214,830 as of July 1979. Details on the PHGWCA are provided in Appendix A.

Water Districts are designated by the BWS according to general service areas. Refer to Figure 1-5.

The areas of Waipahu, Ewa, and Waianae are essentially served by wells located in the Pearl Harbor Water District. The Pearl Harbor Water District consists of a 69-square mile area in south central Oahu. It extends from the crest of the Koolau range and Red Hill at its easterly boundary to Kunia Road on the west. Its southern boundary is the shoreline area of Pearl Harbor Estuary and its northern boundary generally falls below the Waiahole Ditch and Tunnel System.
OAHU WATER USE DISTRICTS

FIGURE 1-5

SOURCE: OAHU WATER PLAN 1975.
There are 22 BWS well fields located in the Pearl Harbor Water District with a combined certified capacity of 70.7 mgd. Of this amount 11.90 mgd (12 well fields) serves users within the Pearl Harbor Water District minus Waipahu, 16.3 mgd (3 well fields) is available for export to serve users in the Ewa-Waianae Water District minus Waipahu, and 42.5 mgd (7 well fields) is available to serve users in the Honolulu Water District. The total resident population within the Pearl Harbor Water District was 124,094 as of July, 1978.

The Ewa-Waianae Water District consists of a 120-square mile area in western Oahu. It includes the region west of the Waianae Ridge Crest from Kaena Point to Nanakuli, Ewa and part of Hoomaluhia up to Kunia Road on the east. The resident population as of April 1, 1970 was 47,545 and had increased to 60,658 by July 1, 1979.

Historically, most of the water demand for the Ewa-Waianae District has been supplied by wells located in the Pearl Harbor Water District, because fresh water resources in the Ewa-Waianae District were formerly considered economically unfeasible for development. This is because the Waianae Coast experiences the lowest rainfall on Oahu, with approximately 20 inches or less per year falling along the
coast and 20 to 30 inches per year falling in the valleys and on the intervening ridges.

The present maximum capacity of existing BWS sources serving the leeward region (Ewa-Waianae District plus Waipahu) is 41.62 mgd. However, since sources within the Pearl Harbor Water District also fall within the PHGWCA, the State has certified pumpage rates which the BWS must not exceed. This has resulted in an actual pumpage limit of 16.30 mgd. Table 1-1 presents a breakdown of maximum capacities by Water District and source, with State pumpage limits for the Pearl Harbor sources also shown.

The BWS is proposing development of additional water sources in the Ewa-Waianae Water District. These include: (1) eight 1-mgd capacity wells in Makaha Valley; and (2) two 1-mgd capacity wells in Waianae Valley. These sources, however, will only be sufficient for the Ewa-Waianae Water District northwest of Makakilo City. The proposed project is proposed to serve the needs of Makakilo City and developments proposed for the Ewa Plain.

B. Existing Transmission System

The existing transmission system consists of the following lines and line boosters [1.1]:

1-10
### TABLE 1-1

**DESIGN CAPACITIES OF WATER SOURCES SERVING THE LEEWARD REGION VERSUS STATE PUMPAGE LIMITS**

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<th>Ewa-Waianae Water District Sources</th>
<th>Maximum Capacity</th>
<th>Operational Capacity</th>
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<tr>
<td>Waianae Tunnel</td>
<td>2.00 mgd</td>
<td></td>
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<tr>
<td>Kamaile Wells</td>
<td>1.00</td>
<td></td>
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<tr>
<td>Waianae Plantation System</td>
<td>0.70</td>
<td></td>
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<tr>
<td>Makaha Shaft</td>
<td>1.44</td>
<td></td>
</tr>
<tr>
<td>Makaha Well</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal:</strong></td>
<td><strong>6.14 mgd</strong></td>
<td><strong>4.61 mgd</strong></td>
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<th>Pearl Harbor Water District Sources Serving Ewa-Waianae Water District</th>
<th>Maximum Capacity</th>
<th>Average Pumpage*</th>
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<td>Hoaeae Wells</td>
<td>14.44 mgd</td>
<td>6.61 mgd</td>
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<tr>
<td>Kunia Wells I</td>
<td>10.08</td>
<td>4.81</td>
</tr>
<tr>
<td>Waipahu Wells</td>
<td>10.96</td>
<td>4.88</td>
</tr>
<tr>
<td><strong>Subtotal:</strong></td>
<td><strong>35.48 mgd</strong></td>
<td><strong>16.30 mgd</strong></td>
</tr>
<tr>
<td><strong>TOTAL:</strong></td>
<td><strong>41.62 mgd</strong></td>
<td><strong>20.91 mgd</strong></td>
</tr>
</tbody>
</table>

* These figures are the State average allowed pumpages per day; however, they are below the operational capacity of these wells.

**Source:** [1.1], [1.2]
Water is transported from Hoaeae Wells to Barbers Point 215 Reservoir through a 30-inch main along Farrington Highway. Refer to Figure 1-6. Water from Kunia Wells I is pumped through a 20-inch main along Kunia Road which connects to the 30-inch main at Waipahu Street. Between Fort Weaver Road and Campbell Industrial Park, three transmission mains branch off the 30-inch main: a 16-inch main running down Fort Weaver road to feed Ewa; a 16-inch main going up Makakilo Drive to feed Makakilo via booster pumps; and a 20-inch main running down Kalaeloa Boulevard to Campbell Industrial Park. Beyond Campbell Industrial Park, water is boosted from the Barbers Point reservoir to a 24-inch main along Farrington Highway to Lualualei 242 Reservoir. From Lualualei Reservoir, the transmission main connects to a 20-inch main running down Hakimo, Paakea, Maillili, and Lualualei Homestead Road to the Waianae 242 Reservoir.

Beyond Lualualei Homestead Road, the 20-inch main reduces to a 16-inch main along Farrington Highway to Kaulawaha Road in Waianae. From Kaulawaha Road, 24 and 8-inch mains run parallel along Farrington Highway to Water Street in Makaha.

Makaha Shaft and Makaha Well, with help from Makaha Booster Station, serve upper Makaha Valley
and portions of Makaha town. Waianae Tunnel and Plantation System serve upper Lualualei and Waianae Valleys and, through a pressure regulator, portions of Waianae town.

Kunia Wells II serve homes above the 128-foot elevation and will serve Village Park subdivision in the future. Waipahu Wells, Hoaale Wells, and Kunia Wells I serve Waipahu and Ewa-Waianae District.

Heavy demands on the existing system necessitated the installation of line boosters to increase carrying capacity and maintain line pressures. The Honouliuli, Lualualei and Barbers Point line boosters help to move water westward, while the Ewa Beach booster increases flow to Ewa.

C. Existing and Projected Water Demand

Average water pumpage rates (demand) of BWS sources within the Pearl Harbor Water District over the last five years are presented in Table 1-2. Sources serving the Ewa-Waianae Water District plus Waipahu total 16.82 mgd.

Average demand of BWS sources within the Ewa-Waianae Water District over the last five years totalled 100.52 mgd, for a total average demand of 20.104 mgd within the Ewa-Waianae Water District plus Waipahu.

1-14
TABLE 1-2
BWS SOURCES WITHIN THE PEARL HARBOR WATER DISTRICT

A. SERVING THE EWA-WAIANAE WATER DISTRICT PLUS WAIAPAHU

<table>
<thead>
<tr>
<th>Mean Pumpage 1975-1979 (mgd)</th>
<th>DLNR Preserved Use (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.55</td>
<td>Kunia Wells I 4.81</td>
</tr>
<tr>
<td>6.83</td>
<td>Hoaeae Wells 6.61</td>
</tr>
<tr>
<td>4.44</td>
<td>Waipahu Wells 4.88</td>
</tr>
<tr>
<td>16.82 ST</td>
<td></td>
</tr>
</tbody>
</table>

B. SERVING HONOLULU WATER DISTRICT

<table>
<thead>
<tr>
<th>Mean Pumpage 1975-1979 (mgd)</th>
<th>DLNR Preserved Use (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.85</td>
<td>Kaahumanu Wells 1.11</td>
</tr>
<tr>
<td>12.82</td>
<td>Punanani Wells 11.97</td>
</tr>
<tr>
<td>.27</td>
<td>Waimalu Wells II 0.30</td>
</tr>
<tr>
<td>1.17</td>
<td>Kaonohi Wells II 1.10</td>
</tr>
<tr>
<td>10.93</td>
<td>Kalanui Wells 11.75</td>
</tr>
<tr>
<td>1.97</td>
<td>Kaamilio Wells 1.99</td>
</tr>
<tr>
<td>12.48</td>
<td>Halawa Shaft 14.28</td>
</tr>
<tr>
<td>40.49 ST</td>
<td></td>
</tr>
</tbody>
</table>

C. SERVING THE PEARL HARBOR WATER DISTRICT MINUS WAIAPAHU

<table>
<thead>
<tr>
<th>Mean Pumpage 1975-1979 (mgd)</th>
<th>DLNR Preserved Use (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.29</td>
<td>Kunia Wells II 0.96</td>
</tr>
<tr>
<td>.59</td>
<td>Waipio Heights Wells 0.63</td>
</tr>
<tr>
<td>1.23</td>
<td>Pearl City Shaft 1.32</td>
</tr>
<tr>
<td>.38</td>
<td>Pearl City Wells I 0.31</td>
</tr>
<tr>
<td>2.12</td>
<td>Pearl City Wells II 2.19</td>
</tr>
<tr>
<td>0.93</td>
<td>Waiau Wells 1.44</td>
</tr>
<tr>
<td>.39</td>
<td>Newtown Wells 1.05</td>
</tr>
<tr>
<td>.08</td>
<td>Waimalu Wells I 0.08</td>
</tr>
<tr>
<td>1.19</td>
<td>Kaonohi Wells I 1.10</td>
</tr>
<tr>
<td>1.01</td>
<td>Aiea Wells 1.03</td>
</tr>
<tr>
<td>.68</td>
<td>Aiea Gulch Wells 0.79</td>
</tr>
<tr>
<td>1.07</td>
<td>Halawa Wells 1.00</td>
</tr>
<tr>
<td>9.96 ST</td>
<td></td>
</tr>
</tbody>
</table>

70.35 TOTAL
SOURCE: [1.2]
Projected water requirements for the leeward region are presented in Table 1-3. Table 1-4 breaks these down by area within the region. The requirements are based on population projections that are, in turn, based on the following:

1. The resident population of the leeward area, consisting of Census Tracts 83 to 88, inclusive, 96, 97, 98 and 89.01.
2. The DPED (Department of Planning and Economic Development) Series II-F Population Projection for the present to the year 2000.

Table 1-3 shows that by 1995, demand will equal the present maximum capacity of the BWS sources (based on design capacities and State pumpage limits) serving the leeward region.

The conclusion, then, is that new sources of water must be developed to service the Ewa-Waianae District plus Waipahu to accommodate growth projected by the State DPED and the General Plan of the City and County of Honolulu.

IV. PROPOSED PROJECT

To meet the requirements discussed in previous sections, several strategies have been proposed. They include: the development of new sources of water (Makaha Wells, Waianae Wells and Honouliuli Wells); a water exchange
### TABLE 1-3
TOTAL POPULATION AND WATER DEMAND PROJECTIONS
FOR THE LEeward REGION(1)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>86,600</td>
<td>73,600</td>
<td>13,000</td>
<td>19.30</td>
</tr>
<tr>
<td>1979</td>
<td>89,300</td>
<td>76,300</td>
<td>13,000</td>
<td>20.20</td>
</tr>
<tr>
<td>1980</td>
<td>92,700</td>
<td>79,600</td>
<td>13,100</td>
<td>20.90</td>
</tr>
<tr>
<td>1985</td>
<td>110,000</td>
<td>96,700</td>
<td>13,300</td>
<td>25.40</td>
</tr>
<tr>
<td>1990</td>
<td>127,000</td>
<td>113,800</td>
<td>13,200</td>
<td>30.30</td>
</tr>
<tr>
<td>1995-96</td>
<td>149,600</td>
<td>136,600</td>
<td>13,200</td>
<td>37.60</td>
</tr>
<tr>
<td>2000-01</td>
<td>168,400</td>
<td>155,400</td>
<td>13,000</td>
<td>43.20</td>
</tr>
</tbody>
</table>

(1) Leeward region refers to the Ewa-Waianae Water District plus Waipahu.

Source: [1.1] (Revised by II-F projections)
| YEAR | RESID POP. | SOURCE INPU | POPULATION | SOURCE INPU | POPULATION | SOURCE INPU | POPULATION | SOURCE INPU | POPULATION | SOURCE INPU | POPULATION | SOURCE INPU | POPULATION |
|------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|
|      | INDS | PRIV. | INDS | PRIV. | INDS | PRIV. | INDS | PRIV. | INDS | PRIV. | INDS | PRIV. | INDS | PRIV. |
| 1970 | 28,800 | 28,200 | 600 | 7.63 | 25,400 | 23,300 | 12,100 | 7.46 | 22,400 | 22,100 | 300 | 4.30 |
| 1971 | 28,900 | 28,400 | 500 | 7.76 | 25,600 | 23,400 | 12,200 | 8.20 | 22,600 | 22,600 | 300 | 4.30 |
| 1972 | 28,900 | 28,400 | 500 | 7.60 | 24,900 | 22,400 | 12,200 | 8.80 | 22,900 | 22,900 | 300 | 4.30 |
| 1973 | 29,100 | 28,600 | 200 | 6.90 | 25,400 | 23,200 | 12,100 | 12.00 | 24,700 | 24,700 | 300 | 4.30 |
| 1974 | 29,500 | 29,000 | 200 | 8.33 | 26,600 | 24,600 | 12,900 | 14.00 | 25,700 | 25,700 | 300 | 4.30 |
| 1975 | 30,700 | 30,300 | 200 | 8.20 | 28,800 | 26,800 | 12,800 | 22.20 | 28,500 | 28,500 | 300 | 5.90 |
| 1995 | 32,600 | 32,400 | 200 | 9.30 | 38,500 | 36,500 | 12,400 | 26.70 | 31,100 | 31,100 | -0- | 6.20 |

**Table 1-4**: Population and Water Supply Projections for the Lesser Bend Area

**Sources**: [1,1] (Revised by H.E. projections)
program between the Board of Water Supply and Oahu Sugar Company; and a demineralization program [1.3]. This environmental impact statement addresses one of the proposals; namely, the development of Honouliuli Wells. The other strategies are more fully explained under "Alternatives" in Section 6.

The 9.0 mgd of water to be developed at Honouliuli would basically serve developments planned for Campbell Industrial Park, Makakilo, and other areas of the Ewa Plain. Although the system serves the entire leeward coast, the Board of Water Supply (BWS) has plans for developing additional sources in the Waianae and Makaha valleys to stabilize or alleviate export from the PHGWCA to these areas.

Initially, two 2.0 mgd wells will be developed with an installed capacity of 4.0 mgd and an operating capacity of 3.0 mgd. These will alternate pumpage on a daily or weekly basis. On any given day/week one well will be pumping the maximum of 2 mgd and the other will be pumping up to 1 mgd, resulting in the operating capacity of 3 mgd. The next day/week the roles will reverse, so that neither pump is operating full time every day/week. Weekly cycle operations are successfully being used at Kaonohi Wells II (3 wells, each 1.0 mgd).

The surplus amount from the difference between operating capacity and installed capacity is saved for emer-
gencies. Another way to minimize the upcoming potential of the well field with respect to the transition zone may also be used; namely, operation of the 2.0 mgd pumps at 1.5 mgd.

The initial two wells will be funded by BWS, Campbell Industrial Park and Makakilo, based on each user's proportionate share of water to be withdrawn. In the future, four more wells will be added, for a total of six wells, with an installed capacity of 12 mgd and operating capacity of 9 mgd. These additional 4 wells will be developed based on water demand and development costs will be paid for by the entity requesting a new well. After development, the cost of maintaining the well(s) and water system would be distributed to all users of the water system.

Before the Board proceeds with the project, arrangements will be made with Oahu Sugar Company for them to cut back an equal amount of ground water pumpage so that net pumpage from the Pearl Harbor aquifer will remain the same. The City will compensate Oahu Sugar for this reduction in pumpage by offering water of lower quality in exchange, on an agreed basis. Such water could theoretically consist of treated sewage effluent, spring water, or surface water. At present, treated sewage effluent is the preferred choice. (Water to mix with the effluent would come from plantation sources). These proposals are discussed in Section 6, pages 6-3 to 6-6.
Oahu Sugar may then use this lower quality water in either
drip or furrow irrigation. This water exchange must be
approved by the Board of Land and Natural Resources, so
that there will be no net increase of pumpage from the
Pearl Harbor Groundwater Control Area.

The proposed project is located just within the
eastern border of the Ewa-Naianae Water District in the
Kunia area, northwest of the town of Waipahu. The wells
and control building would be constructed at approximately
the 380-foot elevation. A transmission line will connect
the wells with the existing Honouliuli Line Booster Station
on Farrington Highway west of Waipahu (note Figure 1-2).

The project includes construction of the following:

1. Drilling and casing of six 2 mgd wells
   having an installed capacity of 12.0 mgd
   and an operating capacity of 9.0 mgd;

2. Installing a 24-inch transmission line
   from the wells to the existing Honouliuli
   Line Booster Station;

3. Installing six pumps, constructing a 3,000-
   foot access road, constructing a concrete
   control building to house electrical equip-
   ment and appurtenances, and installing a
   six-foot high security fence around the
   wells and control building.
Initially, only two wells will be developed; the other four to be developed according to future water demands.

The control building, wells and pumps will be located on a two-acre parcel. Site preparation will involve moderate grading. The building will be approximately 30 feet by 70 feet in floor size and will contain three main rooms. One room will house the electrical control panel, the rate of flow recorder, and the pump controls. The second will contain the chlorine cylinders and the third will be for the chlorinator pumps and appurtenances. Thus, should a chlorine leak occur, protection is provided to the control room and the electrical equipment and controls. The control building will probably be painted and the grounds landscaped.

The wells will be located in a rhomboidal (parallelogram) configuration and spaced approximately 150 feet apart. Refer to Figure 1-7 for a general site layout of the proposed project.

The transmission line will be of cast iron or concrete and buried within the cane haul road, with a minimum cover of three feet to withstand the impact of cane haul trucks or other heavy vehicles.

The proposed alignment follows existing cane roads south of the wells, crosses under the H-1 Freeway, continues
FIGURE 1-7
SITE LAYOUT SCHEMATIC
south to Farrington Highway, and then east to the booster station. This alignment is approximately 6,100 feet (1.2 miles) long.

The well field site was selected after evaluating the potential effects of this new well field on existing wells (Kunia Wells I and II and Oahu Sugar's Ewa Shaft) found in the general vicinity. It is anticipated that this site will have the least hydrologic effect on the existing wells.

V. PHASING AND FUNDING

Initially, two wells would be constructed and other wells phased in as required. Construction will start after a water exchange agreement is settled with Oahu Sugar Company and a permit for the proposed development approved by the State according to DLNR Chapter 166 of Title 13.

After all agreements are settled and permits obtained, drilling of each well will take 6 weeks and construction of the control building and access road would require approximately one year. Approximately 1.5 to 2 years will be required before the water source is operational.

Construction costs of the proposed 6 wells and total facility were estimated at a total of $2,921,000 in 1977 [1.4]. In 1979 prices, the cost is estimated at $3,739,000. The annual operating cost of the proposed project was
estimated at $381,200 in 1977. This translates into $129.00 per million gallons produced from the wells.

Since only two wells are planned for initial development and the other four wells are to be developed according to demand, current cost estimates are more applicable to development of the two wells plus necessary appurtenances. Most of the cost will still apply since the transmission line and control station will still be required. Table 1-5 gives a breakdown of construction costs. Funds have not been appropriated to date.

VI. TERMINOLOGY

As previously noted, the proposed wells site is located within the Ewa-Waianae Water District, but will be tapping the Pearl Harbor aquifer. In various hydrologic studies, the Pearl Harbor aquifer is also alternately referred to as the "Pearl Harbor area", or the "Pearl Harbor basin". These terms are defined in Appendix A.

For the purposes of this report, Pearl Harbor aquifer shall refer to the area roughly bounded by the Waianae Range crest on the west, upper Waikele Stream and Waikalaua Stream on the north, the Koolau Range crest on the east, and South Halawa Stream on the southeast. Refer to Figure 1-8.

Other technical terms are defined in a glossary in Appendix B.
<table>
<thead>
<tr>
<th>ITEM AND UNIT COST</th>
<th>SUBTOTAL FOR 2 WELLS</th>
<th>SUBTOTAL FOR 4 WELLS</th>
<th>TOTAL FOR 6 WELLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipelines:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>400' of 12&quot; @ $120</td>
<td>$48,000</td>
<td>$48,000</td>
<td></td>
</tr>
<tr>
<td>100' of 16&quot; @ $130</td>
<td>$13,000</td>
<td>NA</td>
<td>$13,000</td>
</tr>
<tr>
<td>200' of 20&quot; @ $140</td>
<td>$28,000</td>
<td></td>
<td>$28,000</td>
</tr>
<tr>
<td>5,400' of 24&quot; @ $150</td>
<td>$810,000</td>
<td></td>
<td>$810,000</td>
</tr>
<tr>
<td>Wells:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ $190,000/well</td>
<td>$380,000</td>
<td>$760,000</td>
<td>$1,140,000</td>
</tr>
<tr>
<td>Pumps:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ $200,000/pump</td>
<td>$400,000</td>
<td>$800,000</td>
<td>$1,200,000</td>
</tr>
<tr>
<td>Control Station:</td>
<td>$500,000</td>
<td>NA</td>
<td>$500,000</td>
</tr>
<tr>
<td>a) Control building</td>
<td>$80,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Access road</td>
<td>$15,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Mech. &amp; Electrical</td>
<td>$200,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) Fencing</td>
<td>$26,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e) Landscaping</td>
<td>$100,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f) Site work</td>
<td>$80,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Construction Cost:</td>
<td>$2,179,000</td>
<td>$1,560,000</td>
<td>$3,739,000</td>
</tr>
</tbody>
</table>

1 The associated costs to convey lower quality water to Oahu Sugar Company's fields are not included.
* Estimated cost at 1973 prices.
NA Not applicable because items necessary with initial development of two wells.
REFERENCES


Affected Environment
SECTION 2
DESCRIPTION OF THE AFFECTED ENVIRONMENT

I. PHYSICAL CHARACTERISTICS

A. Climate

1. Island of Oahu [2.1]

Oahu is the third largest of the Hawaiian Islands and is marked by two important mountain systems. The Koolau Range, at an average elevation of 2,000 feet, forms the northeastern coast. The Waianae Mountains, somewhat higher in elevation, forms the west coast.

The prevailing wind throughout the year is the northeasterly trade wind, although its average frequency varies from more than 90 percent during the summer to only 50 percent in January.

Annual rainfall in the Honolulu area averages 24 inches along the coast but increases to about 35 inches one mile inland and to about 60 to 70 inches two miles inland. Parts of the Koolau Range average 300 inches or more a year. This heavy mountain rainfall sustains extensive irrigation of cane fields and the water supply for Honolulu. East (windward) of the Koolau Range coastal areas receive 30 to 50 inches annually; cane and pineapple fields in central Oahu get

2-1
about 35 to 40 inches. Oahu is driest along the coast west of the Waianae Range where rainfall averages about 20 inches a year. However, rainfall variations from month-to-month and year-to-year are considerable. More rain occurs islandwide during the winter months than in the summer.

Hawaii's equable temperatures are associated with the small seasonal variation in the amount of energy received from the sun and the tempering effect of the surrounding ocean. The range in temperature averages only 7 degrees between day and night. Daily maximums run from the high 70's in winter to the mid-80's in summer, and daily minimums from the mid-60's to the low 70's.

Weather severe enough to interfere with shipping or travel is uncommon. Intense rains during the October to April "winter" season sometimes cause localized flash flooding. Thunderstorms are infrequent and usually mild, as compared with those of the midwestern United States. Only a few tropical cyclones have struck Hawaii since 1950.
2. **Kunia Area**

The climate in the vicinity of the project site is generally hot and dry. The temperature regime for Kunia Substation 740.4, located at the intersection of Kunia Road and the H-1 Freeway, is depicted in Figure 2-1 [2.2]. Winter temperatures range from the low 60's to the high 70's. Summer temperatures range from the mid 60's to the mid 80's. The coldest months are January and February, with a mean maximum temperature of approximately 77°F and a mean minimum temperature of approximately 60°F. The warmest months are August and September, with a mean maximum temperature of about 84°F and a mean minimum temperature of about 66°F.

During the winter months, tropical storms occasionally buffet the area, bringing with them heavy showers. These showers account for practically all of the rain which falls in the leeward area.

The project site receives approximately 25 inches of rain per year, primarily from November through April. Farther down the slopes, the Ewa Plain normally receives less than 20 inches per year. This is also the case along the Waianae Coast, while the valleys and ridges
TEMPERATURE
KUNIA SUBSTATION 740.4
FIGURE 2-1

Source: Hawaii State Department of Land and Natural Resources, Water and Land Development Division Print Out, statistical summary of minimum and maximum monthly temperatures.
of that area normally receive between 20 to 30 inches. Note Figure 2-2.

The wind rose for nearby Barbers Point NAS is shown in Figure 2-3. The mean long-term wind speed can be estimated at approximately 8.9 knots, with the most typical wind direction from the northeast for 22% of the time. Other predominant winds come from the north-northeast and the east-northeast, as noted on Figure 2-3.

B. Topography

The project site is located on the lower western slopes of the Koolau Range at an elevation of approximately 380 feet above sea level. Situated on a gentle slope (3.7%), the site is surrounded by fields of cultivated sugar cane and numerous cane haul roads. It is approximately 500 feet west of an unnamed tributary to Honouliuli Stream.

C. Geology [2.3]

The remnants of two shield volcanoes form the island of Oahu. The western part of the island is the eroded Waianae volcano and the eastern part consists of the eroded Koolau volcano. The Waianae shield was greatly eroded before the lavas of the Koolau volcano flowed up against the lower slopes of the Waianae volcano. These events were followed by a long quiet period during which deposition of sediments
and changes in sea level (with the resulting reefs) contributed to the building of a flat coastal plain.

The project site is underlain by the Koolau Volcanic Series. This series is primarily composed of tholeiitic basalts. Below this, separated by a geologic unconformity, is the Waianae Volcanic Series, also primarily composed of tholeiitic basalts with some andesitic basalts (hawaiites) in the upper layers. The Waianae Volcanic Series is the older of the two.

Where the two lava series meet, an erosional unconformity exists, marked by the presence of a buried soil bed that had formed on Waianae rocks and was later covered by the Koolau lavas. This unconformity delineates the boundary of the Koolau and Waianae aquifers. While hydraulic continuity exists between these two aquifers, immediately west of the unconformity in the Waianae aquifer, the head drop has been estimated at two to two-and-a-half feet. The proposed project is located east of the unconformity in the Koolau aquifer. Note Figure 2-4.

Further to the south, both of these series are covered by caprock made up of marine sediments and alluvium. These sediments constitute the Ewa
plain and are less permeable than basaltic lavas. The caprock extends seaward from the vicinity of Farrington Highway.

To the west and south of the project site, along the lower southeastern slope of the Waianae Range, is a row of five very late cones (upper member of Waianae Volcanic Series): Puu Kuua, Puu Kapuai, Puu Makakilo, Puu Palailai, and Puu Kapolei. They are composed of a mixture of cinder, spatter and lava flows.

D. Hydrology

1. Surface Water [2.4]

Two major streams drain the vicinity of the project area, Honouliuli Stream and Waikele Stream. Located approximately 0.9 miles west of the project site, Honouliuli Stream is an intermittent stream flowing after periods of heavy rainfall. It empties into the West Loch of Pearl Harbor.

The U.S. Geological Survey (USGS) maintains a gaging station for Honouliuli Stream at a bridge on Farrington Highway 1.8 miles west of Waipahu Post Office. There, a crest-stage gage measures storm flow from an 11.0 square mile drainage area. The annual maximum instantaneous peak discharge for a given day in recent years is as follows:

2-10
1975  1,460 cfs
1976  1,990 cfs
1977  207 cfs

A tributary of Honouliuli Stream flows south approximately 500 feet east of the project site. It is dry most of the year.

Waikie Stream, located approximately 1.8 miles east of the project site, is a perennial stream which also empties into West Loch of Pearl Harbor. The USGS maintains a gaging and water quality station on the stream, 300 feet upstream from a bridge on Highway 90 and 0.3 miles southwest of the sugar refinery at Waipahu. It measures flow from a 45.7 square mile drainage area.

The annual average daily flow for a 24-year period (water years 1953 to 1959 and 1961 to 1977) was 38.5 cfs. For water year 1977 (October 1976 through September 1977), the daily flow was considerably less, averaging 20.2 cfs.

The Honouliuli Wells site and most of the proposed transmission alignment are not situated in any known flood-prone area. According to the Flood Insurance Study for Oahu by the Federal Insurance Administration, the area is classified Zone D, or area of undetermined but possible
flood hazards. A portion of the alignment is outside the limits of, but within the vicinity of Honouliuli Stream floodplain, and is designated Zone C, or area of minimal flooding. A Department of the Army permit is not required for this project.

2. Ground Water

The ground water beneath the site is part of the great basal aquifer underlying southern Oahu and commonly referred to as the Pearl Harbor aquifer. The Pearl Harbor aquifer is bounded on the south by the caprock of the Ewa Plain. The western boundary is abruptly terminated along a line passing up Makaiwa Gulch to the southern Waianae rift zone. Its northern boundary is the structural feature that impounds the Schofield high-level water body. Its eastern boundary is the rift zone of the Koolau range.

The basal ground water, basically consists of three layers: (1) upper fresh water layer; (2) middle transition zone of brackish water; and (3) bottom salt water layer. The upper layer contains fresh water for domestic use. The water table, is about 15 feet above sea level in the immediate vicinity of the project.

2-12
site. The fresh water extends down to depths in excess of 400 feet below sea level. Within the uppermost portion of this fresh water layer is return irrigation water, extending down from 50 to 200 feet in thickness. This water, although mineralized, is suitable for domestic use.

The upper fresh water layer is contained within the Koolau Volcanic Series. The caprock of the Ewa Plains retards the natural seaward movement of the ground water, causing the water to stand at a higher level in the aquifer than it would if the caprock barrier were absent [2.5].

Below the fresh water basal aquifer is a transition zone of brackish water. Brackish water is also found within the caprock.

In general, the capacity of the caprock to store and transmit water is small, compared to that of the volcanic series. In the Ewa region, however, furrow irrigation returns large quantities of water into the caprock aquifer. Because of its generally poor quality, the brackish caprock water is used only for agricultural and industrial purposes. In Honolulu, small quantities of caprock water have been developed for air conditioning use [2.6].

2-13
Below the brackish water transition zone is a salt water aquifer which extends to an unknown depth below sea level [2.7].

The fresh basal ground water floats on the salt water as a lens-shaped body, because the specific gravity of fresh water is slightly less than that of sea water. The basal ground water occurs in an essentially continuous lens throughout southern Oahu [2.8]. See Figure 2-5. However, the thickness of the lens varies throughout the region, as determined by local heads and artesian areas. Refer to Appendix A for further discussion.

Rainfall is the principal source of fresh basal water on Oahu, supplemented by return irrigation water in this area. In the Pearl Harbor aquifer the head, or elevation of the basal water table, currently reaches a maximum of 25 feet above sea level inland and decreases to about 14 feet near the coast. (Drawdown or discharge heads near the Pearl Harbor springs are about 11 feet).

The lens is a dynamic system through which fresh water moves from areas of recharge (above the 60-inch isohyet - Figure 2-2) to points or zones of discharge (usually along the shore).
GROUND WATER AREAS
OAHU

SOURCE: USGS 1977 ELEMENTS NEEDED IN DESIGN OF A GROUND-WATER-
QUALITY MONITORING NETWORK IN THE HAWAIIAN ISLANDS. PAPER 2041.

2-15
In an aquifer of a given uniform permeability, under natural conditions the thickness of the fresh water lens varies with the amount of water moving through it; that is, the thickness increases as the rate of recharge increases, and vice versa.

Water can be obtained from the basal lens by sinking wells into it. Many of the biggest wells in Hawaii are termed "Maui-type" wells (first used on the island of Maui), consisting of a shaft leading from the ground surface to a narrow, horizontal tunnel in the upper part of the basal lens. The present trend, however, is to drill several vertical wells penetrating only to the uppermost part of the water body, instead of the more costly shaft and tunnel of the Maui-type wells.

Honouliuli Wells will follow the present trend. Examples of this method within the vicinity of the project site are the Hoaee Wells, Kunia Wells I and Kunia Wells II.

Seasonal changes in the thickness of the lens caused by fluctuations in recharge, pumping from wells and the action of the tides keeps the fresh water-salt water interface (transition
zone. Where this brackish water is applied to rate of water pumped from wells must be regulated so that it does not exceed the fresh water recharge of the basal lens, for if it does, salt and brackish water will intrude into the lens, lowering its quality for domestic use.

Artificial discharge from the lens, such as pumping from a well, reduces the amount of water that moves to the shore. This results in a thinning of the lens between the well and the shore, with a thickening of the transition zone towards the coast and a thinning inland, if the rate of withdrawal is constant. If withdrawal is intermittent, the resulting alternate thickening and thinning of the lens will increase the rate of mixing and cause the transition zone to thicken throughout the area influenced by the well. For further discussion, refer to Appendix A. This interception of fresh water by a well may cause increases in salinity of water pumped from other wells seaward of the well.

Pumping in the Pearl Harbor aquifer has an additional effect on the salinity of the basal water because of the use of irrigation water
drawn from wells penetrating into the transition sugar cane fields overlying the basal water table, a large part of it moves down to the water table, adding water of relatively high salinity into the fresh water lens [2.9].

In addition to the caprock barrier recharge of excess irrigation water to the basal water body is important in maintaining a high head throughout the area.

By necessity, sugar cane, which covers much of the tillable portion of the region, is heavily irrigated because the soils are highly permeable. Approximately half of the irrigation water applied by the furrow method returns to the aquifer through percolation below the root zone of the plants [2.10].

Agriculture pumpage in the Pearl Harbor aquifer is heavy from about April to October each year during the sugar cane irrigation period. The draft decreases by about 75% during the wet months of October to March, when sugar cane is not irrigated [2.11]. Pumpage for domestic use also undergoes an annual fluctuation, with pumpage in the summer months approximately 20% greater than in the winter months.
From about 1919 to 1960, pumpage in the Pearl Harbor aquifer averaged 160 mgd, most of which was used to irrigate sugar cane fields. (Natural spring flow averaged 85 mgd). A lowering of the head and shrinking of the fresh water lens initially resulted from this heavy withdrawal, relative to undeveloped conditions, and was accompanied by an inland movement and a thickening of the transition zone near the coast. Most of this change occurred before 1925.

Thereafter, an equilibrium was attained, with total discharge (natural and artificial) averaging 280-290 mgd [2.12]. Because the water level in the basal aquifer did not decline rapidly, it was assumed that recharge from both return irrigation water (approximately 45 mgd) and rainfall must have been approximately equal to the discharge. However, new studies indicate that the basal water head in the Pearl Harbor aquifer has been progressively, though slowly, declining [2.13].

Although pumping for agricultural use has decreased since 1931, net ground water discharge has increased with urban development. From the early 1960's to the present time, pumpage
has been steadily increasing, so that in 1977 pumpage was approximately 240 mgd and natural spring discharge was approximately 50 mgd.

Artificial discharge from the Pearl Harbor aquifer includes BWS sources, Oahu Sugar sources and military sources. BWS sources account for approximately 70+ mgd of the total [2.14]. Figure 2-6 shows developed water sources in the vicinity of the proposed project. Table 2-1 gives data for these sources. For further discussion of pumpage, refer to Appendix A.

A recent State Water Commission Report estimates that the sustainable yield from the Pearl Harbor aquifer ranges from 200 to 245 mgd [2.15]. Further increase in ground water discharge may increase the chloride concentration of water pumped from the wells near the shore of Pearl Harbor unless such increased discharge is balanced by an increased recharge to the basal aquifer. One scheme suggested to accomplish this end was to divert surface flow from the streams in the Pearl Harbor area into recharge areas. This scheme is discussed in Appendix C. Another idea was recently adopted as policy of the Board of Water Supply. This policy requires the
<table>
<thead>
<tr>
<th>Reference Number</th>
<th>DINR Well No.</th>
<th>Head (ft.)</th>
<th>Chloride (ppm)</th>
<th>Owner</th>
<th>Use</th>
<th>Pumpage (MGD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>2301-34 to 39</td>
<td>17.0</td>
<td>147</td>
<td>BWS, Hoosae</td>
<td>D</td>
<td>6.83</td>
</tr>
<tr>
<td>13</td>
<td>2201-06</td>
<td>18.0</td>
<td>250-350</td>
<td>BWS, Kunia II</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>2402-01</td>
<td>20.6</td>
<td>103</td>
<td>BWS, Kunia II</td>
<td>D</td>
<td>0.25</td>
</tr>
<tr>
<td>17</td>
<td>2402-02</td>
<td>24.8</td>
<td>97</td>
<td>BWS, Kunia I</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>2302-01</td>
<td>23.8</td>
<td>141</td>
<td>BWS, Kunia I</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>2302-02</td>
<td>22.3</td>
<td>150</td>
<td>BWS, Kunia I</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>2302-03</td>
<td>15.0</td>
<td>104</td>
<td>BWS, Kunia I</td>
<td>D</td>
<td>5.55</td>
</tr>
<tr>
<td>21</td>
<td>2302-04</td>
<td>15.0</td>
<td>103</td>
<td>BWS, Kunia I</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>2202-21</td>
<td>24.1</td>
<td>184</td>
<td>Oahu Sugar Co.</td>
<td>I</td>
<td>18.6</td>
</tr>
<tr>
<td>23</td>
<td>2201-09</td>
<td>NA</td>
<td>NA</td>
<td>BWS</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>2201-10</td>
<td>18.4</td>
<td>170</td>
<td>BWS</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>2201-12</td>
<td>NA</td>
<td>NA</td>
<td>Oahu Sugar Co.</td>
<td>A</td>
<td>2.86</td>
</tr>
<tr>
<td>26</td>
<td>2201-03,04,07</td>
<td>17.6</td>
<td>318</td>
<td>Oahu Sugar Co.</td>
<td>I</td>
<td>13.02</td>
</tr>
<tr>
<td>29</td>
<td>2202-01</td>
<td>17.0</td>
<td>280</td>
<td>Oahu Sugar Co.</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>2202-03 to 14</td>
<td>19.0</td>
<td>383</td>
<td>Oahu Sugar Co.</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>2201-02</td>
<td>16.8</td>
<td>340</td>
<td>B. Dumalo</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>32</td>
<td>2202-02</td>
<td>21.3</td>
<td>183</td>
<td>C. Hokama</td>
<td>D3</td>
<td>NA</td>
</tr>
<tr>
<td>33</td>
<td>2202-22</td>
<td>20.2</td>
<td>190</td>
<td>C. Hokama</td>
<td>D3</td>
<td>NA</td>
</tr>
<tr>
<td>34</td>
<td>2202-15 to 20</td>
<td>12.0</td>
<td>400</td>
<td>Oahu Sugar Co.</td>
<td>D</td>
<td>9.84</td>
</tr>
<tr>
<td>35</td>
<td>2102-01</td>
<td>NA</td>
<td>NA</td>
<td>T. Matsuda</td>
<td>D</td>
<td>0.04</td>
</tr>
<tr>
<td>36</td>
<td>2101-03</td>
<td>14.3</td>
<td>302</td>
<td>T. Matsuda</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>2101-13</td>
<td>19.8</td>
<td>185</td>
<td>T. Matsuda</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>2102-02, 04 to 22</td>
<td>17.3</td>
<td>549</td>
<td>Oahu Sugar Co.</td>
<td>A</td>
<td>2.86</td>
</tr>
<tr>
<td>40</td>
<td>2101-01</td>
<td>19.8</td>
<td>340</td>
<td>Kahua Meat Co.</td>
<td>NA</td>
<td>0.022</td>
</tr>
<tr>
<td>41</td>
<td>2101-04</td>
<td>19.0</td>
<td>NA</td>
<td>Oahu Sugar Co.</td>
<td>A</td>
<td>NA</td>
</tr>
<tr>
<td>42</td>
<td>2101-05 to 12</td>
<td>16.0</td>
<td>NA</td>
<td>Oahu Sugar Co.</td>
<td>A</td>
<td>NA</td>
</tr>
<tr>
<td>43</td>
<td>2203-01 to 06</td>
<td>16.8</td>
<td>260</td>
<td>U.S. Navy</td>
<td>O</td>
<td>NA</td>
</tr>
<tr>
<td>45</td>
<td>2103-02</td>
<td>16.9</td>
<td>285</td>
<td>U.S. Navy</td>
<td>O</td>
<td>NA</td>
</tr>
<tr>
<td>46</td>
<td>2103-01</td>
<td>16.6</td>
<td>250</td>
<td>U.S. Navy</td>
<td>O</td>
<td>NA</td>
</tr>
<tr>
<td>47</td>
<td>2103-03</td>
<td>14.1</td>
<td>258</td>
<td>U.S. Navy</td>
<td>O</td>
<td>NA</td>
</tr>
</tbody>
</table>

1/ D = Domestic  
A = Agricultural  
I = Industrial  
O = Observation well


3/ Also used for piggery.

4/ Heads very due to time of year the measurements are made, and are instantaneous readings.

2-22
conversion of sugar cane irrigation water to
domestic use whenever sugar cane lands are urban-
ized, resulting in no net increase in ground
water discharge.

E. Water Quality

Water quality data for Honouliuli Stream are
unavailable; however, there is an abundance of such
data for Waieke Stream. Selected water quality
data for years 1975-1977 are presented in Table 2-2.

Waieke Stream is considered as Class 2 waters.
The new water quality standards are given in Appendix
D. In general, the waters of Waieke Stream exceed
the standards for nitrate, phosphorus, turbidity and
specific conductance.

Water quality data for the BWS well systems near
the proposed site are presented in Tables 2-3 and 2-4.
Chloride content is used as an index of the chemical
quality of Hawaiian ground waters since most or all of
the chloride and dissolved solids in fresh water are
derived from sea water. State Safe Drinking Water
Regulations require a limit for chloride of 250 ppm
for potable water. Tables 2-3 and 2-4 show that the
chloride content of water from these wells is presently
about one-half, or less, of the required limit. The
Safe Drinking Water Act and DOH Chapter 49, Potable
Water Systems, are further discussed in Appendix E.
# TABLE 2-2
WATER QUALITY DATA, WAIKELE STREAM.
OAHU, HAWAII, WATER YEARS 1975-1977

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1975</th>
<th>1976</th>
<th>1977</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissolved sodium (Na) (mg/l)</td>
<td>47.</td>
<td>45.</td>
<td>60.</td>
</tr>
<tr>
<td>Dissolved chloride (Cl) (mg/l)</td>
<td>62.</td>
<td>57.</td>
<td>83.</td>
</tr>
<tr>
<td>Dissolved fluoride (F) (mg/l)</td>
<td>.2</td>
<td>.2</td>
<td>.2</td>
</tr>
<tr>
<td>Total nitrate &amp; nitrite (N) (mg/l)</td>
<td>2.1</td>
<td>2.4</td>
<td>2.1</td>
</tr>
<tr>
<td>Total phosphorus (P) (mg/l)</td>
<td>1.1</td>
<td>1.1</td>
<td>1.8</td>
</tr>
<tr>
<td>Dissolved solids (sum of constituents) (mg/l)</td>
<td>223.</td>
<td>206.</td>
<td>280.</td>
</tr>
<tr>
<td>Specific conductance (micromhos)</td>
<td>384.</td>
<td>301.</td>
<td>452.</td>
</tr>
<tr>
<td>pH (units)</td>
<td>6.9</td>
<td>6.5</td>
<td>6.6</td>
</tr>
<tr>
<td>Turbidity (JTU)</td>
<td>25.1</td>
<td>174.2</td>
<td>10.3</td>
</tr>
<tr>
<td>Carbon Dioxide (CO₂) (mg/l)</td>
<td>12.</td>
<td>34.</td>
<td>36.</td>
</tr>
<tr>
<td>Discharge (cfs)</td>
<td>38.6</td>
<td>40.0</td>
<td>20.2</td>
</tr>
<tr>
<td>Fecal coliform (col. per 100 ml)</td>
<td>1623.</td>
<td>3443.4</td>
<td>4235.</td>
</tr>
</tbody>
</table>

1/ Range: 2-100 JTU; mode: 18 JTU.
2/ Range: 3-2100 JTU; mode: 7 JTU.
3/ Range: 3-55 JTU; mode: 6 JTU.
4/ Results based on some colony counts outside the acceptable range.

Source: [2.4] and [2.16]
## TABLE 2-3

**WATER QUALITY DATA, KUNIA AND HOAEAE**

**WELLS, OAHU, HAWAII, FY 1976-77**

<table>
<thead>
<tr>
<th>Source</th>
<th>pH</th>
<th>Alkalinity (Ca)</th>
<th>Hardness (CaCO₃)</th>
<th>Chloride</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoaee Wells</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2301-34)</td>
<td>6.90</td>
<td>77</td>
<td>108</td>
<td>122</td>
</tr>
<tr>
<td>(2301-35)</td>
<td>6.95</td>
<td>77</td>
<td>96</td>
<td>122</td>
</tr>
<tr>
<td>(2301-36)</td>
<td>7.05</td>
<td>80</td>
<td>106</td>
<td>136</td>
</tr>
<tr>
<td>(2301-37)</td>
<td>7.00</td>
<td>78</td>
<td>100</td>
<td>137</td>
</tr>
<tr>
<td>(2301-38)</td>
<td>6.95</td>
<td>70</td>
<td>96</td>
<td>101</td>
</tr>
<tr>
<td>(2301-39)</td>
<td>7.00</td>
<td>72</td>
<td>104</td>
<td>113</td>
</tr>
<tr>
<td>Kunia Wells I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2302-01)</td>
<td>7.00</td>
<td>88</td>
<td>104</td>
<td>135</td>
</tr>
<tr>
<td>(2302-02)</td>
<td>7.00</td>
<td>85</td>
<td>100</td>
<td>119</td>
</tr>
<tr>
<td>(2302-03)</td>
<td>7.00</td>
<td>81</td>
<td>104</td>
<td>108</td>
</tr>
<tr>
<td>(2302-04)</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>Kunia Wells II</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2402-01)</td>
<td>7.10</td>
<td>82</td>
<td>100</td>
<td>97</td>
</tr>
<tr>
<td>(2402-02)</td>
<td>7.20</td>
<td>85</td>
<td>98</td>
<td>92</td>
</tr>
</tbody>
</table>

* a Pumps down for maintenance

**Source:** [2.17]
### Table 2-4
WATER QUALITY DATA
SELECTED B.W.S. WELLS
Oahu, Hawaii 1968

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>Waipahu Well 241-1A</th>
<th>Hoaeae Well 256-3A</th>
<th>Kunia Well 256-2A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>1968</td>
<td>1968</td>
<td>1968</td>
</tr>
<tr>
<td>Date collected</td>
<td>Feb. 28</td>
<td>Feb. 28</td>
<td>Feb. 28</td>
</tr>
<tr>
<td>Time collected</td>
<td>10:15</td>
<td>08:55</td>
<td>09:50</td>
</tr>
<tr>
<td>Laboratory number</td>
<td>102924</td>
<td>102923</td>
<td>102922</td>
</tr>
<tr>
<td>Regional head, feet</td>
<td>23.79</td>
<td>23.35</td>
<td>23.35</td>
</tr>
<tr>
<td>Specific conductance, micromhos @ 25°C.</td>
<td>485</td>
<td>665</td>
<td>622</td>
</tr>
<tr>
<td>pH value</td>
<td>7.35</td>
<td>7.05</td>
<td>7.10</td>
</tr>
<tr>
<td>Turbidity (Nephelometric turbidity units)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Color (parts per million)</td>
<td>0</td>
<td>0.5</td>
<td>0</td>
</tr>
</tbody>
</table>

**IN PARTS PER MILLION:**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Waipahu Well 241-1A</th>
<th>Hoaeae Well 256-3A</th>
<th>Kunia Well 256-2A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissolved oxygen</td>
<td>8.00</td>
<td>7.70</td>
<td>7.80</td>
</tr>
<tr>
<td>Free carbon dioxide</td>
<td>5</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>Silica</td>
<td>57</td>
<td>71</td>
<td>73</td>
</tr>
<tr>
<td>Calcium</td>
<td>8.4</td>
<td>14.4</td>
<td>14</td>
</tr>
<tr>
<td>Magnesium</td>
<td>7.9</td>
<td>15.7</td>
<td>16.2</td>
</tr>
<tr>
<td>Sodium</td>
<td>73.3</td>
<td>85.9</td>
<td>80</td>
</tr>
<tr>
<td>Potassium</td>
<td>2.6</td>
<td>3.8</td>
<td>3.6</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>89</td>
<td>89</td>
<td>107</td>
</tr>
<tr>
<td>Sulfate</td>
<td>21</td>
<td>39.3</td>
<td>36.9</td>
</tr>
<tr>
<td>Chloride</td>
<td>80</td>
<td>120</td>
<td>103</td>
</tr>
<tr>
<td>Fluoride</td>
<td>0.35</td>
<td>0.20</td>
<td>0.25</td>
</tr>
<tr>
<td>Nitrate (NO₃)</td>
<td>7.6</td>
<td>9.2</td>
<td>8.4</td>
</tr>
<tr>
<td>Phosphate</td>
<td>1.05</td>
<td>.75</td>
<td>.95</td>
</tr>
<tr>
<td>Iron</td>
<td>&lt; 0.02</td>
<td>&lt; .02</td>
<td>.02</td>
</tr>
<tr>
<td>Manganese</td>
<td>&lt; .02</td>
<td>&lt; .02</td>
<td>.02</td>
</tr>
<tr>
<td>Copper</td>
<td>&lt; .02</td>
<td>&lt; .02</td>
<td>.02</td>
</tr>
<tr>
<td>Lead</td>
<td>&lt; .02</td>
<td>&lt; .02</td>
<td>.02</td>
</tr>
<tr>
<td>Arsenic</td>
<td>&lt; .02</td>
<td>&lt; .02</td>
<td>.02</td>
</tr>
<tr>
<td>Selenium</td>
<td>&lt; .01</td>
<td>.01</td>
<td>.01</td>
</tr>
<tr>
<td>Chromium³/²</td>
<td>&lt; .01</td>
<td>&lt; .01</td>
<td>.01</td>
</tr>
<tr>
<td>Total dissolved solids</td>
<td>348</td>
<td>449</td>
<td>443</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>72</td>
<td>72</td>
<td>88</td>
</tr>
<tr>
<td>Total hardness</td>
<td>53</td>
<td>100</td>
<td>101</td>
</tr>
</tbody>
</table>

2-26a
### TABLE 2-4 - Continued

WATER QUALITY DATA
SELECTED B.W.S. WELLS

Oahu, Hawaii 1968

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>Waipahu Well 241-1A</th>
<th>Hoaena Well 256-3A</th>
<th>K unin Well 256-2A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IN EQUIVALENTS PER MILLION:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>.419</td>
<td>.719</td>
<td>.699</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>.650</td>
<td>1.291</td>
<td>1.332</td>
</tr>
<tr>
<td>Sodium (Na)</td>
<td>3.190</td>
<td>3.737</td>
<td>3.482</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>.067</td>
<td>.097</td>
<td>.092</td>
</tr>
<tr>
<td>Bicarbonate (HCO₃⁻)</td>
<td>1.459</td>
<td>1.459</td>
<td>1.754</td>
</tr>
<tr>
<td>Sulfate (SO₄⁻)</td>
<td>.437</td>
<td>.818</td>
<td>.768</td>
</tr>
<tr>
<td>Chloride (Cl⁻)</td>
<td>2.307</td>
<td>3.419</td>
<td>2.948</td>
</tr>
<tr>
<td>Nitrate (NO₃⁻)</td>
<td>.123</td>
<td>.148</td>
<td>.135</td>
</tr>
</tbody>
</table>

| TOTALS | 8.652 | 11.688 | 11.210 |

a/ Hexavalent only.
b/ Includes fluoride and phosphate as PO₄⁻.
Another index of potable water quality is the amount of total dissolved solids (TDS). Proposed EPA secondary standards require a limit of 500 ppm. Table 2-4 illustrates that total dissolved solids in water from these wells is presently within this limit but may be exceeded if transition-zone mixing is increased.

The Waiahole Ditch System transports about 25 mgd from the Waiahole Tunnel on the eastern side of the Koolau Range for irrigation of sugar cane in southwest Oahu. The quality of this water, some of which recharges the basal ground water, is very good, as noted by its chloride content of 11 ppm.

As previously noted, irrigation with brackish water is a source of basal lens degradation. However, the magnitude of degradation is much less than that caused by intrusion of saline water. Irrigation with brackish water has not proven sufficiently detrimental to the basal water quality to prevent domestic, agricultural or industrial uses [2.18]. Slightly brackish water can be used for domestic consumption.

Another source of contamination is from fertilizers used on sugar cane. Agriculturalists have estimated that about 50% of the nitrogen in fertilizers is consumed by the sugar cane. Most of the remainder eventually leaches with percolating water
to the water table. Sulfate is also carried to the water table, but phosphate enrichment has not been found in ground water of southern Oahu. Return irrigation water has about 50% more silica. It also has up to 10-20 times the sulfate and 2-3 times the nitrate of unaffected water [2.19]. However, this water is potable.

In general, no overall deterioration of ground water quality has occurred on southern Oahu under the conditions of equilibrium established by long-term patterns of development, use and pumpage of basal water, though local increases in salinity have occurred near the coast [2.20].

F. Soils [2.21]

The soils in the vicinity of the project site are primarily of the Molokai series, with localized areas of Helemano silty clay, rock land, and Kawaihapai clay loam along the streams. Note Figure 2-7.

The soil at the project site is Molokai silty clay loam (MuB), 3-7% slopes. A typical surface layer consists of dark reddish-brown silty clay loam about 15 inches thick. The subsoil is 57 inches thick with a similar profile. The substratum is soft weathered rock. Permeability is moderate, runoff is slow to moderate and the erosion hazard is slight to moderate.

2-28
LEGEND

HONOLIULI SITE

MuB - Molokai silty clay loam, 3-7% slopes

ADJACENT SOILS

MuA - Molokai silty clay loam, 0-3% slopes
MuC - Molokai silty clay loam, 7-15% slopes
HLMG - Helemano silty clay, 30-90% slopes
K1A - Kawaihapai clay loam, 0-2% slopes

SOILS

FIGURE 2-7
Adjacent soils include Molokai silty clay loam (MuA), 0-3% slopes and Molokai silty clay loam (MuC), 7-15% slopes. They are very similar to the soil on-site, with the following exceptions: MuA - runoff slow and erosion hazard slight; MuC - runoff medium to rapid and erosion hazard severe. Small areas along the sides of the gulch east of the site consist of Helemano silty clay HLMG, 30-90% slopes. Permeability is moderately rapid, runoff is medium to very rapid, and the erosion hazard is severe to very severe. There are also small areas of Kawaihapai clay loam, 0-2% slopes, along the bottom of the gulch. Permeability is moderate, runoff is slow, and the erosion hazard is slight.

G. Noise

Noise levels were measured with a Bruel and Kjaer Noise Level Sound Meter. The existing ambient noise environment is dominated by the sounds of nature - the wind, birds and rustling vegetation. Noise levels along the existing access road vary from 40 dBA to 43 dBA. During cane harvesting the noise levels are undoubtedly higher.

II. BIOLOGICAL CHARACTERISTICS

A. Flora

The project site falls in Ripperton and Hosaka's
Vegetation zone "B" [2.22]. Kiawe, koa-haole and klu (*Acacia farnesiana*) are said to grow well in this zone, as well as cactus (*Opuntia megacantha*) and lantana (*Lantana* spp.). Both perennial and annual grasses occur. Annual herbs are prominent during and following rainy periods. Sugar cane fields surround the site and the proposed main line alignment.

Appendix F lists the plants observed on and around the site and gives the relative abundance of each. No rare or endangered species of plants were observed on the project site.

B. **Fauna**

The site does not support a significant population of birds and mammals. Few birds were observed during the field survey, and no mammals were seen. Those species which were observed, as well as those potentially occurring on the site, are listed in Appendix F.

The site does not constitute a sensitive wildlife habitat, due to its proximity to cultivated cane fields.

It should be noted that the Honouliuli Unit of Pearl Harbor National Wildlife Refuge is located 2.8 miles southeast of the project site, along the shore of West Loch. It is approximately 2,000 feet
south of the mouth of Honouliuli Stream, and is an important nesting habitat for the native Hawaiian Stilt (Himantopus himantopus knudseni).

Water to fill the ponds within this refuge is obtained from a well located within the refuge. It is intermittently pumped and the water is saline.

III. SOCIO-ECONOMIC CHARACTERISTICS
A. Population

According to the General Plan Five-Year Review, Final Report (1982), the total residential population of Oahu was 762,874 in 1980 [2.23]. The project site is located in the area identified as Ewa. The Ewa area's population of 35,554 in 1980 constituted 4.7% of the island's total population. The population of Ewa for the year 2000 is projected to be between 74,300 to 81,700, or 8.1 to 8.9 of the total Oahu population. Refer to Table 2-5.

B. Land Use

Sugar cane is the primary crop grown in the vicinity of the project site. Figure 2-8 is a Generalized Land Use map of the area showing sugar cane acreage, as well as other uses. The map was developed for the Hawaii Water Resources Regional Study in 1970. As can be seen, other major uses in the area to be served include urban and military.
# TABLE 2-5

**DISTRIBUTION OF THE RESIDENTIAL POPULATION:**

**1980 AND 2000**

<table>
<thead>
<tr>
<th>Location</th>
<th>Population</th>
<th>% of Total</th>
<th>% of Total</th>
<th>Population</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Urban Center</td>
<td>417,240</td>
<td>54.7</td>
<td>47.5-52.5</td>
<td>435,800</td>
<td>481,600</td>
</tr>
<tr>
<td>Ewa</td>
<td>35,554</td>
<td>4.7</td>
<td>8.1-8.9</td>
<td>74,300</td>
<td>81,700</td>
</tr>
<tr>
<td>Central Oahu</td>
<td>100,640</td>
<td>13.2</td>
<td>13.3-14.7</td>
<td>122,000</td>
<td>134,900</td>
</tr>
<tr>
<td>East Honolulu</td>
<td>42,213</td>
<td>5.7</td>
<td>6.2-6.8</td>
<td>56,900</td>
<td>62,400</td>
</tr>
<tr>
<td>Koolauopoko</td>
<td>109,373</td>
<td>14.3</td>
<td>12.3-13.7</td>
<td>112,800</td>
<td>125,700</td>
</tr>
<tr>
<td>Koolauloa</td>
<td>10,983</td>
<td>1.4</td>
<td>1.5-1.7</td>
<td>13,800</td>
<td>15,600</td>
</tr>
<tr>
<td>North Shore</td>
<td>13,061</td>
<td>1.7</td>
<td>1.8-2.0</td>
<td>16,500</td>
<td>18,300</td>
</tr>
<tr>
<td>Waianae</td>
<td>32,810</td>
<td>4.3</td>
<td>4.3-4.7</td>
<td>39,400</td>
<td>43,100</td>
</tr>
<tr>
<td>Oahu Total</td>
<td>762,874</td>
<td>100.0</td>
<td>95.0-105.0</td>
<td>871,500</td>
<td>963,300</td>
</tr>
</tbody>
</table>

*1980 Census data

*From Population Objective C, Policy 4

Population ranges based on the percentages presented in the preceding column and DPED's Series II-P population projection for the year 2000 of 917,400 for Oahu.
GENERALIZED LAND USE MAP
OAHU, HAWAII

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

SOURCE: LEeward OAHU WATER SUPPLY STUDY, 1977

FIGURE 2-8
The project site is surrounded by an area designated as "prime agricultural land". This is land which has the soil quality, growing season, and moisture supply needed to produce a sustained high yield of crops economically when treated and managed according to modern farming methods.

The acreage of urban and agricultural land use in 1978 in the Ewa-Waianae Water District and Waipahu area is shown in Table 2-6. In addition, land which is zoned for urban use within metropolitan Honolulu (Waialae-Kahala to Pearl City), Ewa and Waianae and which was undeveloped as of 1978 is shown in Table 2-7.

There are several other development projects proposed for the potential service area of Honouliuli Wells [2.24][2.25]. Those currently under construction, or planned but not necessarily approved, include the following:

**Village Park:** A 1,745 unit residential development on 316 acres located directly east of the proposed wells project across Kunia Road.

**Makakilo:** A 3,693 unit residential development of 373 acres located adjacent to (north of) Makakilo City, which currently consists of over 1,700 units. Makakilo will ultimately consist of approximately 6,000 housing units on 865 acres.
| TABLE 2-6 |
| 1978 EXISTING LAND USES (ACRES) |
| LEeward Region, Oahu |

### WAIPAHU SUBTOTAL

<table>
<thead>
<tr>
<th>Urban</th>
<th>Agricultural</th>
<th>Vacant Usable</th>
<th>Other</th>
<th>Total Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>546.3</td>
<td>478.7</td>
<td>182.9</td>
<td>1,773.4</td>
</tr>
<tr>
<td>Multi-family</td>
<td>62.4</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Industrial</td>
<td>88.6</td>
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<tr>
<td>Commercial</td>
<td>108.0</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Hotel</td>
<td>0-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>805.3</strong></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

### WAI'A-MARAKILO SUBTOTAL

<table>
<thead>
<tr>
<th>Urban</th>
<th>Agricultural</th>
<th>Vacant Usable</th>
<th>Other</th>
<th>Total Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>654.9</td>
<td>19,240.9</td>
<td>6,843.9</td>
<td>42,081.1</td>
</tr>
<tr>
<td>Multi-family</td>
<td>108.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>1,697.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td>129.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hotel</td>
<td>0-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,590.8</strong></td>
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</table>

### WAIANAE COAST SUBTOTAL

<table>
<thead>
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<th>Urban</th>
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<th>Vacant Usable</th>
<th>Other</th>
<th>Total Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>2,461.1</td>
<td>1,839.7</td>
<td>8,017.1</td>
<td>38,078.0</td>
</tr>
<tr>
<td>Multi-family</td>
<td>123.2</td>
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</tr>
<tr>
<td>Industrial</td>
<td>461.4</td>
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<tr>
<td>Commercial</td>
<td>415.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hotel</td>
<td>29.4</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,490.1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2-36a
### TABLE 2-6, cont'd.

#### LEeward TOTAL

<table>
<thead>
<tr>
<th>Urban</th>
<th>Agricultural</th>
<th>Vacant Usable</th>
<th>Other</th>
<th>Total Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>3,662.3</td>
<td>21,599.3</td>
<td>15,043.9</td>
<td>38,443.1</td>
</tr>
<tr>
<td>Multi-family</td>
<td>294.5</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>2,247.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td>652.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hotel</td>
<td>29.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6,886.2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

1/ Census tracts: 87.01, 87.02, 87.03, 88.00, 89.01.

2/ Census tracts: 83.00, 84.00, 85.00, 86.01, 86.02.

3/ Census tracts: 96.01, 96.02, 97.00, 98.00.

**Source:** Table 82: Acreages of 1978 Existing Land Uses on Oahu by Census Tracts. Department of General Planning, City and County of Honolulu.


<table>
<thead>
<tr>
<th>Zone</th>
<th>Primary Urban Center(^1)</th>
<th>Ewa</th>
<th>Waianae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>465.0</td>
<td>777.4</td>
<td>1,271.3</td>
</tr>
<tr>
<td>Apartment</td>
<td>395.0</td>
<td>11.1</td>
<td>36.3</td>
</tr>
<tr>
<td>Hotel</td>
<td>9.4</td>
<td>0</td>
<td>9.0</td>
</tr>
<tr>
<td>Business</td>
<td>44.8</td>
<td>24.2</td>
<td>13.1</td>
</tr>
<tr>
<td>Industrial</td>
<td>132.5</td>
<td>523.2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1,046.7</td>
<td>1,335.9</td>
<td>1,329.7</td>
</tr>
</tbody>
</table>

\(^1\) Development Plan Areas 1.1, 1.2, and 1.3 (Waialae-Kahala to Pearl City).

**SOURCE:** Table 95: 1978 Zone District Designations (CZC) of Vacant Usable Land Privately Owned and Controlled by Development Plan Areas (in acres). Department of General Planning, City and County of Honolulu.
West Beach: A resort-residential community with 1,680 residential units and 7,520 resort units on 640 acres located just south of Nanakuli and north of the proposed Barbers Point Harbor. Of this, 190 acres are for a golf course.

Ewa Marina Community: A 1,098 acre residential community surrounding a marina to be located near Oneula. Projected completion of the first increment (5,000 units) is 1985 and of the second increment (3,000 units) is 1990.

Ewa Newtown: A 200 acre residential development to be located on the Ewa Plain.

Barbers Point Deep Draft Harbor: A deep draft harbor on 330 acres (including a 94-acre basin) located in Campbell Industrial Park. Already approved by Congress and the State, this harbor would constitute a second Oahu commercial port.

Honouliuli Wastewater Treatment System: A wastewater treatment plant on 51 acres located in the northeast corner of Barbers Point Naval Air Station. Sponsored by the Environmental Protection Agency, 75% of the construction cost is being funded by the Federal Government. It was placed into operation in January 1982 and provides preliminary treatment. Primary treatment will be provided at a later date.
West Oahu College: A four-year college potentially located on 200 acres at the intersection of Farrington Highway and Fort Weaver Road, with a projected enrollment of 7,000+.

James Campbell Industrial Park: Expansion of the 1,134-acre Campbell Industrial Park to 2,800 acres (1,486 acres to be added). The park is occupied by light, medium and heavy industries, with 99 firms employing over 2,100 persons in 1976.

HPOWER - Honolulu Program of Waste Energy Recovery project is a solid waste recovery facility that would generate power and recover other marketable products from solid waste. It would handle 600, 1,200 or 1,800 tons per day of solid waste. The location has yet to be finalized, but will be in the leeward area.

There are several new subdivisions planned for the Waianae Coast at the present time, and possibly a 412-unit condominium in Makaha Valley [2.26]. A 500-acre agricultural park is also proposed for Waianae Valley. It would be served by a State well in Waianae Valley. Refer to Table 2-8 for a summary of current proposed projects within the Leeward Region. Note however, that the water to be developed at Honouliuli Wells would essentially serve none of the projects in the Waianae area and that the other projects do not
<table>
<thead>
<tr>
<th>Location/Proposal</th>
<th>Type of Development</th>
<th>Estimated Completion Date</th>
<th>Acreage</th>
<th>Dwelling Units</th>
<th>Estimated Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waipahu-Crestview Area</td>
<td>Housing</td>
<td>1985</td>
<td>316</td>
<td>1,745</td>
<td>5,600</td>
</tr>
<tr>
<td>Village Park4/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ewa-Makakilo</td>
<td>Housing</td>
<td>1995</td>
<td>373</td>
<td>3,693</td>
<td>11,800</td>
</tr>
<tr>
<td>Makakilo6/</td>
<td>Housing</td>
<td>2000</td>
<td>640</td>
<td>1,680</td>
<td>33,000</td>
</tr>
<tr>
<td>West Beach</td>
<td>Resort</td>
<td>1995</td>
<td></td>
<td>7,520</td>
<td>35,300</td>
</tr>
<tr>
<td>West Beach</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Campbell Industrial Park4/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Honouliuli WTP</td>
<td>Employment</td>
<td>2000</td>
<td>1,486</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barbers Point Deep</td>
<td>Utility</td>
<td>1982</td>
<td>51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Harbor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Oahu College</td>
<td>Port Employment</td>
<td>2000</td>
<td>330</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ewa Marina Community</td>
<td>Education</td>
<td>NA</td>
<td>200</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Recreation &amp; Housing</td>
<td>1990</td>
<td>1,098</td>
<td>7,200</td>
<td>23,040</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ewa Newtown</td>
<td>Housing</td>
<td>NA</td>
<td>200</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>HPOWER</td>
<td>Solid Waste</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Recovery</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waianae Coast</td>
<td>Resort</td>
<td>NA</td>
<td>8</td>
<td>412</td>
<td>742</td>
</tr>
<tr>
<td>Makaha Condominium</td>
<td>Agriculture</td>
<td>NA</td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waianae Agricultural Park</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NA  Not Available

1/ Ewa-Waianae Water District plus Waipahu.

2/ Population estimates based on: 3.2 persons per dwelling unit and 1.8 persons per hotel room.

3/ According to the West Beach Project Draft EIS, June, 1980.

4/ Developments that have received full or partial water commitments.

Source: [2.26] and [2.28]
necessarily have a water commitment from the BWS. In the Ewa area, the BWS has imposed a moratorium on building until sufficient sources, transmission systems and storage are provided.

C. Economic Aspects

1. General [2.27]

"The economy of Hawaii, especially Oahu, and its development and growth can be largely attributed to its location and climate. Eighty (80) percent of the State's commerce, as well as the population, and nearly all military bases and activities are located on Oahu. The economy is basically service oriented. Manufacturing is modest. Agriculture has been declining."

"Tourism, defense, sugar and pineapple, in that order of importance, represent the four major export industries. Sugar and pineapple dominated the economy up to World War II. Beginning in World War II up to 1970, defense activities prevailed. Tourism is now the major 'industry' and is made of many services from hotel to scenic and travel services, gift shops, restaurants, and entertainment."

"Other industries of non-export category, including the construction industry, provide goods and services to local residents from"
monies earned through sale of labor, products and other services to the export industry sector. The long-term growth of these industries depends upon the performance of the export industries."

2. **Construction**

Construction has been on a decline over the past few years. This is demonstrated, in part, by the data presented for residential construction in Table 2-9, which shows private residential construction authorized by permit from 1970-1978. This table also gives the housing vacancy rate for these years.

An upturn in construction was registered in 1978 [2.29] and was expected to accelerate in 1979. Leading the list of construction activities expected to expand that year were multi-family residences, hotels on Maui and government projects.

3. **Employment** [2.30]

"Employment on Oahu during the first six months of 1978 averaged 313,900 according to information published by the State Department of Labor and Industrial Relations. Employment opportunities reflected a negligible growth rate of 0.2% during the first quarter of 1979. Unemployment showed some improvement, decreasing
TABLE 2-9
PRIVATE RESIDENTIAL CONSTRUCTION AUTHORIZED
BY PERMIT AND VACANCY RATES,
OAHU: 1970 to 1978

<table>
<thead>
<tr>
<th>YEAR</th>
<th>DWELLING(1) UNITS</th>
<th>TOTAL NUMBER OF BUILDING PERMITS</th>
<th>VACANCY RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>7,978</td>
<td>16,792</td>
<td>1.7</td>
</tr>
<tr>
<td>1971</td>
<td>7,958</td>
<td>17,239</td>
<td>2.3</td>
</tr>
<tr>
<td>1972</td>
<td>10,417</td>
<td>17,706</td>
<td>1.7</td>
</tr>
<tr>
<td>1973</td>
<td>13,065</td>
<td>22,767</td>
<td>1.5</td>
</tr>
<tr>
<td>1974</td>
<td>13,160</td>
<td>19,169</td>
<td>2.0</td>
</tr>
<tr>
<td>1975</td>
<td>5,430</td>
<td>16,514</td>
<td>2.3</td>
</tr>
<tr>
<td>1976</td>
<td>4,524</td>
<td>15,937</td>
<td>3.0</td>
</tr>
<tr>
<td>1977</td>
<td>4,683</td>
<td>15,793</td>
<td>1.6</td>
</tr>
<tr>
<td>1978</td>
<td>-</td>
<td>-</td>
<td>1.5</td>
</tr>
</tbody>
</table>

(1) Includes single-family dwellings, duplexes and apartments.

from 7.6% in 1978 to 6.9% in the first quarter of 1979. "Unemployment in the construction industry and related activities were the hardest hit as construction deteriorated in 1975 and 1976. The recovery of the national economy did not help local construction, and the industry continued in a depressed state. A recent uptrend in construction activity and employment may be the turning point in a long-awaited revival."

"The sugar industry, the third largest export industry, is faced with a dilemma as a result of America's abandonment in 1974 of its 40-year-old Sugar Act, which had insulated the domestic sugar industry from competition of surplus world sugar entering into the American market. The market has been chaotic since. Pineapple, the second largest agricultural industry, continues to contribute to the economic health of the local economy. Sales have declined due to intensive price competition from abroad, but the growth prospects for pineapple appear good, especially for fresh pineapple."

The number of people employed in the State declined slightly to 373,000 in March, 1979 from 374,700 in February. The number of unemployed
declined to 25,400, or 6.4% of the labor force, in March. All counties showed a decline in the unemployment rate in March, 1979 [2.31]. Jobs in the private sector were up by 8,100 over March, 1978, to a total of 291,800. About 47% of the increase occurred in the service industries, including hotels. The construction industry accounted for another 26% of the increase, though it should be noted that employment in construction was at a relatively low level in early 1978 [2.32].

4. Ewa Submarket [2.33]

"The Ewa submarket is composed of census tracts 73-89.03 and is conterminous with tax key zone 9 and Ewa Judicial District. Comparisons of 1970 census information with Oahu as a whole are shown on Table 2-10. The Ewa submarket had the highest percentage growth rate of any of the other submarkets on Oahu between 1960 and 1970. The growth rate between 1970 and 1976 decreased. The percentage of persons under 5 years and over 65 years are population indicators which are used to forecast the potential of population growth or loss in an area."

"Ewa is one area on Oahu which would exhibit natural growth potential based on population"
<table>
<thead>
<tr>
<th>ITEM</th>
<th>HONOLULU COUNTY</th>
<th>EWA SUBMARKET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population 1970</td>
<td>630,528</td>
<td>132,299</td>
</tr>
<tr>
<td>Percent Change 1960-1970</td>
<td>26.0%</td>
<td>68.2%</td>
</tr>
<tr>
<td>Population Under 5 Years</td>
<td>58,701</td>
<td>13,913</td>
</tr>
<tr>
<td>Percent Change 1960-1970</td>
<td>9.3%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Population 65 Year and Over</td>
<td>31,385</td>
<td>3,123</td>
</tr>
<tr>
<td>Percent Change 1960-1970</td>
<td>5.0%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Median Age</td>
<td>24.6</td>
<td>22.6</td>
</tr>
<tr>
<td>Number of Households</td>
<td>164,763</td>
<td>27,728</td>
</tr>
<tr>
<td>Persons Per Household</td>
<td>3.6</td>
<td>4.17</td>
</tr>
<tr>
<td>Population in Group Quarters</td>
<td>36,047</td>
<td>15,021</td>
</tr>
<tr>
<td>Percent in Population</td>
<td>5.7%</td>
<td>11.5%</td>
</tr>
<tr>
<td>Median School Years</td>
<td>12.4</td>
<td>12.4</td>
</tr>
<tr>
<td>Median Income</td>
<td>$12,035</td>
<td>$11,712</td>
</tr>
<tr>
<td>Families Below $10,000</td>
<td>53,766</td>
<td>10,656</td>
</tr>
<tr>
<td>Percent</td>
<td>38.9%</td>
<td>39.7%</td>
</tr>
<tr>
<td>Families Above $25,000</td>
<td>11,745</td>
<td>1,262</td>
</tr>
<tr>
<td>Percent</td>
<td>8.5%</td>
<td>4.7%</td>
</tr>
<tr>
<td>Housing Units</td>
<td>174,151</td>
<td>29,456</td>
</tr>
<tr>
<td>Percent Owner Occupies</td>
<td>45.0%</td>
<td>51.4%</td>
</tr>
<tr>
<td>Percent 1-Unit</td>
<td>58.8%</td>
<td>73.0%</td>
</tr>
<tr>
<td>Percent</td>
<td>$38,400</td>
<td>$33,569</td>
</tr>
<tr>
<td>Median Value</td>
<td>136</td>
<td>136</td>
</tr>
<tr>
<td>Median Rent</td>
<td>5,773</td>
<td>560</td>
</tr>
<tr>
<td>Lacking Some or All Plumbing</td>
<td>3.3%</td>
<td>1.9%</td>
</tr>
<tr>
<td>Percent</td>
<td>11,361</td>
<td>1,757</td>
</tr>
<tr>
<td>1.51 or More Persons Per Room</td>
<td>6.9%</td>
<td>6.3%</td>
</tr>
<tr>
<td>Population 1976</td>
<td>718,428</td>
<td>167,300</td>
</tr>
<tr>
<td>Percent Change 1970-1976</td>
<td>14.0%</td>
<td>26.0%</td>
</tr>
<tr>
<td>Housing Units 1976</td>
<td>212,615</td>
<td>40,200</td>
</tr>
<tr>
<td>Percent Change 1970-1976</td>
<td>22.0%</td>
<td>36.0%</td>
</tr>
</tbody>
</table>

Source: [2.34] (State of Hawaii Data Book; 1970 Census)
age patterns. The higher-than-average number of persons per household and lower-than-average median age reflects the fact that the area has a large percentage of husband-wife families with children. Another indicator of the character of the area is the high percentage of one-unit and owner-occupied housing units; however, multiple-unit construction has increased since 1970 with high-rise construction around Salt Lake and Pearl Ridge areas and family-attached units in other areas such as Makakilo and Mililani Town. The area also has a lower percentage of substandard units (8%) compared with Oahu, as a whole, which has 10%."

IV. INFRASTRUCTURE
A. Roads and Traffic
The project site is located adjacent to an unimproved cane haul road, with access from Kunia Road.

Kunia Road (Federal-Aid Secondary Route 750) is a two-lane highway with a 60-foot right-of-way. Current peak hour traffic is approximately 1,400 vehicles per hour (vph) at Farrington Highway (two directions) and about 1,770 vph at the H-1 interchange [2.35]. Capacity is estimated at 2,400 vph (two-lane uninterrupted).
Farrington Highway at Kunia Road is a four-lane highway. Current afternoon peak hour traffic is approximately 1,977 vph (both directions) while capacity of Farrington Highway at this location is estimated at 3,760 vph (four-lane uninterrupted) [2.36].

The H-1 Freeway, located south of the project site, provides the primary connection between the eastern (Waialae) and western (Nanakuli) parts of southern Oahu.

At the Kunia Interchange, the H-1 Freeway has four eastbound and three westbound lanes. Current peak-hour traffic is approximately 1,754 vph in the morning and 1,868 vph in the afternoon [2.37]. The peak-hour capacities of H-1 are approximately 1,400 vph per lane for Level of Service C (free flow), and about 1,800 vph per lane for Levels of Service E (unstable flow) or F (forced flow) [2.38]. Theoretically, maximum capacity is about 2,000 vph per lane.

Refer to Table 2-11 for a summary of existing traffic counts at these and other locations in the general vicinity of the project site.

B. Water

The existing water system is described in Section 1, Part III.
<table>
<thead>
<tr>
<th>Station</th>
<th>AM Peak</th>
<th>PM Peak</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Makakilo Dr.</td>
<td>1,191</td>
<td>1,420</td>
<td></td>
</tr>
<tr>
<td>Honouliuli Bridge</td>
<td>2,053</td>
<td>2,443</td>
<td></td>
</tr>
<tr>
<td>Kunia Interchange</td>
<td>1,754</td>
<td>1,868</td>
<td>9,800²</td>
</tr>
<tr>
<td><strong>Farrington Hwy. at:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kahe Point</td>
<td>1,363</td>
<td>1,751</td>
<td></td>
</tr>
<tr>
<td>Kunia Road</td>
<td>1,172</td>
<td>1,955</td>
<td>3,760</td>
</tr>
<tr>
<td><strong>Kunia Road at:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farrington Hwy.</td>
<td>1,399</td>
<td>1,428</td>
<td>2,400</td>
</tr>
<tr>
<td>H-1</td>
<td>1,763</td>
<td>1,776</td>
<td></td>
</tr>
</tbody>
</table>

Sources: [2.41], [2.42] and [2.43]

1. All figures are two-directional totals.
2. Seven lanes at level of Service C.
C. Liquid and Solid Waste [2.39],[2.40]

1. Liquid Waste

Liquid waste at the project site will be disposed of in a water-tight container which will be periodically pumped out.

Liquid waste from developments in the areas to be served by the project are treated at the Waipahu Sewage Treatment Plant (STP) and the Makakilo STP.

The Waipahu STP has a maximum capacity of 3.6 mgd equivalent flow of sewage. This capacity is based on total suspended solids and biochemical oxygen demand (BOD) in its discharge to Pearl Harbor's Middle Loch. The State Health Department has limited future sewer connections to the sewage plant to this maximum equivalent sewage flow.

In 1973, the City Public Works Department reserved capacity in the existing plant for future sewer service to serve the Village Park planned development. However, after Phase 4 of Village Park, no further building permits will be issued without the approval of the State Health Department until the proposed Honolulu Waste Water Treatment Plant (WWTP) is completed.

2-50
The Makakilo STP has an operating capacity of 1.3 mgd and can be expanded to a capacity of 2.48 mgd. It treats sewage flow from the Makakilo area by the activated sludge process. Most of the effluent, following secondary treatment, is used for irrigation of the surrounding sugar cane fields. This practice is endorsed and monitored by the State Department of Health.

Construction of the 25 mgd capacity Honouliuli Waste Water Treatment Plant (WWTP) will include replacement of the existing 3.6 mgd Waipahu STP with a 7 mgd capacity Waipahu sewage pumping station (SPS) and a new force main to the Honouliuli WWTP. The Makakilo STP would also be phased out. The Honouliuli regional facility is being designed to accommodate all the effluent from the western portion of Namala Bay (Halawa Valley to Barbers Point).

The plant is scheduled to go on line in 1982, however, this schedule is subject to the City's financial capabilities and the present completion target date may not be met if adequate funding is not available.

The treated sewage will be discharged into the ocean by a deep water outfall off Barbers Point. The City has received an exemption from
secondary treatment from the Environmental Protection Agency (EPA), however, the conditions of the exemption will be appealed. It should be noted that secondary treated effluent could still be made available for irrigation under certain conditions.

2. **Solid Waste** [2.44]

Solid waste from developments in areas to be served by the project would most likely be disposed of at the Palailai Sanitary Landfill. The Palailai Landfill is a privately owned and operated disposal site presently operating at 250 tons per day. It has a future capacity for receiving up to 600 tons per day, or approximately 20% of the total refuse of Oahu, and has a 10 to 15 year site life, depending on usage.

Palailai Landfill is a former rock quarry being restored by Pacific Rock and Concrete Co., Ltd. under a lease agreement with the landowner, Campbell Estate. A renewable 5-year Conditional Use Permit was granted in 1973 by the City and County of Honolulu for operation of the site as a sanitary landfill. The permit was renewed in 1978 for another 5 years (expires in June, 1983).
The Waipahu incinerator was built in 1970 and has a design capacity of 600 tons per day. It is presently being operated at full capacity.

There is an acute shortage of City and County-owned sites available for disposal of solid waste on Oahu. Although a site has not been selected, future plans call for the development of a new sanitary landfill in the leeward area.

In addition, recent studies indicate it would be feasible to generate power from the solid wastes on Oahu. A joint venture of Amfac, Inc. and Combustion Engineering was chosen to develop a recovery plant, and it is likely that the plant will be located in the leeward area. A plant capacity of up to 1,800 tons of garbage per day is anticipated, and in exchange, the companies would pay the City roughly $10.00 for each ton of garbage.

D. **Utilities**
   1. **Electricity**
      
      A 46 k.V. Hawaiian Electric Company (HECO) overhead transmission line lies 1,800 feet south-southeast of the project site, running parallel to the H-1 Freeway. There is also a 46 k.V.
circuit on Kunia Road. In addition, there are three power line easements approximately 3,750 feet north-northwest of the project site. Each easement can contain four 138 KV circuits. At present two of the easements each have two 138 KV circuits and one is reserved for future use.

After 50% of the Village Park subdivision is completed (across Kunia Road from the project site), a HECO substation will be built. The proposed location of the substation will be along Kunia Road adjacent to and north of Village Park [2.45].

The project site will have an electrical demand of approximately 700 kilowatts.

HECO has stated that they will have adequate capacity to supply the electrical demand requirements for the service area of the project [2.46]. HECO currently has a generating capacity of 1,186 megawatts, with its capacity increasing to approximately 1,327 megawatts after the Kahe #6 facility goes on line [2.47]. The energy requirements of the area will be fed from a power pool supported by the three generating plants located in downtown Honolulu, Waiau and Kahe.
2. **Gas**

Honolulu Gas Company (GASCO) reports that there are 16-inch and 6-inch gas lines along Farrington Highway south of Kunia Road, as well as a 10-inch oil line [2.48]. There are no GASCO lines along Kunia Road.

3. **Telephone**

Telephone service is available approximately 1/2 mile from the project site, along Kunia Road. The pump station will require at least one phone. For Hawaiian Telephone to provide telephone service to the project site, a pole line of approximately 20 poles with associated wiring must be constructed from Kunia Road to the site [2.49]. In all probability electrical service would also be provided via this proposed pole line.

E. **Schools**

Elementary schools serving the areas in the vicinity of the project site include August Ahrens, Honowai and Waipahu Elementary in Waipahu and Makakilo and Mauka Lani Elementary in Makakilo. The areas are also served by Waipahu Intermediate and Waipahu High in Waipahu, and by Ilima Intermediate and Campbell High in Ewa. Refer to Table 2-12 for a list of the schools' enrollments and capacities.
### TABLE 2-12

SCHOOL ENROLLMENTS AND CAPACITIES

<table>
<thead>
<tr>
<th>School</th>
<th>Present Enrollment</th>
<th>1995 Projected Enrollment</th>
<th>Present Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Elementary 1/</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>August Ahrens</td>
<td>1,609</td>
<td>1,420</td>
<td>1,449</td>
</tr>
<tr>
<td>Honowai</td>
<td>965</td>
<td>700</td>
<td>803</td>
</tr>
<tr>
<td>Waipahu</td>
<td>989</td>
<td>900</td>
<td>877</td>
</tr>
<tr>
<td>Makakilo</td>
<td>527</td>
<td>470</td>
<td>654</td>
</tr>
<tr>
<td>Mauka Lani 4/</td>
<td>422</td>
<td>880</td>
<td>483</td>
</tr>
<tr>
<td><strong>Intermediate 2/</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waipahu 3/</td>
<td>1,115</td>
<td>1,250</td>
<td>1,164</td>
</tr>
<tr>
<td>Ilima</td>
<td>1,213</td>
<td>1,400</td>
<td>1,401</td>
</tr>
<tr>
<td><strong>High School</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waipahu 4/</td>
<td>2,197</td>
<td>2,300</td>
<td>2,051</td>
</tr>
<tr>
<td>Campbell</td>
<td>2,356</td>
<td>2,400</td>
<td>2,404</td>
</tr>
</tbody>
</table>

1/ Three new elementary schools are planned, depending on need.

2/ A new intermediate-high school complex is planned for the Ewa area.

3/ A major replacement program is planned.

4/ New permanent facilities are planned.

5/ Projected enrollments are based, in part, on projected new students from the Village Park, Gentry-Waipio and Makakilo subdivision.

**Source:** Department of Education (as of 9/14/79).
F. Public Services

1. Police

The City and County Police Department substation in Pearl City serves the vicinity of the project site. The project site is located within the Waipahu Police "beat" and could expect a 4+ minutes response time to calls [2.50].

The average response time within the entire Waipahu District is about 6 minutes. The existing crime rate in the immediate area is very low, consisting mainly of nuisance calls for dumping solid waste materials and related refuse, motorcycle noise, children and pet problems. There are no immediate plans for an additional police station facility in the area.

2. Fire

The City and County Fire Department serves the vicinity of the project site. The project site would be served by the fire station located in Waipahu Industrial Park on Leonui Street. This station houses an engine company of 18 personnel, an aerial ladder company of 18 firefighting personnel and headquarters for a battalion chief and his aide [2.51].

The Makakilo area is served by the fire station located on Makakilo Drive. The average
response time is estimated to be 3.5 to 4 minutes. At present, Campbell Industrial park has its own Fire Brigade and depends on the support of the Honolulu Fire Department only in extreme emergencies [2.52].

3. Medical

Medical services are available at the Waipahu Clinic and the Punawai Clinic (a Kaiser Foundation Clinic). The Waipahu Clinic has a staff of about 50 and serves the basic health needs of residents from Waipahu to Waianae. By 1985 the staff is expected to increase to 70. Hospital services for residents are available at Wahiawa General Hospital in Wahiawa and Pearlridge Hospital (Fronk Clinic) in Aiea.

G. Parks and Recreation

Public recreational lands and facilities in the leeward area, plus Mililani, are summarized in Table 2-13. There are several private facilities, such as golf courses, in addition to these.

V. ARCHAEOLOGICAL/HISTORICAL CHARACTERISTICS

No historical or archaeological sites are known to exist on the project site, which is in an area previously disturbed by sugar cane cultivation. The closest site
<table>
<thead>
<tr>
<th>Area</th>
<th>Total Acreage</th>
<th>Beach Acreage</th>
<th>Hunting Acreage</th>
<th>Improved Acreage</th>
<th>Trails (miles)</th>
<th>Launching Areas</th>
<th>Public Facilities</th>
<th>Tennis Courts</th>
<th>Golf (holes)</th>
<th>Camping Sites</th>
<th>Swimming Pools</th>
<th>Moorages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ewa-Mililani</td>
<td>14,407</td>
<td>54</td>
<td>—</td>
<td>284</td>
<td>35</td>
<td>—</td>
<td>24</td>
<td>18</td>
<td>14</td>
<td>2</td>
<td>—</td>
<td>90</td>
</tr>
<tr>
<td>Waianae Coast</td>
<td>8,619</td>
<td>78</td>
<td>2,440</td>
<td>249</td>
<td>1</td>
<td>1</td>
<td>16</td>
<td>—</td>
<td>127</td>
<td>1</td>
<td>90</td>
<td>—</td>
</tr>
</tbody>
</table>

Source: [2.53]
Petroglyphs, approximately 0.9 mile from the project site. However, in the event that unanticipated sites or remains are encountered during construction, all work will stop and the State Historic Sites Office will be contacted.
REFERENCES TO SECTION 2


References to Section 2, cont'd.


[2.13] Ibid. [2.12].


2-62
References to Section 2, cont'd.


References to Section 2, cont'd.

[2.36] State of Hawaii, Department of Transportation. 1979. Personal communication with staff.
Land Use Plans Policies Controls
SECTION 3

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

I. GENERAL

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

Site Land Use

State Land Use Classification: Agriculture
Development Plan: Agricultural
Zoning: Agriculture-1 (AG-1)

Surrounding Land Use

State Land Use Classifications: East - Urban and Agriculture; West - Urban, Conservation and Agriculture; North - Agriculture; South - Urban and Agriculture.
Detailed Land Use Map: North and east - Agriculture, Residential, Apartment and School in the Waipahu-Crestview area, and Industrial near Pearl Harbor.
Development Plan: South and west Agricultural.
Zoning: East - Planned Development Housing (PDH) and AG-1; South and West - AG-1.

II. CITY AND COUNTY OF HONOLULU

The Statement of Objective and Policies of the City and County of Honolulu's General Plan sets forth the broad
policies for the long-range development of the City. The project is located in the area identified in the General Plan as Ewa. As required by the City's Revised Charter of 1973, a Development Plan for Ewa has been prepared and adopted in accordance with the provisions of Sections 5-407, 5-409, and 5-411 of the Charter and the City's 1977 General Plan. The purpose of the Ewa Development Plan is to provide a relatively detailed scheme for implementing the objectives and policies of the General Plan for Ewa. Relevant General Plan policies for Ewa encourage its gradual development as a secondary urban center in order to relieve development pressures in the urban-fringe and rural areas. Specific General Plan Objectives and Policies, in the proposed revised wording [3.1], include the following:

A. Population

Objective A, Policy 4—"Seek to maintain a desirable pace of physical development through City and County regulations."

Objective C, Policy 2—"Encourage the gradual development of a secondary urban center in the West Beach-Makakilo area to relieve development pressures in the urban-fringe and rural areas."

Objective C, Policy 3—"Limit growth in the urban fringe and rural areas to a level which essentially maintains their 1980 proportion of the islandwide population."
These policies give a clear direction for the nature and sequencing of development in Ewa. The Primary Urban Center is to be fully developed, and a secondary urban center in the West Beach-Makakilo area of Ewa is to be gradually developed as needed to relieve the pressures in the urban-fringe and rural areas. As a result, expenditures for new public facilities and utilities that provide for new growth should first be directed toward the Primary Urban Center and Ewa.

A description of the distribution of residential population of Ewa for the years 1980 and 2000 is presented in Section 2, "Population".

B. Economic Activity

Objective C, Policy 3—"Provide sufficient agricultural land in Ewa, Central Oahu, and the North Shore to encourage the continuation of sugar and pineapple as viable industries."

Objective G, Policy 1—"Direct economic activity primarily to Honolulu, Aiea, and Pearl City; and secondarily, to the West Beach-Makakilo area."

The proposed project may be located in cane fields. If so, two acres of prime agricultural land would be withdrawn from productivity.

The objective of the proposed project is to provide water for projected growth in the West Beach-Makakilo area.
C. **Transportation and Utilities**

Objective B, Policy 1—"Develop and maintain an adequate supply of water for residents and visitors."

Objective B, Policy 2—"Develop and maintain an adequate supply of water for agricultural and industrial needs."

Objective C, Policy 3—"Plan for timely and orderly expansion of utility systems."

Objective D, Policy 1—"Give primary emphasis in the capital-improvement program to the maintenance and improvement of existing roads and utilities."

Objective D, Policy 4—"Evaluate the social, economic, and environmental impact of additions to the transportation and utility systems before they are constructed."

As discussed in Section 1, "Proposed Water System", the proposal project would be one of several strategies to provide water for growth projected by the City.

This EIS addresses the above mentioned concerns before the actual implementation of the project.

D. **Physical Development and Urban Design**

Objective A, Policy 1—"Plan for the construction of new public facilities and utilities in the various parts of the island according to the
following order of priority: first, in the primary urban center; second in the secondary urban center; and third, in the urban-fringe and rural areas.

Objective A, Policy 2—"Coordinate the location and timing of new development with the availability of adequate water supply, sewage treatment, drainage, transportation and public safety facilities."

Objective A, Policy 3—"Phase the construction of new developments so that they do not require more regional supporting services than are available."

Objective C, Policy 1—"Allocate funds from the City and County's capital improvement program for public projects that are needed to bring about the gradual development of the West Beach-Makakilo area as a secondary urban center."

Objective C, Policy 2—"Encourage the development of a major residential, commercial and employment center within the secondary urban center."

Objective C, Policy 4—"Coordinate plans for the development of the secondary urban center with the State and Federal governments and with the sugar industry."

The development of the Honouliuli Wells is proposed to comply with these policies.
In addition to the Objective and Policies of the General Plan, special provisions for urban design guide public and private development in the Ewa Development Plan Area. Specific urban design considerations include: open space, public views, height controls and density controls. It is not anticipated that the project will detract from the open space and aesthetic values of the area in the vicinity of the project. The height of control building will be significantly less than the 25-feet height limit specified for Agricultural designated areas in Ewa, and the only occasion when the project site will be visible is during the periods when sugar cane is newly planted or just harvested. The density controls specified for Agricultural areas in Ewa are not applicable as the proposed action does not include construction of any dwelling units.

The proposed project is not located on the Development Plan Public Facilities Map which provides notice of approximate site and corridor locations of future public facilities.

Due to its utility nature, the proposed project is a permitted use according to the County zoning controls. The site is outside of the Special Management Area (SMA) and will not need an SMA permit.
III. STATE OF HAWAII

A. Hawaii State Plan

Several objectives and policies stated in the Hawaii State Plan generally relate to the proposed project [3.2]. One policy 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."

Other objectives and policies which refer to agriculture include the following:

Objectives:

Section 7 (a) (1): "Increased viability in sugar and pineapple industries."

Section 7 (a) (2): "Continued growth and development of diversified agriculture throughout the State."

Policy:

Section 7 (b) (6): "Assure the availability of agriculturally suitable lands with adequate water to accommodate present and future needs."

Finally, objectives and policies regarding facility systems include the following:

Objectives:

Section 16 (a): "Planning for the State's facility systems with regard to water shall be directed towards achievement of the objective of the provision of water to adequately accommodate domestic, agricultural, commercial, industrial, recreational, and other needs within resource capacities."
Policies:

Section 15 (b) (2): "Encourage re-use and recycling to reduce solid and liquid waste and develop a conservation ethic."

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) (3): "Reclaim and encourage the productive use of runoff water and waste water discharge."

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."

Section 16 (b) (6): "Promote water conservation practices."

The proposed project is consistent with Section 5 (b) (3), since the BWS is developing this water source to support existing and planned developments which are part of the future growth outlined by the Honolulu General Plan.

The project does not appear to be inconsistent with the agricultural objectives and policies listed above, with the exception that the proposed project may possibly remove two acres of existing cane land from cultivation. An effort is being made to site the control station and wells in locations where loss
of cane land will be minimal. An agreement regarding water exchange will be resolved with Oahu Sugar Company (OSC) so that its operations are not adversely impacted by their reduction in ground water withdrawal. The amount of sewage effluent that could be diverted for the water exchange proposal will depend on the amount that OSC will accept.

The project does not appear to be inconsistent with the facility systems objectives and policies listed above. The BWS is involved with and supports development of alternate water sources which would minimize demands on existing ground water sources.

Two Priority Directions stated in the Hawaii State Plan also relate in some way to the proposed project [3.3]:

Section 103 (h) (3): "Encourage restriction of new urban development in areas where water supply is insufficient for both agricultural and domestic uses."

Section 104 (b) (2): "Plan the development and availability of land and water resources in a coordinated manner so as to provide for the desired levels of growth in each geographical area."

The proposed project is not inconsistent with Section 103 (h) (3), since an equitable water exchange will be arranged with Oahu Sugar Company. The project is consistent with Section 104 (b) (2), since it is being provided to support the growth plans of the General Plan of the City and County of Honolulu.
B. Designated Ground Water Control Areas

The BWS is the primary water management agency on Oahu with the authority to limit the amount of water drawn from any well covered under the BWS Rules and Regulations, Section 3-313 (see Appendix G). These rules apply to all areas except designated "ground water control areas" established by the State of Hawaii, Department of Land and Natural Resources (DLNR).

Pursuant to Chapter 177, Hawaii Revised Statutes, as amended, DLNR has authority to designate critical areas and is the primary agency with control of these areas. Chapter 166 of Title 13, which implements this Act, has been adopted and the first designated "ground water control area" was recently declared. It encompasses the Pearl Harbor aquifer and the Schofield high-level water body (Figure 3-1). All those withdrawing water from this area would have had to apply to the State between October 4, 1979 and January 2, 1980. This is described further in Appendix A.

C. Special Use Permit

A State Special Permit will be required. Act 221 of the 1979 Legislative session amended the law for requests involving 15 acres or less, which may be processed and approved at the County level.
For requests over 15 acres, the counties have initial jurisdiction, with denial of a project being final. Projects which are approved by the counties then go to the State Land Use Commission for final approval or denial.

D. **State Water Commission Report**

The State Water Commission was appointed by the Governor in mid-1977 to review the availability of water supplies and recommend appropriate administrative and legislative actions. After reviewing available reports and receiving testimony from major water purveyors, the Commission focused on major problems and issues. The resulting findings and recommendations are contained in a report titled "Hawaii's Water Resources: Directions for the Future". The priority recommendations from this report are reproduced in Appendix H.

E. **State Environmental Policy (Chapter 344, HRS)**

The guidelines, "§344.4 item (2) Land, water, mineral, visual, air and other natural resources.

The following guidelines are applicable:

(A) "Encourage management practices which conserve and fully utilize all natural resources;" The conservation of potable water resources is one of the many ongoing conservation programs of the BWS.

(B) "Promote irrigation and waste water management practices which conserve and full utilize vital water resources;"

3-12
(C) "Promote the recycling of waste water and solid wastes." The BWS is actively seeking the use of recycled water for irrigation, thereby conserving potable water supplies. The BWS is also actively participating in irrigation and waste water management policies.

(D) "Encourage management practices which conserve and protect waterbeds and water sources, forestry and open space areas." The BWS actively participates in the protection of waterbeds and water sources.

IV. COASTAL ZONE MANAGEMENT PROGRAM

The proposed project is not inconsistent with the purpose of the Coastal Zone Management (CZM) Act of 1972. The CZM Act declares that it is national policy [3.4]:

(a) To preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation’s coastal zones for this and succeeding generations;

(b) to encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone, giving full consideration to ecological, cultural, historic and aesthetic values as well as to needs for economic development;

(c) for all Federal agencies engaged in programs affecting the coastal zone to cooperate and participate with state and local governments and regional agencies in effectuating the purposes of this title; and

(d) to encourage the participation of the public, of Federal, state, and local governments, and of regional agencies in the development of coastal zone management programs. With respect to implementation of such management programs, it is the national policy to encourage cooperation among the various state and regional agencies,
including establishment of inter-state and regional agreements, cooperative procedures, and joint action, particularly regarding environmental procedures (Public Law 92-583, Sec. 303, hereafter referred to as CZMA)."

V. HAWAII WATER RESOURCES PLAN [3.5]

The purpose of the Hawaii Water Resources Regional Study was to formulate a comprehensive plan of action to achieve the balanced conservation, development and use of Hawaii's water resources. Coordinated by the U. S. Water Resources Council, the study was conducted by an intergovernmental team representing nearly 50 agencies, with the participation of private industry and the public. The result was the "Hawaii Water Resources Plan", which was published in January, 1979.

Recommendations from the plan which are clearly pertinent to the issue at hand include the following:

1-1 Develop additional fresh water supplies to meet year 2000 needs statewide.

Oahu: Develop ground water islandwide, especially Schofield Plateau and Waialua areas.

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.
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.

11-1 Reuse treated sewage effluent water for beneficial purposes.

Encourage agricultural operations to locate near existing sewage treatment plants where feasible.

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 spaces.

14-1 Use more efficient irrigation methods. [3.6]

Convert to drip or sprinkler irrigation where feasible.

Reduce storage and transmission losses.

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 sugar cane irrigation.

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.
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."

VI. FEDERAL WATER POLLUTION CONTROL ACT/CITY AND COUNTY'S "208" PLAN [3.7]

The 1972 Federal Water Pollution Control Act Amendments (P.L. 92-500) set two basic goals for the nation:

1. That wherever attainable, water quality which provides for the protection and propagation of fish, shellfish and wildlife and for recreation in and on the water, must be achieved by July 1, 1983. In other words, the waters are to be "fishable and swimmable" by that time.

2. That the discharge of pollutants into the navigable water of the United States be eliminated by 1985.

The U. S. Environmental Protection Agency (EPA) administers the Act nationally and the State Department of Health (DOH) administers it within the State of Hawaii. Section 101 (a) (5) of the Act requires that "areawide waste treatment and management planning processes be developed and implemented to assure adequate control of sources of pollutants in each State". The specific requirements for the development and contents of these plans
are contained in Section 208 of the Act; hence, they are referred to as "208" plans.

The "208" plan for the City and County of Honolulu was completed by DOH and the City and County in October, 1978. It has been approved by the Governor and EPA, and was recently adopted by the City Council.

The plan focuses on streams and coastal water quality, but is not limited to consideration of surface waters only. Recommendations regarding fresh water diversions and salt water intrusion include the following:

- "If the Attorney General determines that the DOH has legal authority to establish minimum stream flow standards, and if no other appropriate State agency has acted to do so, the DOH should adopt minimum flow standards as part of the State's water quality standards (Chpt. 37-A of the Public Health Regulations)."

- "If the Attorney General determines that the DOH does not have adequate legal authority, the DOH should either seek appropriate authority from the legislature or coordinate revisions to the 208 plan which would require another appropriate agency to adopt and implement minimum flow standards."

- "Any minimum flow standards that are developed pursuant to the above recommendations should protect the few "natural" streams that currently exist."

- "DLNR be designated the primary agency responsible for controlling salt water intrusion into groundwaters on Oahu, with the City and County of Honolulu Board of Water Supply sharing such management responsibility to the extent permitted by its legal authority."
establish State water quality standards for ground-water to address salt water intrusion. If it determines there is such a need, DOH shall adopt appropriate revisions to Chapter 37A, PHR by July 1, 1980."

"DOH, in its review and approval of new sources of underground drinking water, should discourage development of any such source if its quality may likely exceed chloride standards, set forth in National Secondary Drinking Water Regulations proposed or adopted by the U. S. EPA."
REFERENCES TO SECTION 3


[3.3] Ibid. [3.2]


Environmental Impacts
SECTION 4

ANTICIPATED ENVIRONMENTAL IMPACTS AND
MITIGATIVE MEASURES TO MINIMIZE ADVERSE IMPACTS

This section will summarize and discuss the probable impacts of the proposed action on the environment.

I. INTRODUCTION

The proposed project will generate primary and secondary environmental impacts. Primary impacts are those resulting directly from construction and from the operation of the proposed wells, primarily the discharge of ground water from the wells. Secondary environmental impacts are those indirect impacts which are anticipated over the duration of the project life and may include potential use conflicts and indirect benefits arising from the proposed action. Examples of secondary impacts would include impacts resulting from the water exchange and from potential changes in land use.

II. DISCUSSION OF IMPACTS FROM THE PROPOSED PROJECT

A. Primary Impacts

1. Short-term Impacts

Short-term impacts, beneficial and adverse, generally result from construction related activities. Consequently, these impacts are of short duration and should not last longer than the construction period.
a. Water Quality and Erosion

The well field site is approximately 2 acres in area. During construction proper grading and a revegetation program will be maintained to minimize potential erosion into surrounding cane fields.

Between the H-1 Freeway and Farrington Highway, the proposed transmission line alignment will be located about 60 to 250 feet from Honouliuli Stream for a length of about 2,000 feet. Although soil in this area has a severe erosion hazard rating, proper grading should minimize sedimentation into the stream during construction. Potential sediments being carried to the stream should be minor since the trench width will be about 42 inches. If necessary, siltation basins will be constructed. Denuded areas will be revegetated as portions are completed.

Honouliuli Stream drains into Pearl Harbor's West Loch. The potential amount of sediment contributed by the construction of the transmission line near the stream is negligible compared to the normal amount
of sediment carried by the stream. Of the 7,000 square feet of exposed ground which could contribute sediment to the stream, only a portion of that sediment would actually reach the stream.

Potential for soil erosion and sedimentation of Honouliuli Stream will be short-term, lasting only for the duration of the construction period. Therefore, the proposed project is not expected to have a significant effect on the water quality of Honouliuli Stream and Pearl Harbor's West Loch.

b. Noise

During site preparation and construction, an increase in ambient noise is inevitable. Noise levels (generated by construction machinery) which can be expected are presented in Figure 4-1.

To mitigate impacts of construction noise, the contractor will ensure that mufflers on equipment are in proper operating condition and will limit the hours of construction, if necessary.

As sound waves move uniformly in all directions, the amplitude decreases as they
FIGURE 4-1
CONSTRUCTION EQUIPMENT NOISE RANGES

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Noise Level (dBA) at 50 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60</td>
</tr>
<tr>
<td>COMPACTORS (ROLLERS)</td>
<td>H</td>
</tr>
<tr>
<td>FRONT LOADERS</td>
<td></td>
</tr>
<tr>
<td>BACKHOES</td>
<td></td>
</tr>
<tr>
<td>TRACTORS</td>
<td></td>
</tr>
<tr>
<td>SCRAPERS, GRADERS</td>
<td></td>
</tr>
<tr>
<td>PAVERS</td>
<td></td>
</tr>
<tr>
<td>TRUCKS</td>
<td></td>
</tr>
<tr>
<td>CONCRETE MIXERS</td>
<td></td>
</tr>
<tr>
<td>CONCRETE PUMPS</td>
<td></td>
</tr>
<tr>
<td>CRANES (MOVABLE)</td>
<td></td>
</tr>
<tr>
<td>CRANES (DERRICK)</td>
<td></td>
</tr>
<tr>
<td>PUMPS</td>
<td></td>
</tr>
<tr>
<td>GENERATORS</td>
<td></td>
</tr>
<tr>
<td>COMPRESSORS</td>
<td></td>
</tr>
<tr>
<td>PNEUMATIC WRENCHES</td>
<td></td>
</tr>
<tr>
<td>JACK Hammers and Rock Drills</td>
<td></td>
</tr>
<tr>
<td>PILE DRIVERS (PEAKS)</td>
<td></td>
</tr>
<tr>
<td>VIBRATOR</td>
<td></td>
</tr>
<tr>
<td>SAWs</td>
<td></td>
</tr>
</tbody>
</table>

Note: Based on Limited Available Data Samples

Source: Noise From Construction Equipment and Operations Building Equipment, and Home Appliances, EPA, 1971
move from the source of the sound. In air when the distance doubles, the amplitude drops by half, which is a drop of 6 dB. Therefore, if one moves one meter from the source to two meters from the source, the sound pressure level will drop by 6 dB [4.1]. Given the noise levels presented in Figure 4-1 and assuming the highest noise level generated by pile driving (110 dBA), the theoretical noise levels, in air, from the sound source are estimated as follows:

<table>
<thead>
<tr>
<th>Distance (feet)</th>
<th>dBA Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>110</td>
</tr>
<tr>
<td>100</td>
<td>104</td>
</tr>
<tr>
<td>200</td>
<td>98</td>
</tr>
<tr>
<td>400</td>
<td>92</td>
</tr>
<tr>
<td>800</td>
<td>86</td>
</tr>
<tr>
<td>1600</td>
<td>80</td>
</tr>
<tr>
<td>3200</td>
<td>74</td>
</tr>
<tr>
<td>6400</td>
<td>68</td>
</tr>
</tbody>
</table>

These particular estimates would be true only when there are no reflecting or blocking objects in the sound path. An obstacle in the path of the sound wave would reflect and absorb some of the sound, the amount of which would depend on the physical properties of the obstacle [4.2].
The project site is about 0.76 mile from the nearest populated area (new homes at Village Park) and impacts are anticipated to be minimal. Cane fields between the project site and residences will attenuate some of the potential impact so the anticipated noise level at the nearest residence will be less than 68-74 dBA. Chapter 44-B of the Department of Health regulations regarding allowable noise levels on Oahu allows 70 dBA during the day for an agricultural area and 55 dBA for a residential area, except during construction. The increase in noise will be temporary and should last only for the duration of the construction period.

Some wildlife species may be displaced to surrounding areas during construction but could return to the site upon completion. No endangered species would be affected.

c. Economic

During the construction of the wells, control building and transmission line there will be an infusion of cash into the local economy. This will be a short-term, positive impact for the local economy.
The estimated total construction cost for the project is $3,739,000.

d. Traffic

Since most of the proposed alignment of the transmission line is located along a cane haul road, the impact on traffic in this area should be minimal. Potential problems can be mitigated by coordinating with Oahu Sugar Company construction scheduling to avoid conflict with cane haul trucks.

Approximately 875 feet of the alignment will be along Farrington Highway. During construction hours one lane of the highway will be blocked from traffic, but two-way traffic will not be interrupted. Construction will be confined to non-peak traffic hours and traffic control devices will be used for safe direction of traffic. During peak traffic hours the trench will be covered and the blocked lane will be opened.

e. Air Quality

During construction there will probably be some increase in airborne particulate matter in the vicinity of the site; however, this will be temporary and is not expected
to be significant. Cane operations presently contribute to similar, if not greater, increases.

During construction along Farrington Highway, the increased emissions are not expected to be significant and will only last for the duration of the construction period.

f. Biological

Vegetation in the vicinity of the project site is not considered rare or endangered by State or Federal agencies. The majority of species are introduced. Significant impacts on the existing botanical community are not expected.

Terrestrial fauna in the project area are primarily introduced species associated with agricultural and urbanized areas. Native birds, with the exception of the pueo, would be unlikely to visit the area, as the site does not offer suitable habitat.

During construction, fauna in the immediate vicinity of construction activities may relocate into adjacent areas, but would be able to return to the site upon completion.
of construction. Adverse impacts on faunal communities are not anticipated as a result of the proposed action. In fact, landscaping of the control building site may provide new habitat for certain species of birds.

9. **Infrastructure**

Potential conflicts between the transmission line placement along Farrington Highway and existing gas and oil lines will be mitigated by coordination with GASCO; electrical lines with Hawaiian Electric Company, Inc; and telephone lines with Hawaiian Telephone Company. Coordination for this phase of construction will also be maintained with the State Department of Transportation.

h. **Archaeological**

There are no archaeological sites listed in the State or Federal registers of historic sites which are located on the subject property. Thus, discussion of impacts are precluded. However, if evidence of a site or cultural remains are discovered during construction, the State Historic Preservation Officer will be notified.

4-9
2. **Long-term Impacts**

Primary long-term impacts, both beneficial and adverse, are those anticipated to result directly from the project. These are impacts that can be expected for the duration of the site's use.

a. **Surface Water**

Honouliuli Stream and its tributary, which are located west and east of the site, respectively, are dry most of the year. Their source is surface runoff and possibly dike impounded water within the southeast slopes of the Waianae Range. These dikes overflow during rainy months. Apparently, basal ground water does not contribute significantly to their flow. Hence, drawdown of the ground water in the vicinity of these streams should not have a significant, if any, impact on their flow.

The perennial flow of Waikele Stream is contributed to mainly by the basal water body; however, since it is nearly 2 miles away and not down-gradient from the proposed wells it is unlikely that drawdown from the Honouliuli Wells would affect flow in this stream.

4-10
b. Ground Water

BWS' policy is to negotiate an agreement with Oahu Sugar to reduce their pumpage in direct proportion to the amount of water to be developed by Honouliuli Wells. Although there will be no net increase in discharge from the greater Pearl Harbor aquifer, there will still be an effect on a portion of the aquifer; more specifically, the Koolau aquifer (refer to Figures 4-2 and 4-3). The water sources closest to the site and that draw from the Koolau aquifer are Kunia Wells I, Kunia Wells II and Oahu Sugar's Ewa Shaft. These sources will probably experience some drop in head level with continued pumping from the new wells, if the cut-back is not at Ewa Shaft. However, this is difficult to quantify until the wells begin operation and it is known which of Oahu Sugar's water sources will be reduced in pumpage.

Development of a well field may affect nearby wells, because the drawdown produced around the well field results in a "cone of depression" in the water table. The
SOUTHERN OAHU
EQUIPOTENTIAL SURFACE
EQUILIBRIUM STORAGE HEADS
MAY 1958


FIGURE 4-2
POTENTIOMETRIC SURFACE MAP - 1958
size of this cone depends upon the character of the water-bearing formation (aquifer) and upon the rate and duration of pumping.

The more permeable the aquifer is or the larger the interconnected openings in the formation are, the less the drawdown at any given pumping rate will be. In cases where the aquifer is very "open" or permeable (as in the volcanic series beneath the site), the drawdown may be almost negligible for low pumping rates [4.3].

All of the adjacent sources will continue to be closely monitored throughout the development and use of the new wells, so that any impacts can be identified and mitigated in a timely manner. In addition, studies were undertaken by John F. Mink to determine whether wells in the Pearl Harbor aquifer could be operated at lower head levels. In summary, he concluded that "at low head a unit change in sustainable yield results in much larger loss of storage head than the same unit change at high head."

To mitigate impacts on head levels, the Honouliuli Wells could be operated at
a lower capacity, if necessary. However, significant impacts are not anticipated because the new wells have been planned hydro-geologically to have the least effect on other wells in the vicinity. They are also far enough inland to permit seasonal changes in the thickness of the fresh water lens without increases in salinity in the wells.

c. Water Quality

Surface water quality would be impacted only if drawdown were to reduce surface flow. However, as mentioned above, this situation appears unlikely.

Ground water quality would be impacted if the Honouliuli Wells were to reduce the amount of ground water flowing to the shore in this area, to the extent that the transition zone were to thicken. This is discussed in greater detail on page 2-17. If this occurred, the salinity of the water pumped from other wells seaward of Honouliuli Wells could increase, lowering their quality for domestic use (if domestic wells). Domestic wells are identified in Table 4-15.
2-1. In addition, the EPA recommended secondary limit for total dissolved solids could be exceeded.

The probability of this occurring is low because it is considered unlikely that drawdown from the Honouliuli Wells will affect the amount of ground water seepage to the shore, since net draft from the aquifer will be equal to the current rate.

The exact effects of pumpage from the new wells cannot be predicted quantitatively at the present time. Thus, there are several wells in the vicinity, including those mentioned above, which will be closely monitored in order to detect increases in the chloride content of the water, which could be indicative of salt water intrusion.*

As above, any significant impacts could be mitigated by operating the wells

* Under perfect equilibrium conditions in accordance with theory, permanently lowering the storage head of the fresh-water aquifer by 1 foot results in a rise in the transition zone of 40 feet. Conversely, an increase in the rate of recharge will cause a thickening of the freshwater lens and a seaward displacement of the salt water.
at a lower capacity, if necessary, to the extent that other domestic wells would no longer be affected.

A moderate decline in water quality (i.e. increase in chloride content) of the sources used for irrigation would not have a significant impact on sugar cane, as most of the sources have chloride contents well below 1,000 ppm. It should be noted that the chloride content of 1,000 ppm does not represent an absolute demarcation between non-water quality limited growth and dead cane. Reports by sugar industry agriculturists infer that progressive declines in production are related to increases in the chloride concentration of irrigation water.

Since the well serving the National Wildlife Refuge West Loch Unit is presently saline, an increase in the chloride content of the water would not change the present situation.

d. Noise

Pump noise is not anticipated to be a problem at the present time, since the site is surrounded by cane fields. However,
if land use should change over the years and noise from the pumps were to impact residential areas, mitigation measures are available, such as building sound barriers around the offending equipment.

e. Population

Development of the wells will require allocating 0.5 mgd, of the initial 3.0 mgd, to Makakilo for a portion of its expansion of the subdivision, since Makakilo will be helping to finance the project. The full expansion will consist of 3,693 dwelling units, accommodating a total population of 11,800 persons (based on 3.2 persons per dwelling unit).

However, the residential population which could be served by 0.5 mgd is approximately 3,200 persons, based on 1,000 dwelling units requiring 500 gallons per day apiece and 3.2 persons per unit.

Subtracting the 1980 Ewa population of 35,554 from the State's Series II-F projected year 2000 population of 74,300 to 81,700 leaves 38,746 to 46,146 remaining. An increase from Makakilo of 3,200 would
represent approximately 7-8% of the total projected population increase for the Ewa area until the year 2000.

The total population of the Makakilo expansion, at 11,800 persons, would represent about 25-30% of the projected population increase for Ewa.

The per capita daily water consumption was 220 gallons in 1971. [4.4]

f. Land Use

The project would have little initial impact on land use in the vicinity of the project site, as at least 83% of the first 3 mgd to be developed will serve areas which are already zoned for urban use (Campbell Industrial Park and Makakilo).

Likewise, there should be little impact on cane lands immediately surrounding the site. Every effort is being made to site the wells and control building in a location where loss of cane land will be minimized.

Occasional cane burning should not be a significant effect on the proposed development. While smoke and ashes might dirty the interior of the station, they will not
adversely affect the mechanical equipment, which is maintained to minimize the corrosive effects from smoke and ash. Several other BWS stations are located in areas surrounded by sugar cane without adverse impacts to either party.

g. **Economic**

The proposed development of the wells would directly support the expansions of Campbell Industrial Park and Makakilo subdivision. This, in turn, would contribute to an increase in jobs in the Ewa-Makakilo area for industrial and construction workers, which may be considered a long-term beneficial impact.

It is not anticipated that this project alone will cause an increase in water rates. The rate structure for Oahu is based on uniform rates for regular domestic service throughout the entire island.

The total cost of water production breaks out to $0.13 per 1,000 gallons (in 1977 dollars) and is considered to be relatively low in comparison to alternative sources.
h. **Water Demand and Conservation Measures**

The project would provide 3 mgd of water to the Ewa-Makakilo area initially. As demand increases, another 6 mgd would be available to the area. It is not anticipated that this water will be exported to the Waianae Coast, as proposed water projects in that area should be sufficient to accommodate future needs of that area.

Approximately 2.0 mgd will be developed in Makaha and Waianae Valleys by 1985, in addition to 0.5 mgd from the recently completed Kamaile Wells. Later, it is anticipated that an additional 4 mgd can be developed from the Makaha and Waianae Wells [4.5].

Refer to Table 4-1 for a summary of present and projected water use in the leeward area.

To mitigate increases in water demand, a long-range water conservation program was begun by the BWS in FY 1976-1977. A leak detection and repair program was started and during the first year over 85 miles of mains in 23 different pressure zones were inspected and repaired. In
### Table 4-1

**Demand of Water Use, Expanded Region, 1979-2000**

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<tbody>
<tr>
<td>Molokai</td>
<td>4.88</td>
<td>4.2</td>
<td>-</td>
<td>3.0 Moonialii Wells (3)</td>
<td>-1.66</td>
<td>17.20</td>
<td>6.0 Moonialii Wells (3)</td>
<td>12.0 Water Exchange (4)</td>
<td>-</td>
<td>16.10</td>
<td>-9.70</td>
<td>37.90</td>
<td>-19.70</td>
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<tr>
<td></td>
<td>7.42</td>
<td>7.46 Rikaiilo (1)</td>
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<tr>
<td>Kauai</td>
<td>4.70</td>
<td>4.0</td>
<td>-</td>
<td>4.0 Kukaha Wells</td>
<td>8.20</td>
<td>17.10</td>
<td>-6.00</td>
<td>6.00</td>
<td>-4.00</td>
<td>6.00</td>
<td>-4.00</td>
<td>6.00</td>
<td>-4.00</td>
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<tr>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td>2.0 Maliau Wells</td>
<td>7.15</td>
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<td></td>
<td>5.80</td>
<td>7.63</td>
<td>16.0</td>
<td>16.57</td>
<td>-0.57</td>
<td>8.20</td>
<td>6.00</td>
<td>4.00</td>
<td>-2.00</td>
<td>4.00</td>
<td>-2.00</td>
<td>4.00</td>
<td>-2.00</td>
</tr>
<tr>
<td>District</td>
<td>9.00</td>
<td>19.19</td>
<td>19.0</td>
<td>49.51</td>
<td>-5.31</td>
<td>44.10</td>
<td>48.00</td>
<td>18.10</td>
<td>-17.70</td>
<td>18.10</td>
<td>-17.70</td>
<td>18.10</td>
<td>-17.70</td>
</tr>
</tbody>
</table>

(1) As outlined by DRBM. All source from Pearl Harbor Water District except 4.70 mgd from Ewa-Waianae Water District.
(2) Standard Oil Refinery uses 2.7 mgd of this.
(3) If allowed by DMW.
(4) Assumes that 25% of water available for exchange. If for some reason a water exchange cannot be facilitated, the development of alternate sources must occur at an earlier date than presently planned. (Exchange must be approved by DMW).
(5) After the year 2000, alternate sources will have to be developed for this District.
addition, three abandoned private wells, one of which was leaking, were sealed.

Since then, the BWS initiated a low ground water plan which gives them the power to institute mandatory controls, if necessary. The rules provide for progressively restrictive measures as ground water levels decline, beginning with purely voluntary reductions. Ultimately, surcharges and installation of flow restrictors may be used to insure reduction in usage.

A bill amending Chapter 19, Revised Ordinance of the City and County of Honolulu was passed and became effective November, 1979. It provides for limiting maximum flow rates of faucets, limiting water closet flushing volumes, and recirculation of cooling water for new installations.

In April, 1979 the BWS staff coordinated the first annual Water Conservation Week in Oahu's public schools. This was preceded by a water conservation poster contest in March. Over 400 entries were received and all were displayed during Water Conservation Week.
The BWS Public Relations Office also distributes information on water conservation. During the 1976-77 drought, the office conducted radio and television interviews, released periodic news releases on how consumers could conserve water, initiated news series in the media, held a "Water Conservation Fair," and notified individuals and businesses observed by consumers to be wasting water.

More recently, tours have been arranged and speakers have been made available to discuss the island's water supply and conservation measures. Visual aids are also made available, as well as publications for schools, hotels, restaurants, gardeners, and homeowners or renters.

One pamphlet outlines water conservation measures that residential users have at their disposal, including toilet tank alterations, faucet and flow controls, shorter showers, watering lawns at night, and dry landscaping. A summary of household water saving devices and the new City ordinance requiring conservation devices is shown in Appendix I.
The BWS is also planning adjustments to the water rate structure. Lower block rates are being considered for lower usage, as well as seasonal rates.

BWS' policy favors voluntary conservation and it attempts to educate consumers towards this end. To date, public acceptance and cooperation have been good. The conservation plea that was issued at the height of the 1977 dry period resulted in an estimated 8-10% reduction in consumption. Despite increases in the number of services by the BWS, annual pumpages in 1978 and 1979 were below that of 1977. (A recent study of metered customers indicated that 65% of all the water supplied by the BWS was for domestic use.)

Conservation measures can be adopted by industry as well as by individuals. The primary method used by industry and business is to recycle or reuse cooling waters. This method increases energy consumption, however, and with the tradeoff between energy consumption and water conservation, water conservation loses to the higher energy costs.
Another indirect measure relates to sewer charges. As of July 1, 1981, nonresidential users, such as restaurants, bars, laundries, and canneries, paid a sewer charge based on $0.59 per 1,000 gallons. Also, a "suspended solids surcharge" that went into effect in July, 1979, affects food and fruit processors.

The Wastewater Management Division of the City and County of Honolulu's Department of Public Works classifies users according to suspended solids concentration of their effluent. All those with a suspended solids concentration over 200 parts per million (ppm) generally pay more than the basic rate. Large water users, therefore, are faced with high sewer costs as incentives to lower water consumption. The sewer surcharge does not affect residential users, except food and fruit processors.

Other conservation measures being investigated include dual systems and cistern systems. Dual water systems utilize higher quality water for consumption and lower quality water for remaining needs. Cisterns collect and store rainwater, primarily in
areas where rainfall exceeds 50 inches per year. However, there are many health and operational problems that must be resolved before such systems can be promoted.

Restoration of dike storage by bulk-heading tunnels and decreasing withdrawals during wet weather could make available additional high level dike-confined water during dry periods.

Finally, the reuse of sewage effluent or other lower quality water for irrigation or other uses is a viable form of water conservation, since it decreases the need to pump higher quality water for this purpose. However, the plugging problem of using effluent in drip irrigation systems has to be resolved before this technique can be applied.

B. Secondary Impacts
1. Water Quality

Potential secondary impacts on ground water quality are related to the use of diluted sewage effluent for furrow or drip-irrigation of sugar cane. Since 1971, the University of Hawaii Water Resources Research Center (WRRC) has been conducting field studies of this method in
conjunction with the BWS, the City's Wastewater Management Division, Hawaii Sugar Planters Association (HSPA) and Oahu Sugar Company, Ltd.

Results indicate that with a dilution ratio of three parts water to one part secondary treated sewage effluent, the irrigation water meets the needs of sugar growers and meets State Department of Health regulations, which specify that sewage receive a minimum of secondary treatment before being used for irrigation. The final progress report notes the following [4.6]:

"The quality of percolate from the effluent-irrigated sugarcane-cultured soil is of acceptable concentration from the standpoint of groundwater quality protection with the only possible concern for nitrogen which sporadically exceeded the 10mg/l limit for drinking water during the first 6 to 7 months of growth. However, similar exceedance occurred in the ditch water irrigated sugarcane plots and the plots irrigated with effluent during the first year and ditch water during the second year."

It also states that:

"Both total dissolved solids and chloride in the percolates met the drinking water standards".

Presently, the primary problem is that diluted effluent clogs the holes in drip irrigation tubes over time, limiting its use for drip irrigation. Also, improper location of effluent
application can raise the TDS levels of Kunia and Hoaean Wells above the maximum level of 500 ppm.

2. Land Use

The 3 mgd to be developed initially is to provide water to approved developments. The remaining 6 mgd, which can be developed later, is to provide water for proposed development in the Ewa Plain area and to support current City and County land use plans and policies calling for planned growth in the Ewa region of Oahu.

Indirectly, impacts associated with this growth would primarily be impacts on population and infrastructure, and are discussed below.

a. Population

Based on a daily residential use of 500 gallons per dwelling unit, the 6 mgd could support approximately 12,000 units. Assuming 3.2 persons per unit, this would equal a population of 38,400 persons.

However, industrial and other urban uses would undoubtedly claim a portion of this water, thus the actual increase in population which could be served would likely be less than 38,400. Assuming 0.5 mgd goes to other uses, the "worst case"
(most) population accommodated would be 35,200. The total population then, which
could be served by the project (adding
the 3,200 to be served initially) would
be 38,400, or approximately 68% of the
Series II-F projected population increase
for the area.

The Environmental Assessment for the
proposed West Beach Resort notes that
Honouliuli Wells are one possible source
of water for the resort, the others being
existing plantations wells [4.7].

b. **Traffic**

Assuming a "worst case" condition,
or 35,200 persons accommodated by the
additional 6 mgd of water, and assuming
that metropolitan Honolulu remains the
major employment center for the Ewa area,
an increase in traffic on the H-1 Freeway
and Farrington Highway can be expected.

Traffic impacts due to potential de-
velopments in the Ewa-Waianae area are
shown in Table 4-2. Since the Makakilo
expansion is a residential subdivision
about 1/3 the size of the "worst case"
condition, tripling the increases associated
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<tbody>
<tr>
<td>(1) Waianae Coast</td>
<td>18,700</td>
<td>25,000</td>
<td>31,000</td>
<td>35,900</td>
<td>37,000</td>
</tr>
<tr>
<td>(2) West Beach</td>
<td></td>
<td>950</td>
<td>8,920</td>
<td>18,350</td>
<td>19,200</td>
</tr>
<tr>
<td>(3) Campbell Industrial Park</td>
<td>5,400</td>
<td>9,050</td>
<td>10,500</td>
<td>13,400</td>
<td>16,600</td>
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<tr>
<td>(4) Barbers Pt. Deep Water Harbor</td>
<td></td>
<td>2,050</td>
<td>3,450</td>
<td>5,600</td>
<td>7,000</td>
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<tr>
<td>(5) Makakilo</td>
<td>9,800</td>
<td>29,000</td>
<td>30,700</td>
<td>30,700</td>
<td>30,700</td>
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<tr>
<td><strong>TOTALS</strong></td>
<td>33,900</td>
<td>66,050</td>
<td>84,570</td>
<td>103,950</td>
<td>110,500</td>
</tr>
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</table>

**Source [4.8]:**

(1) State of Hawaii Department of Transportation 1978 volume shown is January 1977 traffic count and 1995 projection. Other traffic volumes for 1985 and 2000 were interpolated by HUD staff.

(2) EIS for West Beach prepared by Environmental Communications Inc.


(4) Reference (3) above and Barbers Point Harbor Final EIS prepared by Department of Army, U. S. Army Corps of Engineer District, Honolulu, July 1978.

(5) State of Hawaii, Department of Transportation Letter to Benjamin Lum, Department of Housing and Urban Development, dated February 10, 1978.

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with that development would give an example of the impacts that might be expected from the "worst case" condition.

There has been no attempt to translate these potential trips into vehicles per hour for a peak condition because there are so many variables that could influence the projections [4.8]. However, the increase due to the "worst case" condition would be likely to increase peak hour congestion on H-1, in the Pearl City area if not in Ewa. According to the State Office of Environmental Quality Control, the capacity of H-1 for the Ewa area is about 90,000 vehicles.

c. Liquid Waste

Assuming an average sewage flow of 100 gallons per capita per day, a population of 35,200 persons would generate approximately 3.5 mgd of flow.

The Honouliuli WWTP should have adequate capacity to accommodate an increase in flow of this magnitude. However, if the plant is not completed by the time the 6 mgd water goes on the line, developments
to be served would have to delay construction or install their own plants, such as has been done at Makakilo.

The projected de facto population to be served by the Honouliuli WWTP was 132,000 in 1970 and is now expected to increase to 226,800 in the year 2,000 [4.9]. The plant will have an initial capacity (25 mgd) to serve a population of 197,000 and will thus have to be expanded to serve the projected population of 226,800 people [4.10].

d. Solid Waste

Assuming a solid waste generation rate of 4 pounds per capita per day, a population of 35,200 persons would generate approximately 140,800 pounds per day of solid waste (70.4 tons per day). This would be approximately 13% of the daily capacity of Palailai Landfill.

Future solid waste will be disposed of at the Palailai Landfill and/or the new City and County sanitary landfill. The service life of both of these facilities will be shortened in direct proportion to the magnitude of the development. The
City and County Department of Public Works is also proposing a solid waste recovery plant, HPOWER, which may have a capacity to process up to 1800 tons of municipal solid wastes per day.

e. **Electricity**

Assuming an electricity use rate of 700 kilowatt hours (kwh)/month/unit in a residential area, the annual energy consumption of 12,000 units would equal 100,800,000 kwh/year.

While there will be no technical problems in supplying energy to the Ewa area, any future growth will put an increasing burden on the overall energy sources for Oahu. As the energy requirement is presently satisfied exclusively from fuel oil, consumption of this source will increase.

Coal is being considered as either a partial or a total substitute energy source for Oahu. Such a conversion would save money and oil but may increase air pollution.

In terms of mitigation, primary solutions to the long-term increase in energy consumption are to implement known conservation
measures and to develop new ones. In addition, new sources of energy should be investigated. Atomic energy would not be cost-efficient in Hawaii; however, geothermal, wind and solar energy show promise [4.11]. When inexpensive solar collectors can be mass produced and installed in private dwellings, an estimated 30% reduction in electric consumption may occur [4.12]. Finally, the City and County Department of Public Works is proposing a solid waste recovery plant, HPOWER, which would produce electricity as well. The capacity of the plant is presently unknown.

f. **Telephone**

Hawaiian Telephone Company is able to provide service to the project site after a satisfactory right-of-way is acquired.

g. **Schools**

As noted on Figure 2-12, future enrollments in the Ewa-Waipahu-Makakilo area are anticipated to exceed present capacities in some cases. However, the Department of Education's long-range capital improvements program (CIP) calls for the construction
of several improvements and new schools in the Waipahu-Ewa-Makakilo area. For example, Ewa Intermediate-High is planned to be operational in 1982-1987, with a projected 1995 enrollment of 2,200. These plans are elaborated on in the Environmental Impact Statements for Village Park and Makakilo [4.13, 4.14].

In addition, long range plans include possibly purchasing 200 acres of land at the intersection of Fort Weaver Road and Farrington Highway for a four-year college. This addition to the University of Hawaii would serve 7,500 students and would include dormitory facilities.

It appears likely, then, that there would be no significant impact on educational facilities in the area if further growth were to occur, other than the increased public costs that would be necessary to build, staff and maintain the new schools.

h. Police

A population of 35,200 persons would generate a need for an additional 74 police officers, based on a service ratio of 2.1
officers per 1,000 persons. The additional manpower needed, as well as support personnel and equipment, would be an added public cost but would provide some job opportunity.
i. Fire

The existing fire station at Makakilo can provide adequate fire protection to the existing subdivision and its future expansion. However, as the surrounding commercial and industrial areas develop, additional fire stations will be required, resulting in increased public costs but some job opportunity.

j. Medical

The present health care system in central Oahu appears adequate to serve the proposed Makakilo expansion [4.15]. However, the long-term adequacy of this system will be negatively impacted by cumulative growth in the area, including Village Park. The additional facilities, staffing and operating funds necessary to provide adequate medical care will result in increased public costs but some job opportunity.

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k. **Parks and Recreation**

City Ordinance #4621 requires the dedication of park lands within residential developments. Thus, the estimated 12,000 units in our example would require approximately 96 acres of park land to be dedicated, based on 350 square feet of park land per single family unit, or 30 acres based on 110 square feet per townhouse unit.

However, the residents will undoubtedly also use the beaches and other parks in the vicinity, which are already heavily used. Thus, adverse impacts can be expected with regard to these facilities, which would result in increased public costs for maintenance.

1. **Agriculture**

By providing water to urban developments it has been suggested that the project could indirectly impact agriculture by putting those urban developments into competition with agricultural enterprises for available land on the Ewa Plain. This is an issue which will have to be addressed by all government agencies, pursuant to
C.1.4. of the Honolulu General Plan (refer to page 3-5).

Based on BWS water consumption guidelines (Table A-9), the industrial or commercial use (0.5 mgd) in our example would require about 125 acres and the residential use (5.5 mgd) would require 1,375-2,200 acres of land (depending on multifamily or single family use). Assuming an average of 1,788 acres were necessary for residential use, a total of 1,913 acres would theoretically be required for urban development (assuming no agricultural use of the available water).

Since about 1,336 acres of vacant privately-owned land are already zoned for urban use in the Ewa Development Plan Area (Table 2-7), up to 577 acres might theoretically have to be rezoned, most likely from agriculture. (In 1978 there were 5,211 acres of vacant usable privately-owned land zoned for agriculture in the Ewa area). However, some of the water will undoubtedly serve urban development on publicly-owned land. Thus, it is possible that no land would need to be rezoned.
By providing water in trade to Oahu Sugar Company, the BWS believes it will mitigate impacts on agriculture to the maximum extent possible given its jurisdiction.
REFERENCES TO SECTION 4


[4.2] Ibid. [4.1]


References to Section 4, (cont'd)


Probable Environmental Effects
SECTION 5

PROBABLE ADVERSE ENVIRONMENTAL EFFECTS
WHICH CANNOT BE AVOIDED

This section will briefly discuss probable adverse environmental impacts and mitigative measures, when applicable, and the rationale for proceeding with the proposed action, notwithstanding unavoidable effects.

I. PRIMARY SHORT-TERM IMPACTS

A. Probable Impacts and Mitigative Measures

During construction of the wells, control station, access road and transmission line, there will be an increase in existing noise. As stated in Section 4, however, the level for the loudest activity should be less than 68-74 dBA at the nearest residence. This will be of short duration, lasting only for the construction period, and can be mitigated by the contractor ensuring proper functioning of mufflers on equipment and by limiting the hours of construction, if necessary.

Construction of these facilities may also result in short-term increases in fugitive dust, which is expected to be comparable to, if not less than, cane harvesting activities experienced regularly in this area. If dust should be a serious problem it will be mitigated by water sprinkling.
During development of the access road and transmission line there will be minor disruption to traffic patterns on Kunia Road, Farrington Highway, and the cane haul roads, lasting only for the duration of these construction phases. It should not result in significant adverse impacts with proper direction of traffic and coordination of construction with appropriate agencies and companies.

Although emissions from construction vehicles are inevitable, the expected level of emissions should be insignificant and are not anticipated to result in adverse environmental impacts. They will last only for the duration of construction.

Construction of the transmission line along Honolulu Stream should be a minor source of sediments with proper construction practice during trenching and filling. If necessary, siltation basins will be provided.

Some clearing and grubbing are necessary for site preparation, but vegetation at the site is not considered rare or endangered and most are exotic common species. This site also does not provide critical habitat for native fauna species. Denuded portions will be revegetated after construction.

Although fauna species present at the site will relocate to adjacent lands during construction,
they will be able to return to the site after construction has been completed. Species to be affected are common to agricultural and urban areas and the small numbers that will relocate are not expected to significantly affect the existing faunal community.

B. Reasons for Proceeding

The probable short-term adverse impacts encountered during the construction phase of the proposed project are minor and acceptable mitigative measures will be taken.

II. PRIMARY LONG-TERM IMPACTS

A. Probable Impacts and Mitigative Measures

Of concern is the effect the proposed wells will have on water levels of existing wells in the immediate vicinity of the project site. These existing wells will be closely monitored and appropriate mitigative measures will be taken in the operation of the Honolulu Wells to alleviate adverse impacts.

It is not anticipated that draft from the new wells will significantly impact the location of the transition zone or cause an increase in chloride content of the other wells in the vicinity, since net draft from the aquifer will not increase. However, if this were to occur, the situation could be mitigated through adjustments in operations of the new wells.
In addition to the above precautions, the proposed wells must be approved by the State Board of Land and Natural Resources prior to construction. Subchapter 5 - Permits To Use Water In Designated Areas, of Chapter 166 of Title 13 13-166-22 states, in part, that:

§13-166-22 Use permit required. In a designated water control area, no withdrawal of water nor any well or other works for withdrawal shall be constructed until an application for a permit to use the water has been filed and a permit issued by the board as provided in §177-10, Hawaii Revised Statutes. [Eff. June 22, 1981] (Auth: HRS §177-7) (Imp: HRS §177-19)

§13-166-23 Applications for use permit; filing fee. (a) A person shall file an application with the board to withdraw ground water within a designated ground water control area. No withdrawal of water shall be made by the applicant until receipt of a permit issued by the board.

The BLNR must also approve any water exchange agreements between the BWS and Oahu Sugar Company.

Finally, maintenance of the well system will require a commitment for the duration of its use.

B. Reasons for Proceeding

Development of any new water source will have environmental costs as well as benefits, and it is the professional opinion of the BWS that potential impacts associated with draft from Honouliuli Wells
will be sufficiently minor to warrant proceeding with the project in this case. Careful monitoring of the other wells in the vicinity of the site will continue.

Although development of the wells will require commitment of funds, the relative cost is low compared to most of the other alternatives. Further, it is BWS policy to optimize development of Oahu's ground water resources before proceeding with other alternatives. This reason is elaborated in Section 6.

Several characteristics of basal water make this alternative desirable. Basal water is readily accessible in many parts of the islands, little water is lost through evaporation, no construction is required to provide storage capacity, and water is of good quality, requiring no treatment [5.1].

III. SECONDARY IMPACTS

A. Probable Impacts and Mitigative Measures

As previously stated, the BWS plans to develop the proposed wells if a water exchange agreement can be negotiated with Oahu Sugar Company. This involves a one-to-one exchange of Oahu Sugar's ground water pumpage with water of lesser quality. The secondary impact associated with exchange of lesser
quality water is the potential impact this lesser quality water may have on the ground water's quality. However, results of research conducted on recycling sewage effluent for irrigation indicate that with a dilution ratio of three parts water to one part secondary treated effluent, the irrigation water meets State Department of Health regulations.

B. Reasons for Proceeding

The development is proposed to provide necessary support requirements of the goals and objectives of the City and County of Honolulu's General Plan, which calls for growth in the Ewa area. Associated with this growth are some potential adverse impacts to support services. These include increased traffic and load on existing roadways, waste disposal concerns, energy concerns, load on existing parks, needs for schools, and increased demands on existing emergency services. With careful planning, however, improvements and new facilities and service can be provided to assist this growth.
REFERENCES TO SECTION 5

Alternatives
SECTION 6
ALTERNATIVES TO THE PROPOSED ACTION

I. NO ACTION

A no action alternative would result in no development of the Honouliuli Wells by the Board of Water Supply. Approximately 0.6 mgd excess exists within the present system, but it would not be enough to satisfy the current needs of the Campbell Industrial Park and Makakilo expansions, nor will it meet the support needs of the other 1,495 acres of vacant land zoned urban within the Ewa area.

Although alternate water sources are being seriously investigated, feasible sources, such as desalinization, are not presently considered to be cost effective nor technologically reasonable. (A discussion on alternate water sources is presented later in this section). The BWS plans to optimize development of ground water sources on Oahu to meet existing demands and needs for the near future.

Water from other existing sources could not be delivered to the Ewa area without a simultaneous decrease in amounts allocated to existing users.

II. RESCHEDULING THE ACTION

Well development could be postponed for at least another year or two, or until an acceptable water exchange
has been developed for the sugar industry. However, as previously mentioned, the main problem with using sewage effluent for drip irrigation involves clogging of the drip irrigation lines. Since at least two years are required before the water can go on line after the wells are drilled and it is possible that the remaining problems with drip irrigation could be solved by that time, postponing development until the problem is resolved would only add unnecessary delays to the project. This would primarily cause delays in serving the future users, particularly Campbell Industrial Park and Makakilo. In addition, sewage effluent may be used for furrow irrigation as well.

III. ALTERNATIVE SITES

There are no alternative sites as desirable or available for the proposed project. Wells to be drilled in the Makaha and Waianae Valleys are to provide water for the Waianae Coast and to reduce or eliminate export of water from the Pearl Harbor District. Thus, these sites cannot be considered as alternatives to the Honouliuli Wells.

The proposed location has been situated to have the least geohydrological effect on adjacent existing water sources, such as Kunia Well I and II and Oahu Sugar's
Ewa Shaft. Thus, other locations in the general vicinity of the proposed site would be less desirable.

IV. ALTERNATIVE ALIGNMENT

One alternate alignment for the transmission line was examined and rejected. The line would have gone east from the wells to Kunia Road, south on Kunia Road to Farrington Highway, and west on Farrington Highway to the Honorouliuli booster station. This alignment was the least favored because it would have involved greater traffic interruptions on the highways concerned and noise impacts. It was finally rejected after the State Department of Transportation (DOT) indicated that the alternate alignment would conflict with the completion of the new Kunia Interchange.

V. ALTERNATIVE WATER SOURCES

A. Water Exchange Program

This program would consist of an exchange of water between Oahu Sugar Co. and the Board of Water Supply. A transfer of preserved use will be arranged so that there will be no net increase of pumpage from the Pearl Harbor Groundwater Control Area. Presently, Oahu Sugar is pumping for sugar cane irrigation approximately 7 mgd of water that meets the acceptable chloride concentration levels for drinking water. The BWS would trade water of lower quality
for this potable water on an agreed basis. The lower quality water for exchange would come from any of the potential sources listed below. In addition, another 20 mgd of slightly brackish water 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]**

   According to the EIS for the Mamala Bay Wastewater Treatment and Disposal System, the Honouliuli Wastewater Treatment Plant is estimated to treat 25 mgd of sewage by the year 1990. The Mililani Wastewater Treatment Plant is anticipated to treat about 8 mgd at the same time for a total of 33 mgd available for the exchange program, if it is found to be cost effective. The amount of sewage effluent that could be diverted for the water exchange proposal will depend on the amount that Oahu Sugar Company would accept for irrigation. The effluent would be mixed with higher quality water on a ratio of one part effluent to three parts water and then used for drip or furrow 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 to Pearl Harbor. The effluent mixture from this plant will be used in irrigation mauka of the H-1 Freeway, as shown in Appendix J.

The Honouliuli WWTP is the other sewage treatment plant besides Makakilo WWTP 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, makai of Ewa Village. The treated effluent from Honouliuli WWTP could be used in irrigation makai of the H-1 Freeway, as shown in Appendix J.

The cost of supplying the sewage effluent has been estimated at $.09 per thousand gallons for the Miliiani STP and $.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].

It should be noted that sugar cane is not the only crop that can be irrigated with sewage effluent. Forage crops can also be irrigated with effluent, remove a large portion of the nutrients, and can be used for ground water recharging.
This alternative will require the approval of the City Department of Public Works.

2. **Pearl Harbor Springs** [6.4]

The average discharge of water of low salinity from Pearl Harbor Springs, free flowing artesian sources, and other leakages is approximately 55 mgd [6.5]. About 25 mgd of this is from Pearl Harbor Springs. About 12 mgd of the total discharge is pumped to sugar cane fields, and the remaining estimated 43 mgd discharges into the sea. Thus, pending DLNR approval, only a portion of this water could be economically 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 have been and still are used for irrigation. To improve the use of the springs for sugar cane irrigation, these waters must be collected and pumped westward to the cane growing areas.

A more feasible scheme would also encompass an integrated pipeline pumping system involving all three spring areas and two surface streams -- Waikie and Waiawa. Assuming that the pumping
installations are sized to accommodate the lower flows expected during the summer months, up to 33 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 per thousand gallons [6.6].

Diverting spring and stream waters in this area may impact water quality in Pearl Harbor. A feasibility study is being conducted by the BWS to evaluate the impacts and potential impacts will be addressed prior to pursuing this alternative.

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 Waikiki Stream. 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. The dam would be designed to prevent adjacent lands from becoming inundated.

To deliver the stored flood water, an intake structure pumping station and pipeline would be required. Delivery of this source of water to the Waikele area would require a pipeline 16,500 feet long. Consequently, this would be a relatively expensive source, at $.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.

Important environmental concerns include preventing eutrophication of the Loch, maintaining the oyster beds, and maintaining habitat necessary to the life cycle of endemic fish and crustaceans. Goby (Awaous stamineus) and Hawaiian prawn (Macrobrachium grandimanus), which are diadromous, are both found in Waikele Stream [6.9].
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 sugar cane. About 25 mgd is presently being drafted from this area for irrigation, and there may not be any additional water to develop.

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 generally ranges from 1000 ppm or less to 2000 ppm and total dissolved solids (TDS) up to 4000. 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 [6.10]. 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 [6.11]. A 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% of the dissolved solids in the feed water. Pre-treatment 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 [6.12].

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 [6.13].

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

2. **Reverse Osmosis** [6.14]

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 pre-treated 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 a mechanical force is required for its operation.
PRINCIPLES OF OSMOSIS AND REVERSE OSMOSIS

SOURCE: WRC TECHNICAL REPORT #72.
CONCEPTUAL DESIGN
REVERSE OSMOSIS SYSTEM

SOURCE: WRRC TECHNICAL REPORT #73.
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 20-30% 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.

6-16
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 increases to about 600 kw per mgd for high concentration feed waters. The higher the recovery ratio, the less the energy required per unit volume of production since less pressure is required.

The major maintenance cost is the high pressure pump, which should be provided as multiple parallel pumps with stand-by 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 [6.15].

Four reverse osmosis pilot units have been tested on Oahu at the following locations: Miliilani Sewage Treatment Plant, Wahiawa Sewage Treatment Plant, Well 82-ZA (located on the Diamond Head side of the Neal S. 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 ground water from both basaltic and reef limestone aquifers were then field tested at 600 psig operating pressure [6.16].

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 de-salting 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 [6.17].

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 [6.18]. Capital and operating costs of a like-sized electrodialysis plant are comparable. If Waiau and Waiawa springs were used as sources (with 1000 TDS), a 10 mgd reverse osmosis plant could operate at about $0.25 to $0.30 per 1,000 gallons [6.19].

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
<table>
<thead>
<tr>
<th>Consideration</th>
<th>Electrodiagnosis (ED)</th>
<th>Reverse Osmosis (RD)</th>
</tr>
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<tbody>
<tr>
<td>Stage of Demonstration</td>
<td>Up to 2 MGD, less than 10 years</td>
<td>Up to 4 MGD, less than 5 years</td>
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<tr>
<td>Design and Construction</td>
<td>1-2.5 years based on size</td>
<td>1-2.5 years based on size</td>
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<td>Period</td>
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<tr>
<td>Land Requirement</td>
<td>.4-.4 acres</td>
<td>.7-.8 acres</td>
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<tr>
<td>TDS Range</td>
<td>Low TDS</td>
<td>Greater than ED</td>
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<tr>
<td>Removal Capability</td>
<td>Limited to 50% per pass</td>
<td>Up to 99% per pass, removes organics</td>
</tr>
<tr>
<td>Sensitivity to Operating</td>
<td>High (voltage, pH, flow, concentration)</td>
<td>Low</td>
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<td>Conditions</td>
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<td></td>
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<tr>
<td>Pretreatment</td>
<td>Med. requirement</td>
<td>Modest to extensive</td>
</tr>
<tr>
<td>Production Rate</td>
<td>Slight decrease with time</td>
<td>Decrease with time</td>
</tr>
<tr>
<td>Waste Disposal</td>
<td>Lesser problem</td>
<td>Lesser problem</td>
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<tr>
<td>Mechanical problems</td>
<td>Some</td>
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<tr>
<td>Corrosion</td>
<td>Very little</td>
<td>Very little</td>
</tr>
<tr>
<td>Scaling</td>
<td>May limited recovery</td>
<td>May limited recovery</td>
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<tr>
<td>Field Cleaning</td>
<td>Easy equipment disassembly</td>
<td>In-site chemical cleaning</td>
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<tr>
<td>Water Temperature</td>
<td>Ambient</td>
<td>Ambient</td>
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<tr>
<td>System Complexity</td>
<td>Medium</td>
<td>Low</td>
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<tr>
<td>System Pressure (leakage)</td>
<td>Low</td>
<td>High, leakage problem</td>
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<tr>
<td>Energy demand</td>
<td>8,000 kwh/mgd, direct proportion to TDS</td>
<td>400 kwh/mgd, increases somewhat with TDS</td>
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6-20
<table>
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<tr>
<th>Consideration</th>
<th>Electrodialysis (ED)</th>
<th>Reverse Osmosis (RO)</th>
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<tr>
<td>O &amp; M Cost</td>
<td>Least up to 4 mgd</td>
<td>1.2-1.6 times ED up to 4 mgd</td>
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<tr>
<td>Capital Cost</td>
<td>Least of all methods</td>
<td>1-1.5 time ED</td>
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<tr>
<td>Unit Water Cost</td>
<td>Low for low TDS</td>
<td>In range of ED</td>
</tr>
</tbody>
</table>

\(^1\) Based on low TDS and plant size of 0.5 to 20 mgd

Source: [6.11]
property in Waiau, the plant would operate from two to three years and will provide the Board with realistic costs of constructing and operating a desalination 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 water rates will have to be restudied and may increase.

C. Surface Water [6.20]

In the past surface streams on Oahu have not been used for domestic sources due to readily available, reliable, high quality ground water sources. 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 ground water and thus present the potential of ground water 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 ground water development. After all the ground water potentials have been developed, the remaining streamflow can be developed via treatment plants.

In the case of Kahana Stream, the State is planning a regional park encompassing the entire valley. Present BWS ground water development plans in Kahana are oriented entirely on the northwest side of the valley. After ground water is fully developed, stream flow should be monitored for a few years to determine the residual flow. Only then would the treatment of Kahana Stream flow be considered. Preliminary sites for diversion and treatment plants have been selected but close coordination
with State park planning will be necessary to avoid future problems. It should be noted that Kahana and Punalu'u Streams are included in the Nationwide Rivers Inventory which recognizes the scenic and historic value of the streams.

Punalu'u Stream also offers ground water development potentials, and stream development should await further study of this potential.

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 Opa'au 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 about 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 could 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 typical stream valley shows a narrow elongated valley floor covered with relatively impervious strata and 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 (15,000-20,000 ppm). Numerous studies have shown the cost of desalting sea water to be two to three times as much as desalting brackish waters [6.21]. 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 viable, but expensive.

E. **Wastewater Reclamation** [6.22]

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 but the necessity for these two cases has long since passed. Direct reuse is presently practiced 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. As mentioned on page 6-4, approximately 20 mgd may be available, via a water exchange program.

G. **Individual Demineralization Units [6.23]**

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.
REFERENCES TO SECTION 6


[6.12] Ibid. [6.10].


[6.17] Ibid. [6.15].


Short Term Uses · Long Term Productivity
SECTION 7

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

This section will include a brief discussion
of the extent to which the proposed action
involves trade-offs between short-term
environmental gains at the expense of long-
term losses, or vice versa, and a discussion
of the extent to which the proposed action
forecloses future options, narrows the
range of beneficial uses of the environment,
or poses long-term risks to health or safety.

Development of Honouliuli Wells, according to con-
straints imposed by the BWS and in conformance with the
new Chapter 166 of Title 13 should not result in long-term
adverse impacts to the Pearl Harbor ground water aquifer.
Development of these wells will rely on an agreement with
Oahu Sugar Company to exchange their current ground water
pumpage with lesser quality water for their irrigation
purposes. Therefore, development of these wells will
not result in a net increase in current withdrawal from
the aquifer.

Until pilot studies on development of alternate water
sources are complete, ground water development will have
to be optimized to meet current and near future water
demands of planned growth for this region of Oahu. The
water exchange with Oahu Sugar is an attempt to optimize
use of existing water sources and current economically
feasible alternatives.
Optimizing current options will provide the BWS with the time required to develop alternate potable water sources. Current estimates are that it will be another 20 years before feasible alternates will be available.

The wells will be carefully monitored to determine their effect on the aquifer and surrounding wells. The project, therefore, will not narrow the range of beneficial uses of the environment or pose long-term risks to health and safety.
Commitment of Resources
SECTION 8

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

This section considers the commitment of resources that is made once the project is implemented.

City and County and private funds, labor, construction and building materials, and fuel will be committed to the project. Additional maintenance and operation, manpower, and funds will be required. As previously stated, the designed operating capacity of the wells will be about 9 mgd. Initially, 3 mgd is to be developed to supply the needs of the approved expansions of Makakilo and of Campbell Industrial Park. The remaining 6 mgd are to be provided for future approved projects and to supply the needs current land use plans and policies designated for this region of Oahu.

Development of the 9 mgd of water is contingent upon a water exchange agreement with Oahu Sugar Company, whereby they will decrease their withdrawal by the same amount in exchange with water of less quality but suitable for irrigation. Therefore, there will be no net increase in commitment of water since that amount is currently committed for use. The water exchange with Oahu Sugar will enable them to maintain current irrigation flows while enabling the BWS to optimize ground water development for domestic use.
Government Policies to Offset Adverse Effects
SECTION 9

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

As indicated in Section 4, Anticipated Environmental Impacts and Mitigative Measures to Minimize Adverse Impacts, most of the adverse impacts are short-term and related to construction activities. Those impacts which are long-term are primarily secondary, or indirect, and are related to the effects of the wells on the ground water aquifer. In accordance with agreements with Oahu Sugar Company, there will be no net increase in ground water withdrawal from the Pearl Harbor aquifer. The agreements will still provide Oahu Sugar with the same amount of irrigation flow with nonpotable water suitable for irrigation. The BWS will then have use of approximately 9 mgd total potable ground water to meet current and future water demands and to comply with current land use plans and policies for this area, as designated by the City and County of Honolulu’s General Plan of 1977.
Approvals
SECTION 10
LIST OF NECESSARY APPROVALS

1. City and County grading permit, grubbing permit, stockpiling permit, and building permit.

2. Construction permits will be required from the Highways Division, State Department of Transportation, for any work which falls within a State highway right-of-way.

3. Compliance with Section 29 of Chapter 49, Public Health Regulations, which requires approval of the Director of Health prior to use of any new source to serve potable water.

4. Compliance with Chapter 166 of Title 13 of the State Department of Land and Natural Resources, which requires approval of the Board of Land and Natural Resources prior to construction of "any well or other works" for withdrawal of water within a Designated Ground Water Control Area.

5. State Special Permit.
Organizations and Persons Consulted
SECTION 11

ORGANIZATIONS AND PERSONS CONSULTED
DURING THE NOP CONSULTATION PROCESS

The following list includes those agencies and organizations to whom Preparation Notices were sent or comments received during the review process. Those with an asterisk sent in written comments, and the comments and corresponding responses are presented on the indicated pages.

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<td>Department of Transportation Services</td>
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<th>OTHER</th>
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<td>Alu Like</td>
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<tr>
<td>Dr. Bryce Decker</td>
<td></td>
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<tr>
<td>* Ewa Neighborhood Board</td>
<td>11-31</td>
</tr>
<tr>
<td>* Hawaiian Electric Company, Inc.</td>
<td>11-32</td>
</tr>
<tr>
<td>* Hawaiian Telephone Company</td>
<td>11-33</td>
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</tbody>
</table>

11-la
<table>
<thead>
<tr>
<th>OTHER, Continued</th>
<th>PAGE</th>
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<tbody>
<tr>
<td>Honolulu Gas Co., Ltd.</td>
<td></td>
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<td>Legal Aid Society of Hawaii</td>
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<tr>
<td>Mililani Town, Inc.</td>
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<tr>
<td>Oahu Sugar Company, Ltd.</td>
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<td>Pearl City Neighborhood Board</td>
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<td>The Estate of James Campbell</td>
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<tr>
<td>Waianae Coast Neighborhood Board</td>
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<tr>
<td>* Waipahu Community Association</td>
<td></td>
</tr>
<tr>
<td>Waipahu Development Plan Ad Hoc Committee</td>
<td>11-37</td>
</tr>
</tbody>
</table>

11-1b
Dear Mr. Hayakawa:

Thank you for allowing the U.S. Army Corps of Engineers to review and comment on the Notice of Preparation for Honolulu Wells Environmental Impact Statement. Our comments are provided as Enclosure 1.

Sincerely yours,

[Signature]

Chief, Engineering Division

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DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, HONOLULU

Review Comments
for
Notice of Preparation for Honolulu Wells
Environmental Impact Statement

Item Part
1 1-7 A map is needed to understand the description of the
   1-9 Oahu-Waianae District water supply system.
2 1-18 Line 21: The sources noted are not identified in Figure
   2-6 in Section 2.
3 Table 1-5 The following items are not shown in the cost estimates:
   a. access road
   b. booster station
   c. power lines
   d. fencing
   e. landscaping
   f. maintenance costs
4 2-22 Para 2: These water quality standards have been super-
   2-4 ceded by the Water Quality Standards of Chapter 37-A, as
   amended, 6 September 1979. Change this paragraph to
   conform to new standards.
5 2-30 Suggest providing an equivalent noise level that a layman
   can relate to, i.e., 40-45 db is the equivalent noise
   level of a quiet room in a residential area at night.
December 4, 1979
KAZU HAYASHIDA
Manager and Chief Engineer

Mr. Kisuk Chung
Chief, Engineering Division
U. S. Army Engineer District,
Honolulu
Department of the Army
Building 230
Fort Shafter, Hawaii 96850

Dear Mr. Chung:

Subject: Your Letter of November 30, 1979, on the Honolulu Welle Environmental Impact Statement Preparation Notice

Thank you for reviewing our environmental document. Your comments will be addressed in the environmental impact statement. Should you have questions or require additional information, please call Lawrence Wang at 548-5221.

Very truly yours,

Kazu Hayashi
Manager and Chief Engineer

cc: Environmental Impact Study Corp.
Mr. Kane Hasekado
Manager and Chief Engineer
Honolulu Board of Water Supply
630 South Beretania Street
Honolulu, Hawaii 96813

Dear Kane:

Attached are the comments made by my staff on the EIS preparation notice for the Honolulu Wells. I hope they will be useful in the preparation of your final environmental impact statement.

Thank you for giving us an opportunity to comment on this document.

Aloha,

Benjamin L. Jones
District Chief

Attachment

Comments on Notice of Preparation of Environmental Impact Statement
Honolulu Wells

Page 1-15
Para. 2
Line 1-3
This cyclic mode of operation is generally considered to be a bad technique from a standpoint of transition zone mixing as was indicated on page 2-16. Unless there is a compelling reason to operate in this way, it might be better to have two 3 mgd wells with one acting as standby.

Page 1-15
Para. 5
Line 1-4
Tradeoffs with reduced pumping for irrigation must take into account the fact that the water qualities in question might not be the same as the fact that under present irrigation techniques, about half of the water is returned to the ground water system. This figure should be 2.7.

Page 2-8 and figure 2-5
Para. 6
Line 2-11
A geologic profile drawn normal to the Waimanalo slope suggests that the bottom of the Koolau Tertiary is at about 200 feet below sea level rather than the approximately 600 feet indicated in the text or the approximately 1,000 feet indicated on figure 2-5.

Page 2-12
Para. 2 and 3
Line 2-12
The annual peak discharges shown are instantaneous peaks.

Page 2-12
Para. 4
Line 2-13
The drainage area is 45.7 square miles.

Page 2-12
Para. 4
Line 2-13
The upper layer of water is also overlain by a lower quality return irrigation water of unknown thickness. This may or may not be suitable for domestic use.

Page 2-12
Para. 4
Line 2-13
The thickness of the fresh water body may be correct but not all of it may be contained within the Koolau volcanic series.

Page 2-13
Para. 3
The wording of this paragraph would indicate that return irrigation water increases the capacity of the aquifer to store and transmit water.
<table>
<thead>
<tr>
<th>Page</th>
<th>Para.</th>
<th>Line</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-14</td>
<td>1</td>
<td>5</td>
<td>This discussion is misleading as is figure 2-6. Although the entire area is underlain by basal water, the characteristics of these basal water bodies in relation to land and therefore lens thickness are quite different.</td>
</tr>
<tr>
<td>2-14</td>
<td>2</td>
<td>4-7</td>
<td>Minimum heads are about 11 foot near the Pearl Harbor Springs.</td>
</tr>
<tr>
<td>2-18</td>
<td>5</td>
<td></td>
<td>Our data indicate that water levels in the Pearl Harbor area, especially in the east side have declined progressively since 1910 at a rate of about 1/10th foot per year.</td>
</tr>
<tr>
<td>2-19</td>
<td></td>
<td></td>
<td>Present artificial discharge from Pearl Harbor basin is approximately 40 gpm. Total discharge of pumping plus natural flow is approximately 275 gpm. The State Water Commission reports gave a range in sustainable yield of 200 to 245 gpm.</td>
</tr>
<tr>
<td>2-24</td>
<td>1</td>
<td>2-10</td>
<td>Although chloride are well within limits, total dissolved solids in some cases approach the limits of acceptable water quality. Other constituents also will enter into the long-term acceptability of these sources.</td>
</tr>
<tr>
<td>2-21</td>
<td>3</td>
<td>1-2</td>
<td>Irrigation with brackish water maybe a major source of contamination of the basal lens.</td>
</tr>
<tr>
<td>2-25</td>
<td></td>
<td></td>
<td>Alkalinity and hardness should be shown as their chemical equivalents (CaCO₃, etc.).</td>
</tr>
<tr>
<td>2-26</td>
<td></td>
<td></td>
<td>Units for turbidity and color should be shown and the nitrate oxidation state should be indicated.</td>
</tr>
<tr>
<td>4-11</td>
<td>1 and 2</td>
<td></td>
<td>We agree that careful monitoring will be necessary to determine the effects of pumping in Homestead and other wells in the vicinity. The likelihood is that there will be some impact. Even increased chlorides in the irrigation water would have a cumulative impact if that water were used to irrigate land from the caprock.</td>
</tr>
</tbody>
</table>

This discussion presents a confusing array of possible mixes of water use particularly on Page 4-20, paragraph 3. The discussion does not take into account the additional sewage effluent to be used for irrigation. The discussion also seems to indicate that only drip irrigation would be used for returning sewage effluent of. In fact, furrow irrigation may be the best way to apply much of this water. To some extent this discussion is mixing apples and oranges because much of the water that is being discussed for irrigation is not potable.
4. A geologic profile drawn normal to the Kealian slope suggests that the bottom of the Koolau low is at about 100 feet below sea level rather than the approximately 600 feet indicated in the text or the approximately 1,600 feet indicated on Figure 2-5. (p. 2-8)

The label of Figure 2-6 is for descriptive purposes only. The dimensions are not exact. (p. 2-11)

5. The annual peak discharges shown are instantaneous peaks. (p. 2-11)

The EIS will be corrected to indicate the flows are the maximum instantaneous peak discharges. (p. 2-12)

6. The drainage area is 45.7 square miles. (p. 2-12)

We concur. The EIS will be corrected. (p. 2-12)

7. The upper layer of water is also overlain by a lower quality return irrigation water of unknown thickness. This may or may not be suitable for domestic use. (p. 2-12)

The EIS will be corrected to indicate that the upper layer of groundwater is return irrigation water of a thickness ranging up to 100 feet. This return irrigation water is usable for domestic use. (p. 2-13)

8. The thickness of the fresh water body may be correct but not all of it may be contained within the Koolau volcanic series. (p. 2-12)

Data from drilling and geophysical logs indicate that the fresh water is in the Koolau volcanic series. (p. 2-12)

9. The wording of this paragraph would indicate that return irrigation water increases the capacity of the caprock to store and transmit water. (p. 2-13)

The paragraph will be worded.

We concur. The correction will be made in the EIS.
10. This discussion is misleading as is figure 3-4. Although the entire area is underlain by basal water, the characteristics of these basal water bodies in relation to head and therefore lens thickness are quite different. (p. 2-14)

We assume that lens thickness as determined by local heads and arid area expansions are variable.

11. Minimum heads are about 11 feet near the Pearl Harbor Springs. (p. 2-14)

Heads around springs are drawdown or discharge heads.

12. Our data indicate that water levels in the Pearl Harbor area, especially in the east side, have declined progressively since 1910 at a rate of about 1/10th foot per year. (p. 2-18)

The average head loss over a long term trend shows a progressive decline in heads, but this is not true when viewed over a shorter period.

13. Present artificial discharge from Pearl Harbor basin is approximately 240 mgd. Total discharge of pumping plus natural flow is approximately 215 mgd. The State Water Commission report gave a range in sustainable yield of 200 to 225 mgd. (p. 2-19)

The SIS will be reword to indicate the total discharge and the range of the estimated sustainable yield from the Pearl Harbor Basin.

14. Although chlorides are well within limits, total dissolved solids in some cases approach the limits of acceptable water quality. Other constituents also enter into the long term acceptability of these sources. (p. 2-24)

No comment with your comments. The section will be revised to indicate other constituents also determine the acceptability of the source, especially total dissolved solids (limit = 500 ppm).

15. Irrigation with brackish water maybe a major source of contamination of the basal lens. (p. 2-24)

Brackish water may be a major source of degradation of the basal lens. We refrain from using the word contamination in this instance since it implies to make something impure. However, slightly brackish water could still be used for domestic consumption.

16. Alkalinity and hardness should be shown as their chemical equivalents (CaCO₃, etc.). (p. 2-25)

Alkalinity and hardness are always assumed to be expressed in terms of CaCO₃.

17. Units for turbidity and color should be shown and the nitrates oxidation state should be indicated. (p. 2-26)

The units for turbidity, color, and nitrates will be shown in the SIS as:

1. Turbidity: nephelometric turbidity units
2. Color: parts per million
3. Nitrates: mg/L.

18. We agree that careful monitoring will be necessary to determine the effects of pumice in Honouliuli and other wells in the vicinity. The likelihood is that there will be some impact. Even increased chlorides in the irrigation water would have a cumulative impact. If that water were used to irrigate inland from the caprock. (p. 4-11)

We assume that increasing chlorides in the irrigation water would have a cumulative impact. If the water used for irrigation would decrease the amount of brackish water used for irrigation would decrease and result in improved water quality.
Mr. Benjamin L. Jones  
January 17, 1980

Page 5

19. This discussion presents a confusing array of possible mixes of water use particularly on Page 4-20, paragraph 3. The discussion does not take into account the additional sewage effluent to be used for irrigation. The discussion also seems to indicate that only drip irrigation would be used for returning sewage effluent of, in fact, furrow irrigation may be the best way to apply much of this water. To some extent this discussion is mixing apples and oranges because much of the water that is being discussed for irrigation is not potable. (p. 4-19, 20, 21)

Oahu Sugar Company has not yet made any firm commitment to use treated sewage for furrow irrigation.

Presently, the City’s Department of Public Works is negotiating with Oahu Sugar Company on the use of treated sewage.

Also, Oahu Sugar Company has made a commitment to convert all of its fields to drip irrigation except for those fields receiving well water. So far, the research project at the City’s Million Sewage Treatment Plant indicates that it is not feasible to use secondary treated sewage to drip irrigation systems.

We agree that the water being discussed is not potable and we will consider deleting this portion of the discussion on recharge.

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

Very truly yours,

[Signature]

Eldu Hayashida
Manager and Chief Engineer

cc: Environment Impact Study Corporation
December 4, 1979

Mr. Kozo Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
615 South Beretania St.
Honolulu, Hawaii 96813

Dear Mr. Hayashida:

Subject: Notice of Preparation for Honolulu Molii Environmental Impact Statement

We reviewed the subject notice and have the following comments:

The proposed project area is located on land that is classified as prime agricultural land. Prime agricultural land is defined as land which has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed according to modern farming methods.

The Soil Conservation Service advocates the preservation of prime agricultural lands. We suggest that the EIS contain statements to the fact that the project area is located on prime agricultural land. The environmental impact statement should state that 2 acres of prime agricultural land will be taken out of production.

Thank you for the opportunity to review this document.

Sincerely,

JACK F. KANAI
State Conservationist

December 14, 1979

Mr. Jack F. Kanai
State Conservationist
Soil Conservation Service
U.S. Dept. of Agriculture
P.O. Box 50004
Honolulu, Hawaii 96850

Dear Mr. Kanai:

Subject: Your letter of December 4, 1979, Commenting on the EIS Preparation Notice for the Honolulu Molii.

Thank you for reviewing our environmental document. Your concerns for the preservation of prime agricultural lands and the impact of the project on prime agricultural lands will be addressed in the environmental impact statement.

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

Very truly yours,

Kozo Hayashida
Manager and Chief Engineer
December 5, 1979

Lt. Commander J. W. Carl, USN
Deputy Facilities Engineer
Naval Base Pearl Harbor
Box 110
Pearl Harbor, Hawaii 96860

Dear Commander Carl:

Subject: Your Letter of November 30, 1979 on the EIS Preparation Notice for Honolulu Wells

We have placed your name on our consulted party's list. A copy of our preparation notice is enclosed for your review and comments. We would appreciate receiving your comments by January 15, 1980.

Should you have questions or require additional information, please call Lawrence Wang at 549-5221.

Very truly yours,

[Signature]

Encl.

CO: Environmental Impact Study Corp.

Mr. Kaku Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
222 South Beretania Street
Honolulu, Hawaii 96813

Dear Mr. Hayashida:

Honolulu Wells, Kakaako, Oahu
EIS Preparation Notice

Per the Environmental Quality Commission DEC Bulletin of 23 November 1979, it is requested that this Command be a consulted party in the EIS Preparation Notice for Honolulu Wells, Kakaako, Oahu.

Sincerely,

[Signature]

W. CARL
Lieutenant Commander, CEC, USN
By Direction of the Commander
November 28, 1979

MEMORANDUM

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

Subject: Notice of Preparation for Honoluli Wells Environmental Impact Statement

The Department of Agriculture has reviewed the above-captioned Notice of Preparation and offers the following comments:

1. The proposed Honoluli Wells project would eventually be developed to withdraw 6 MGD from the Pearl Harbor aquifer with no net increase in pumpage achieved by a cutback of an equal amount of pumpage by Oahu Sugar Company.

2. The Board of Land and Natural Resources, found evidence of long-term decline in water levels, increase in salinity in and ground water basins withdraws from the Pearl Harbor ground water basin and on September 28, 1979, designated the Pearl Harbor Ground Water Control Area. The zero net increase in pumpage of this project is in keeping with the findings of the Board.

3. The project would be achieved by either of two alternatives: (a) withdrawal of Oahu Sugar Company lands from production and reallocation of the irrigation water to domestic use; or (b) development of an alternative irrigation water source to replace the potable water to be withdrawn by this project.

4. Based on figures provided, this Department believes that from 900 to 1,200 acres of sugarcane land in production would have to be urbanized to release sufficient water for domestic use. The difference in acreage depends on whether furrow or drip irrigation is assumed.

5. Formerly, urbanized lands could include water resources from the phased-out fields to more adequately irrigate urban areas. It is, therefore, not the primary intent of the project to phase out its fields to make water available for urbanization.

6. Alternative (b), above, could take place in several ways, including substitution of sewage effluent water or spring and stream water for potable water presently withdrawn for irrigation.

7. According to figures provided, sewage effluent water could be provided for irrigation at a cost ranging from $4 to $10 per 1,000 gallons. Spring and stream water could be developed for irrigation at a cost of $12 per 1,000 gallons. The operating costs of the proposed wells would be $12 per 1,000 gallons.

8. While tests have shown that use of treated effluent appears to be compatible with certain stages of plant growth of sugarcane if the effluent is properly mixed with potable water, problems remain with clogging of drip irrigation systems. The long-run economic feasibility of the use of treated effluent for irrigation on a year-round basis remains to be demonstrated.

9. The population projection figures cited do not reflect the latest population contained in the Department of General Planning's "Development Plans Population Capacity," (September, 1979), which shows a lower total population for Ewa in the year 2000.

10. The Alternative Notice of Preparation appears to be equivocal on whether the proposed project would either cause a significant increase in growth or indirectly contribute to the secondary impacts associated with growth. The report does suggest that the later stages of the project, which would develop 6 MGD of water, could support 12,000 dwelling units. At 8 units per acre, these units would require approximately 2,000 acres of land to be urbanized.

Based on information contained in the Notice of Preparation, this Department believes that the Honoluli Wells project has the potential to contribute to the premature urbanization of prime agricultural lands in sugarcane production, either through reduction in the amount of water available for sugarcane irrigation, or through stimulation of additional urban growth in the Ewa-Waipahu area. We believe that the need for additional domestic water in this region must be met by development of alternative sources as suggested in the Notice of Preparation, and by carefully worked out water exchange agreements which ensure the provision of present quantities of irrigation water to Oahu Sugar Company.

Thank you for the opportunity to comment.

John Farrak, Jr.
Chairman, Board of Agriculture

cc: Mr. Susan Kau, DLNR
    Mr. Hideto Kano, GPED
    Mr. David M. Ballieu, Ahef Sugar
Mr. John Farias, Jr.
Page 2

December 31, 1979

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

Dear Mr. Farias:

Subject: Your Letter of November 28, 1979, Commenting on the EIS Preparation Notice for the Honolulu Rail

Thank you for your comments on the proposed project.

We submit the following reply to your remarks:

1. The proposed Honolulu Rail project would eventually be developed to withdraw 9 MDL from the Pearl Harbor aquifer with no net increase in pumpage achieved by a drawdown of an equal amount of pumpage by Oahu Sugar Company.

We concur with the statement.

2. The Board of Land and Natural Resources, found evidence of long-term decline in water levels, increase in salinity in and around water basin withdrawals for the Pearl Harbor ground water basin, and on September 28, 1979, designated the Pearl Harbor ground water control area. The zone net increase in pumpage of this project is in keeping with the findings of the Board.

We concur with the statement.

3. It appears that the objective would be achieved by either of two alternatives: (a) withdrawal of Oahu Sugar Company lands from production and reallocation of the irrigation water to domestic use or (b) development of an alternative irrigation water source to replace the potable water to be withdrawn by this project. Either alternative would seem to require a water exchange agreement between the Board of Water Supply and Oahu Sugar Company.

We will be negotiating with Oahu Sugar Company and Campbell Estate on a suitable water exchange agreement.

4. Based on figures provided, this Department believes that from 560 to 1,800 acres of sugarcane land in production would have to be urbanized to release sufficient water for domestic use. The difference in acreage depends upon whether furrow or drip irrigation is assumed.

We concur with the statement.

5. Correspondence with Oahu Sugar Company indicates that while the plantation has plans to phase out approximately 1,000 acres over the next decade, it will do so in large part to enable diversion of its existing water resources from the phased-out fields to more adequately irrigate other areas. It is, therefore, not the primary intent of the plantation to phase out its fields to make water available for urbanization.

Our correspondence with Oahu Sugar Company indicates that their outreach to arrange for urbanization is due to poor water quality at Waiawa. Furthermore, AMDA, owner of Oahu Sugar, proposes to divert part of the irrigation water for urbanization of some of their land.

6. Alternative (b), above, could take place in several ways, including substitution of sewage effluent water or spring and stream water for potable water presently withdrawn for irrigation.

We concur with this statement.

7. According to figures provided, sewage effluent water could be provided for irrigation at a cost ranging from $4 to $10 per 1,000 gallons. Spring and stream water could be developed for irrigation at a cost of $12 per 1,000 gallons. The operating costs of the proposed facilities would be $10 per 1,000 gallons.
Mr. John Parias, Jr.

December 31, 1979

Page 4

To match this statement. Estimated cost figures are
good for the dates referred in the EIS Preparation Notice and
must be up-to-date in a future meeting with any of
the items discussed.

8. While tests have shown that use of treated effluent
appears to be compatible with certain stages of plant
growth of sugarcane if the effluent is properly mixed
with potable water, problems remain with clogging of
drip irrigation systems. The long-run economic
feasibility of the use of treated effluent for
irrigation on a year-round basis remains to be
demonstrated.

We concur with this statement.

9. The population projection figures cited do not reflect
the actual allocation of growth contained in the
Department of General Planning's "Development Plans
Population Capacity," September, 1979, which shows
a lower total population for the area in the year 2000.

The latest Department of General Planning's population
distribution will be used in the environmental impact statement.
The population for the area is projected to be 25,000 in the year
2000. However, the distribution figures are subject to change
until the City Council adopts the "New General Plan."

10. The Notice of Preparation appears to be equivocal
on whether the proposed project would either cause a
significant increase in growth or indirectly contribute
to the secondary impacts associated with growth. The
report does suggest that the larger stages of the project,
which would develop 5,000 acres of land, could support
12,000 dwelling units. At 6 units per acre, these units
would require approximately 2,000 acres of land to be
urbanized.

Although additional water to be developed could support
dwelling units on about 2,000 acres, the land would not
necessarily be agricultural lands. The water would be used for
development in areas already owned "urban.

11. Based on information contained in the Notice of
Preparation, this Department believes that the
Honolulu Hill project has the potential to contribute
to the premature urbanisation of prime agricultural
lands in sugarcane production, either through reduction
in the amount of water available for sugarcane
irrigation, or through stimulation of additional urban
growth in the Ewa-Waipahu area. We believe that the
need for additional domestic water in this region
must be met by development of alternative sources as
suggested in the Notice of Preparation, and by
carefully worked out water exchange agreements which
ensure the provision of present quantities of
irrigation water to Ohu Sugar Company.

It is our policy to develop water and have it available in
order to avoid having our option's water demand exceed its
supply. Presently, the most economical way of furnishing water
is to develop groundwater, which would be pumped directly into
the water distribution system with little or no treatment.

The decision to urbanize agricultural land was made by the
landowner. Our concern is where all the water to support the
development comes from. In order for Campbell Estate to develop
their lands, they would be required to develop their own water
facilities or give up water which we could pump to water to
their development. As we do not specify how much water to be
used. Also, approval from the State Land Use Commission must
be obtained to reserve agricultural land to urban use.

We are presently trying to negotiate a viable water exchange
agreement.

The only source of alternative water supply in the area
would be to desalinate or treat shallow water. However, this is
a very expensive alternative and would be considered only as a
last resort.

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

Very truly yours,

[Signature]

Hiroyuki Hamaishi
Manager and Chief Engineer

[Company Name] Environment Impact Study Corp.
Mr. Kaze Hayashida
Manager and Chief Engineer
Board of Water Supply
City & County of Honolulu
620 South Beretania Street
Honolulu, HI 96813

December 6, 1979

Dear Mr. Hayashida:

Subject: Request for Comments on Proposed Environmental Impact Statement for Honolulu Wells

Thank you for the opportunity to comment on the subject preparation notice. The following comments are submitted for your information:

1. As you are aware, Section 29 of Chapter 49, Public Health regulations requires approval of the Director of Health prior to the use of any new source to serve potable water. It is our understanding that the Honolulu Wells will serve potable water, in which case they will be subject to the terms and conditions of Section 29. As required under Section 29, an engineering report must be submitted to the Department. Such report must satisfactorily address concerns such as existing and potential sources of contamination, anticipated benefits, and expected impact on surrounding existing wells.

2. The location of these wells in the Pearl Harbor area and the recent designation of the area by the Department of Land and Natural Resources as a ground water control area focuses special attention on any discussion of the hydrologic budget. Page 1-15 of the document refers to arrangements to be made with the Oahu Sugar Company so as not to increase the net pumping from the Pearl Harbor Basin. Such arrangements if agreed to by the Oahu Sugar Company may have to be legally binding in order to prevent any such increase. All possible steps must be taken to insure constant adherence to the terms of the arrangements by all parties involved. We believe the existing conditions dictate the utmost caution in this area.

Sincerely,

[Signature]

JAMES S. AMBAGAI, Ph.D.
Deputy Director for Environmental Health

Considerable

December 8, 1979

Mr. George A. L. Yuen
Director
Department of Health
P. O. Box 3378
Honolulu, Hawaii 96801

Attention: James E. Kumagai

Dear Mr. Yuen:

Subject: Your Comments of December 6, 1979 on the Proposed Environmental Impact Statement for Honolulu Wells

Thank you for your comments on our proposed water project.

We will comply with the requirements of Section 29 of Chapter 49, Public Health Regulations when we proceed with our Honolulu Well Project.

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

Very truly yours,

[Signature]

KAZU HAYASHIDA
Manager and Chief Engineer

[Environmental Impact Study Corporation]
Mr. Kazu Hayashida  
Manager and Chief Engineer  
Board of Water Supply  
610 South Beretania Street  
Hilo, HI 96620

Dear Mr. Hayashida:

Thank you for sending us the preparation notice for the Honolululi Mela Environmental Impact Statement.

We suggest that the EIS cover the following points:

1. Extent of the aquifer.
2. Current and future demands upon the aquifer, including industrial and agricultural uses.
4. Direct and indirect impacts upon agriculture.

If we may be of any further service, please feel free to contact Gordon Schur of our Planning Office at 348-6461.

Very truly yours,

[Signature]

[Date]

Mr. Susumu Ono  
Chairman  
Board of Land and Natural Resources  
P.O. Box 321  
Hilo, HI 96720

Dear Mr. Ono:


Thank you for your comments. The four points that you suggested we include in the EIS will be covered in that document.

Should you have questions or require additional information, please call Lawrence Shung at 348-5921.

Very truly yours,

[Signature]

[Date]

[Title]

[Position]

cc: Environment Impact Study Corporation
December 7, 1979

Mr. Kazu Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
Ala Moana Boulevard
Honor, Hawaii 96813

Dear Mr. Hayashida:

Subject: Notice of Preparation for Ho oaulauli Wells
Environmental Impact Statement

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

With regard to discussion on the relationship of the proposed project with the objectives of the Island State Plan, on pages 3-7, 3-8, and 3-9 of the project document, we would like to clarify an apparent misunderstanding of the term objectives and policies. As used in the State Plan, objectives reflect goals toward which concentrated effort is focused and which, when attained, represent a step toward achievement of related goals. Policies are courses of action carried out in order to achieve related objectives. The project document speaks only of objectives and lists both objectives and policies without any differentiation between the two.

In addition, the relationship of the statement:

"The proposed project is not inconsistent with these objectives, providing that a safe and equitable method of water exchange can be arranged." (pages 3-8 & 3-9)

to the State Plan objectives and policies is unclear and should be explained more fully.

Finally, we note that Part III of the State Plan relating to Priority Directions, particularly Sections 103(b)(3) and 104(b)(1) appear pertinent to the proposal.

Sincerely,

hideto kono
December 18, 1979

Mr. Hideto Kono
Director
Department of Planning and
Economic Development
P. O. Box 2512
Honolulu, Hawaii 96813

Dear Mr. Kono:

Subject: Your Comments of December 7, 1979
on the Notice of Preparation for
Honouliuli Wells Environmental
Impact Statement

Thank you for your comments on our proposed well project.

In the preparation of the EIS, the use of the terms
objectives and policies will be clarified. Also, the
relationship of the following statement to the State Plan
will be more fully explained:

"The proposed project is not inconsistent with
these objectives, providing that a safe and equitable
method of water exchange can be arranged."

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

Very truly yours,

[Signature]

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Environmental Impact Study Corporation
December 19, 1979

Mr. Keiji Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96813

Dear Mr. Hayashida:

Subject: Notice of Preparation for Honolulu Wells Environmental Impact Statement

Thank you for giving us the opportunity to review and comment on the above-captioned notice. We have the following comments to offer which could improve the preparation of the EIS.

1. The document does not clearly indicate the area of service of the proposed system, especially on future developments. This should include those listed in Table 2-4, "Major Proposed Developments, Leonard Region, Oahu, Hawaii." A plan depicting the situs in relation to the proposed system may be adequate.

2. There should be further discussions on the level of demand which will initiate the construction of the other four wells and the capital costs assessments to the users.

3. Construction permits will be required from our Highways Division should any work fall within our highway rights-of-way.

Very truly yours,

Keiji Hayashida
Director of Transportation

cc: Environmental Impact Study Corporation
November 30, 1979

Mr. Kau Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
610 South Beretania Street
Honolulu, Hawaii 96813

Dear Mr. Hayashida:

Subject: HHS Preparation Notice for Honolulu Halls Environmental Impact Statement

We have no comments to offer regarding the subject statement at this time; however, we appreciate the opportunity to comment on this matter.

Sincerely,

[Signature]

GORDON Y. PURUTANI
Executive Officer

December 6, 1979

Mr. Charles M. Duke
Chairman, Land Use Commission
Suite 1755
Pacific Trade Center
196 South King Street
Honolulu, Hawaii 96813

Attention Mr. Gordon Y. Purutani

Dear Mr. Duke:

Subject: Your Letter of November 30, 1979 on the HHS Preparation Notice for the Honolulu Halls

Thank you for your comments.

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

Very truly yours,

[Signature]

GORDON Y. PURUTANI
Executive Officer

cc: Environment Impact Study Corp.

Kau Hayashida
L. Whang/ 79-4754
December 5, 1979

MEMORANDUM

TO: MR. KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER
   BOARD OF WATER SUPPLY

FROM: GEORGE S. HONOGUCHI, CHIEF PLANNING OFFICER

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE
   FOR HONOLULU WELLS, DATED NOVEMBER 1979
   COMMENTS REQUESTED NOVEMBER 15, 1979

The environmental impact statement should focus on the
hydrology of the Pearl Harbor ground water control area, the
existing use of water resources, the existing water distribution
system, and possible future use of the water resources.
Details follow.

Hydrology

Discussion on this (p. 2-11 et. seq.) covers the Pearl Harbor
area generally. The graphics and tabular data cover only the
service area 7B and water sources in the vicinity of the
Honolulu wells. Table 2-1 (p. 2-21a) accounts for about
50 mgd in water pumps out of the 140 mgd average during 1919
to 1958. Discussion in the EIS should be broadened to cover
the entire basin and its resources: who are the major users?
how much are they pumping? from where? to where? for what use?

It is indicated that the area of recharge is above the 50-inch
isohyet. (p. 2-14.) But Figure 3-4 does not show where this
isohyet extends. Also, the 350 ppm isochlor and the extent of
caprock are not labelled. These should be shown on a map of the
ground water control area so that a reviewer can get a better
understanding of the problem facing the Board of Water Supply
and Department of Land and Natural Resources in managing water
resources here.

Mr. Kazu Hayashida
Page 2

Water Distribution System

The existing water transmission system in the water district
is described. (P. 1-7 et. seq.) Water demand data and
projections are provided for the entire Lewer area. A
suitable map showing the major elements of the distribution
system and demand for the various major urbanized areas
should be provided in the EIS. The Project Vicinity Map
(Figure 1-2) is good, but only shows the well site and
transmission line to the Honolulu Booster Station.

Water Use

Discussion in the EIS preparation notice (p. 2-10) indicates
that 1910 to 1958 pumpage averaged 160 mgd. Current pumpage
is not reported. Total discharge during 1931 to 1965 is said
to have averaged 250 mgd, with present discharge estimated at
240 mgd. The difference between "pumpage" and "total discharge"
should be explained, with an indication as to why total
natural discharge is occurring. Here again, the discussion
should cover the entire Pearl Harbor Basin, rather than be
limited to the Honolulu area.

Sustainable Yield

It is indicated that the sustainable yield from the Pearl
Harbor basin is about 245 mgd. (P. 2-15.) With present
discharge at 240 mgd, the ultimate development of wells at
Honolulu operating at 5 mgd would bring total discharge
above sustainable yield unless the increase in domestic use
is offset by a reduction in irrigation use. The EIS should
indicate, if possible, where such reductions in irrigation use
are presently contemplated. This could have a bearing on the
future land use pattern in the area.

Use of Honolulu Water

It is indicated that . . . at least 83% of the first 3 mgd
to be developed will serve areas which are already zoned for
urban use (Campbell Industrial Park and Kahakilo) . . .
(p. 4-13), and . . . will require allocating 0.5 mgd of
the initial 1.6 mgd, to Kahakilo for expansion of the subdivision,
since Kahakilo will be helping to finance the project.
(P. 4-12.) This leaves 174 or about 0.5 mgd for other areas
of the Ewa Plain. Further, it "is not anticipated that any of
this water will be delivered to the Waianae Coast." (P. 4-14.)

It is also estimated that the subsequent 6 mgd operating
capacity proposed could support up to 12,000 units or a
population of about 35,200. (P. 4-24.) This is a significant increase.

Accordingly, the EIS should indicate, insofar as is possible at this time, what other areas are prospects for use of the additional 6 mgd in the later phase of the project, plus the 8.3 mgd not accounted for in the initial phase. One such area mentioned is West Beach. (P. 4-24.) For what areas does the Board of Water Supply make firm commitments for providing water? For what areas have there been requests for future water?

Related to this, it might be appropriate for the EIS to include discussion of the impact of the Department of Land and Natural Resources' designation of the Pearl Harbor Basin as a "ground water control area" pursuant to Chapter 177, Hawaii Revised Statutes. (P. 3-9.)

Growth Policy

Appendix A discusses policy constraints and assumptions of the Directed Growth Alternative, which is based on housing needs generated by a population of 1,398,000 by 1995. Material here is taken from an outdated (1974) report using a high population projection which was not officially adopted. The officially adopted population projection at that time was the UH CED Series B-2 (1,039,000 for Oahu for the year 2000), and this has since been replaced by UH CED's II-F projection of 3,400,000 for Oahu for the year 2000.

It is recommended that Appendix A be evaluated and either omitted or revised to reflect the current population projection (II-F) and possible constraints under Chapter 177.

Drip Irrigation

Discussion of impacts on ground water (pp. 4-19 to 4-21) seems to indicate that drip irrigation and furrow irrigation require the same amount of water. The general impression is that drip irrigation, being more efficient, would require less water all other things being equal, e.g., growing conditions, yields, etc. This should be clarified.

Other

P. 2-64 Bruce Duncan is not a member of the Department of General Planning staff, but Deputy Director of the Department of Planning and Land Utilization.

2-52 Kenia Road capacity of 9,800 vph seems to be an error.

Mr. Kazu Hayashida
Page 4

P. 2-1 The General Plan referred to here is the 1964 General Plan. This should be noted.

3-3 The General Plan referred to here is the Revised General Plan, Resolution No. 239, January 18, 1977.

6-17 It is indicated that Hall 62-2A is on the "Diamond Head side of the Neil Blaisdell Center Exhibition Hall." Our previous notice was Neil S. Blaisdell.

Thank you for affording us the opportunity of reviewing your preparation notice.

GEORGE H. MORIUCHI
Chief Planning Officer

GSM:fmt
TO:  MR. GEORGE S. MORIGUCHI  
     CHIEF PLANNING OFFICER  
     DEPARTMENT OF GENERAL PLANNING  
FROM:  KAZU HAYASHIDA  
     BOARD OF WATER SUPPLY  
SUBJECT:  YOUR LETTER OF DECEMBER 5, 1979, CONCERNING ON  
THE ENVIRONMENTAL IMPACT STATEMENT PREPARATION  
NOTICE FOR HONOLULU WELLS  

In response to your comments, we submit the  
following:

1. Hydrology  
Discussion on this (p. 2-10 et. seq.) covers the Pearl  
Harbor area generally. The graphics and tabular data  
describe only the service area 7b and water sources in the  
vicinity of the Honolulu wells. Table 2-3 (p. 2-21) accounts for about 50 mgd in water consumption out of the  
160 mgd average during 1971 to 1978. Discussion in the  
EIS should be broadened to cover the entire basin and its  
resources. Where are the major users? How much are they  
pumping? From where? To where? For what use?  

The EIS will address your questions based on data in the  
attached table which will also be inserted into the EIS.  

It is indicated that the area of recharge is above the  
50-inch isohyet. (P. 2-14.) But Figure 2-4 does not  
show where this isohyet extends. Also, the 250 ppm  
isohyet and the extent of caprock are not labelled.  
These should be shown on a map of the ground water control  
area so that a reviewer can get a better understanding of  
the problem facing the Board of Water Supply and  
Department of Land and Natural Resources in managing  
water resources here.  

Figure 2-4 will be revised to show the 50-inch isohyet and  
the labelling of the 250 ppm isohyet and the caprock  
boundary.

2. Water Distribution System  
The existing water transmission system in the water district  
is described. (P. 1-7 et. seq.) Water demand data and  
projections are provided for the entire Loward area. A  
suitable map showing the major elements of the distribution  
system and demand for the various major urbanized areas  
should be provided in the EIS. The Project Vicinity Map  
(Figure 1-2) is good, but only shows the well sites and  
transmission line to the Honolulu Booster Station.  

A map showing the major transmission mains, reservoirs, and  
pump stations and a table showing the demands of major  
urbanized developments within the Honolulu area will be  
inserted in the EIS.

3. Water Use  
Discussion in the EIS preparation notice (p. 2-18) indicates  
that 1971 to 1978 water use averaged 160 mgd. Current pumping  
is not reported. Total discharge during 1971 to 1977 is  
said to have averaged 250 mgd, with present discharge  
estimated at 220 mgd. The difference between "pumping" and  
"total discharge" should be explained, with an indication  
as to where major natural discharge is occurring. Here  
again, the discussion should cover the entire Pearl Harbor  
basin, rather than be limited to the Honolulu area.  

"Pumping" means water pumped, whereas "discharge" includes  
water pumped and all free flows of groundwater (springs  
and tunnels). The differences between the two words will  
be explained in the EIS.

4. Sustainable Yield  
It is indicated that the sustainable yield from the Pearl  
Harbor Basin is about 245 mgd. (P. 2-18.) With present  
development of wells at discharge at 240 mgd, the ultimate  
development of wells at above sustainable yield unless the increase in domestic use  
is offset by a reduction in irrigation use. The EIS should  
indicate, if possible, where such reductions in irrigation  
use are presently contemplated.

Figure 2-4 will be revised to show the 50-inch isohyet and  
the labelling of the 250 ppm isohyet and the caprock  
boundary.
Mr. George S. Moriyuchi  
Page 3  
January 7, 1980

The present "pumpuha" from the Pearl Harbor area is approximately 240 mgd and not "discharge" as was stated in the preparation notice. Therefore, any increases in domestic pumpage in this ground water control area will require a like pumpage reduction from Campbell Estate's losses or the use of alternative water sources. The EIS will address this pumpage control problem and show where and how pumpage reductions are contemplated.

5. Use of Honolulu Water

It is indicated that * ... at least 83% of the first 3 mgd to be developed will serve areas which are already zoned for urban use (Kamakuli Industrial Park and Kukuiolono ... * (p. 1-13), and * ... will require allocating 6.5 mgd of the initial 3.0 mgd to Kukuiolono for expansion of the subdivision, since Kukuiolono will be helping to finance the project." (P. 4-12.) This leaves 171 or about 0.5 mgd for other areas of the Ewa Plain. Further, it is anticipated that any of this water will be delivered to the Ko'olina City.* (P. 4-14.)

It is also estimated that the subsequent 6 mgd operating capacity proposed could support up to 12,300 units for a population of about 35,000. (P. 4-24.) This is a significant increase.

Accordingly, the EIS should indicate, insofar as is possible at this time, what other areas are prospects for use of the additional 6 mgd in the later phase of the project, plus the 0.5 mgd not accounted for in the initial phase. One area mentioned in West Beach. (P. 4-24.) For what areas has the Board of Water Supply made firm commitments for providing water? For what areas have there been requests for future water?

Related to this, it might be appropriate for the EIS to include discussion of the impact of the Department of Land and Natural Resources' designation of the Pearl Harbor Basin as a "ground water control area" pursuant to Chapter 177, Hawaii Revised Statutes. (P. 3-9.)

There are no estimates for the remaining 4.6 mgd of estimated source capacity from the proposed Keaau Valley. The water will be held in reserve to handle future growth in the Ewa-Maunaloa areas.

Mr. George S. Moriyuchi  
Page 4  
January 7, 1980

The EIS will discuss the impact that the Department of Land and Natural Resources' designation of the Pearl Harbor Basin as a ground water control area has on the development of ground water sources.

6. Growth Policy

Appendix A discusses Policy Constraints and Assumptions of the Directed Growth Alternative, which is based on housing needs generated by a population of 1,938,000 by 1995. Material here is taken from an outdated (1974) report using a high population projection which was not officially adopted. The officially adopted population projection at that time was the DPED Series B-2 (1,639,000 for Oahu for the year 2000), and this has since been replaced by DPED's II-F projection of 1,740,000 for Oahu for the year 2000.

It is recommended that Appendix A be evaluated and either omitted or revised to reflect the current population projection (II-F) and possible constraints under Chapter 177.

Appendix "A" will be deleted from the EIS.

7. Drip Irrigation

Discussion of impacts on ground water (pp. 4-19 to 4-21) seems to indicate that drip irrigation and furrow irrigation require the same amount of water. The general impression is that drip irrigation, being more efficient, would require less water all other things being equal, e.g., growing conditions, yields, etc. This should be clarified.

Section (4.18), pages 4-19 to 4-21, will be clarified.

8. Other

F. 2-64  Bruce Duncan is not a member of the Department of General Planning staff, but Deputy Director of the Department of Land Utilization.

2-52  Kualoa Road capacity of 9,000 vph seems to be an error.

3-1  The General Plan referred to here is the 1964 General Plan. This should be noted.
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(1) Exclude Waikane Tunnel & Ditch and Waikane Stream & Springs.
(2) Exclude Shallow Creek Wells.
(3) Exclude H.E. Co. Tunnel, Waterreek Wells and Spring.
December 7, 1979

MEMORANDUM

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

FROM: THORNE T. KUSAO, DIRECTOR

SUBJECT: NOTICE OF PREPARATION FOR HONOLULU WELLS
ENVIRONMENTAL IMPACT STATEMENT

We have reviewed the above EIS Preparation Notice and feel that you have thoroughly covered all aspects of the project.

As a minor comment, we would like to point out that a county Conditional Use Permit will not be required for the proposed project, contrary to what is reported on Page 3-9 of the Preparation Notice. In addition, the document incorrectly asserts that a state Special Use Permit (SUP) will not be required because the site is less than 15 acres. Act 221, SLH, 1979 does not eliminate the requirement for a state SUP. Rather, it allows the county Planning Commission to make the final decision on projects proposed on sites less than 15 acres in size.

If you have any questions concerning the procedures for the SUP, please call Henry Ng at 523-4248.

THORNE T. KUSAO
Director of Land Utilization

December 17, 1979

Mr. Tyrone T. Kusao
Director
Department of Land Utilization
653 South King Street
Honolulu, Hawaii 96813

Dear Mr. Kusao:

Subject: Your Comments of December 7, 1979 on the Notice of Preparation for Honolulu Wells Environmental Impact Statement

Thank you for your comments on our proposed water project.

We will make the corrections noted in your letter in the EIS.

Should you have questions or require additional information, please call Lawrence Ihn at 568-5221.

Very truly yours,

THORNE T. KUSAO
Manager and Chief Engineer

Office of Environmental Impact Study Corporation
November 28, 1979

MR. KAZU HAYASHIDA
MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

WALLACE NITAHIRA, DIRECTOR AND CHIEF ENGINEER

SUBJECT: EIS PREPARATION NOTICE FOR HONOLULU WELLS

We have reviewed the subject Preparation Notice and have the following comments:

1. The West Beach development (page 2-18) will have about 7,200 resort units which should be considered in determining future water demand. See Table 2-8.

2. Seventy-five percent of the eligible construction cost of the Honoluli WTP (page 2-31) is being funded by the Federal government.

3. The Waipahu Incinerator (page 2-35) has a designed capacity of 600 tons per day. The water needs of the proposed HPOWER plant that may be located in the Barbers Point Industrial Park should be considered in determining the overall water needs of the area. The initial plant may have a capacity to process 600, 1200 or 1800 tons of municipal solid waste a day.

4. The term non-residential user is preferred over industrial users (page 4-17) with respect to sewer service charges.

5. The initial capacity (25 mgd) of the Honoluli WTP will be able to serve a population of 197,000. The plant will have to be expanded to serve the projected 2000 population of 220,000 people (page 4-27).

Mr. Kazu Hayashida
November 28, 1979

WALLACE NITAHIRA
Director and Chief Engineer
December 5, 1979

TO: MR. WALLACE NISHIYAMA  
DIRECTOR AND CHIEF ENGINEER  
DEPARTMENT OF PUBLIC WORKS

FROM: KAZU HAYASHIDA  
BOARD OF WATER SUPPLY

SUBJECT: YOUR LETTER OF NOVEMBER 28, 1979, ON THE GIS PREPARATION NOTICE FOR THE CONCEALED WELLS

Thank you for your comments on our proposed project. Your comments will be incorporated into the environmental impact statement.

Should you have questions or require additional information, please call Lawrence Whang at 546-5221.

KAZU HAYASHIDA  
Manager and Chief Engineer

cc: Environmental Impact Study Corp.
December 14, 1979

Mr. Laurence Wnang
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96813

Dear Mr. Wnang:

I am writing to request that I be consulted in the preparation of an Environmental Impact Statement for the Honouliuli Wells at Kahoe, Oahu, as noted in the November 23, 1979 Environmental Quality Commission Bulletin.

Second, I also wish to be consulted in the preparation of the EIS at Hakea Exploratory Well II noted in the Environmental Quality Commission Bulletin of November 8, 1979.

Please keep me informed about the submission of information and documents and testimony in the preparation of the EIS on both of these projects.

Very truly yours,

Winoa E. Rubin
Director, Aú Like

December 27, 1979

Ms. Winoa E. Rubin
Director
Aú Like
Suite 3035
2222 Pan Street
Honolulu, Hawaii 96819

Dear Ms. Rubin:

Subject: Your Letter of December 14, 1979
on the Environmental Impact Statements for Honouliuli Wells and Hakea Exploratory Well II

We have placed your name on the list of consulted parties for the proposed Honouliuli Wells. A copy of the Honouliuli Wells EIS preparation notice is enclosed for your review and comments. We would appreciate your comments by January 28, 1980.

Also enclosed is a copy of the environmental assessment for Hakea Exploratory Well II. Please submit your comments on the assessment by January 28, 1980.

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

Very truly yours,

Karu Hayashida
Manager and Chief Engineer

Encl.
cc: Environmental Impact/Study Corporation

E alu like mai kahon, E ao 'efini o Hawai'i
Let us work together, spirits of Hawaii

Fest Hānai... wahine's guardian—act wisely
December 7, 1979

Dr. Bryce Deckur
Department of Geography
University of Hawaii
2530 Dole Street
Honolulu, Hawaii 96822

Dear Dr. Deckur:

Subject: Your Telephone Request of December 6, 1979 on the EIS
Preparation Notice

Thank you for your interest in our project. Your name has been added to our consulted party’s list. Enclosed is a copy of the preparation notice for your review and comments. We would appreciate receiving your comments by January 15, 1980.

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

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

Encl.

cc: Environmental Impact Study Corp.
December 5, 1979

Mr. Kenu Hayashida
Manager and Chief Engineer
Ewa Neighborhood Board No. 23
City and County of Honolulu
629 South Chunana
Honolulu, Hawaii 96813

Dear Mr. Hayashida:

Subject: Notice of Preparation for Honnoluli Wata

Environmental Impact Statement

We received your request for comments on your EIS preparation notice too late to take action by the Ewa Neighborhood Board No. 23 prior to December 7, 1979.

In view of the anticipated increase of the Ewa Area population it is obvious that steps must be taken to ensure a viable water supply for the future.

I presume that it may be necessary to revise your EIS estimates as a result of the Department of General Planning's upward revision of the Ewa Area population to 39,000 by the year 2000.

Will there be a sharp increase in the cost of water to the present residents to subsidize the cost of construction and maintenance for anticipated future users?

Thank you for an opportunity to comment on the EIS preparation notice.

Sincerely,

Charles R. Bannister
Manager and Chief Engineer

December 18, 1979

Mr. Charles R. Bannister
Chairman
Ewa Neighborhood Board No. 23
P. O. Box 297
Ewa Beach, Hawaii 96706

Dear Mr. Bannister:


Thank you for your comments on our proposed project.

The EIS will be revised to indicate that the Ewa Area Development Plan population for the year 2000 is estimated to be 39,000 by the Department of General Planning.

Any future increases in the cost of water would follow the normal inflationary trend. Governmental agencies and private developers will be required to share in the construction costs for water facilities needed to increase water supply.

Should you have questions or require additional information, please call Lawrence Wang at 546-5221.

Very truly yours,

[Signature]

Manager and Chief Engineer

cc: Environmental Impact
Study Corporation
Mr. Lawrence Whang  
Board of Water Supply  
630 South Beretania Street  
Honolulu, Hawaii 96813  

Dear Mr. Whang:  

Subject: Comments on Notice of Preparation – Honolulu  
Holls EIS  

Several members of the staff of Hawaiian Electric Company have reviewed the Notice of Preparation for the Honolulu Holls EIS and have the following comments:  

Page 2-55 (D.1) Sentence 1 – Lines are 46 kv, not 44 kv. There are three parallel cases, not two as stated in the last sentence of the first paragraph. Two of the cases have 11.8 kv circuits on each case. The third case is reserved for future use. Each case can contain four 11.8 kv circuits.  

The third paragraph should read “The project will have an electrical demand of 700 kilowatts.”  

The first sentence of the fourth paragraph should read “HECO has stated that they will have adequate capacity to supply the electrical demand requirements for the service area of the project.” The generating capacity values should be 1,209,400 kw and 1,350,400 not 1,210,000 and 1,400,000 as stated.  

Since Section 5 – Adverse Environmental Effects is not contained in this document, we are unable to comment on the environmental aspects of the project.  

Yours truly,  
John E. McCain  
Manager, Environmental Department  
Hawaiian Electric Company, Inc.  
P. O. Box 2750  
Honolulu, Hawaii 96806  

Dr. John C. McCain  
Manager, Environmental Department  
Hawaiian Electric Company, Inc.  
P. O. Box 2750  
Honolulu, Hawaii 96806  

Commenting on the Notice of Preparation for the Honolulu Holls EIS  

Thank you for reviewing our environmental document. We will make the corrections noted in your letter when the EIS is prepared.  

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

Very truly yours,  
John E. McCain  
Manager and Chief Engineer  

cc: Environmental Impact/Study Corporation  

L. Hayashida  
Manager and Chief Engineer  

S. K. H.  
Assistant Manager  

3-30-79
December 4, 1979

Donald M. Kuyper
President

Mr. Kaui Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
610 South Beretania Street
Honolulu, Hawaii 96813

Dear Mr. Hayashida:

Notice of Preparation for Honolulu Wells Environmental Impact Statement

We have reviewed the subject Environmental Impact Statement (EIS) Preparation Notice as transmitted under your letter dated November 15, 1979 and offer the following comments:

Page 2-57, paragraph 3, indicates that telephone service is available in the vicinity of the project site. In fact, the nearest telephone facilities are located on Kaimuki Road, approximately half a mile from the project site. To provide telephone service to the project site, a pole line of approximately 20 poles with associated wiring must be constructed from Kaimuki Road to the site. In most probability, electrical service will also be provided via this proposed pole line.

It is our understanding that access to the project site will be from an existing unpaved road that is not permanent. Public access roadway will be constructed initially. As such, the exact location of the proposed pole line cannot be determined until satisfactory right-of-way is acquired. Negotiations for said right-of-way and determination of cost-sharing responsibilities will commence when notification of project approval is received.

Thank you for giving us the opportunity to review and comment on this EIS Preparation Notice. If you should have any further questions, please contact our Environmental and Construction Staff Manager, Mr. Richard Mau, at 546-3656.

Sincerely,

Donald M. Kuyper

December 13, 1979

Mr. Donald M. Kuyper
President

Mr. Kaui Hayashida
Manager and Chief Engineer

Subject: Your Letter of December 4, 1979

Thank you for your comments on our proposed project.

The EIS will be corrected to indicate the location of the nearest telephone facilities and your requirements for providing telephone service to the project site.

Should you have questions or require additional information, please call Lawrence Wang at 548-5231.

Very truly yours,

[Signature]

[Signature]

Manager and Chief Engineer
December 4, 1979

Mr. Lawrence Whang
Board of Water Supply
City and County of Honolulu
630 9th Avenue Street
Honolulu, Hawaii 96813

Dear Mr. Whang:

I am writing to request that my clients and I be consulted in the preparation of an environmental impact statement for the Honouliuli Wells at Koko, as noticed in the November 23, 1979 Environmental Quality Commission Bulletin.

Second, I also wish to be consulted in the preparation of the EIS at Makaha Exploratory Well II as noticed in the Environmental Quality Commission Bulletin of November 8, 1979.

I am writing on behalf of and represent farmers at Camp Keaia in Wai'anae Valley and Neighborhood Board No. 24 (Makaha Valley), Hawaii Hawaiian Homestead Association, the Waianae Hawaiian Civic Club, Nikilua Farm Bureau, and the Kaua Maui Land Use Concerns Committee.

Please keep me informed about the submission of information and documents and testimony in the preparation of the EIS on both of these projects.

Very truly yours,

William H. Tam
Staff Attorney

Mr. William H. Tam
Staff Attorney
Legal Aid Society of Hawaii
65-336 Farrington Highway
Waianae, Hawaii 96792

Dear Mr. Tam:

Subject: Your Letter of December 4, 1979 on the Environmental Impact Statement for Honouliuli Wells and Makaha Exploratory Well II

We have placed you and your clients on the list of interested parties for the Honouliuli Wells project. A copy of the Honouliuli Wells preparation notice is enclosed. We would appreciate your comments on it by January 18, 1980.

Also enclosed is a copy of the environmental assessment for Makaha Exploratory Well II. Any comments you may have on the assessment should be sent to us by January 18, 1980.

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

Very truly yours,

L. R. Rundel
Ryotaro Hayashida
Manager and Chief Engineer

Encl.
cc: Environmental Impact Study Corporation
December 19, 1979

Mr. Lawrence Whang
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96813

Dear Mr. Whang:

Honolulu News, Kapaa, Oahu

Pursuant to the Bulletin of the Environmental Quality Commission, this is to request that Millani Town, Inc. be a party to be consulted in the preparation of the EIS.

We do have an interest in the proposed project. We are not quite certain what the consultation relates to but wish to be kept informed of the project.

Very truly yours,

George Yin
Vice President

Mr. George Yin
Vice President
Millani Town, Inc.
P.O. Box 2385
Honolulu, Hawaii 96803

Dear Mr. Yin:

Subject: Your Letter of December 15, 1979, on the EIS Preparation Notice for the Honolulu Wells

We have placed your name on our consulted party’s list and have enclosed a copy of our EIS Preparation Notice for your review and comments. We would appreciate receiving your comments by January 21, 1980.

Should you have questions or require additional information, please call Lawrence Whang at 548-4611.

Very truly yours,

Kazu Hayashida
Manager and Chief Engineer

Encl.

cc: Environment Impact Study Corp.

Your water...our greatest need - use it wisely.
January 14, 1980

Kazu Hayashida
Manager & Chief Engineer
Board of Water Supply
Oahu Section
Honolulu, Hawaii 96814

Dear Mr. Hayashida:

Thank you for allowing the Waipahu Community Association, the opportunity to review the environmental impact statement for the proposed Honosuihui Wastewater treatment expansion program.

Your proposed development of additional water sources/alternate resources to meet the needs of the 1980's, is a carefully documented and complete study covering each aspect of public need, and safety restraints that will ensure continued of adequate health/welfare standards for Oahu residents.

Sincerely,

C. O. "Andy" Anderson
President

Mr. C. O. Anderson
President
Waipahu Community Association
94-229 Waipahu Depot Street
Waipahu, Hawaii 96797

January 21, 1980

Dear Mr. Anderson:

Subject: Your Letter of January 14, 1980

Commenting on the Proposed Honosuihui Wastewater treatment expansion program.

Thank you for your comments which will be appended to the environmental impact statement.

Should you have questions or require additional information, please call Lawrence Whang at 548-5211.

Very truly yours,

Kazu Hayashida
Manager and Chief Engineer

cc: Environment Impact Study Corporation
EIS Review Period 12
SECTION 12
ORGANIZATIONS AND PERSONS CONSULTED DURING THE EIS REVIEW PERIOD

The following list includes those agencies and organizations to whom the Environmental Impact Statement was sent during the EIS review process. Those with an asterisk sent in written comments. The comments and their responses follow this list.

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**CITY AND COUNTY OF HONOLULU**

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**OTHER**

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- Hawaiian Electric Company, Inc. | 12-46 |
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- Oahu Sugar Company, Ltd.
  - The Estate of James Campbell
  - Wai'anae Coast Neighborhood Board
  - Waipahu Community Association
- Pacific Resources, Inc. | 12-50 |
January 27, 1982

Colonel Malph A. Right
Director of Engineering and Housing
Headquarters U. S. Army Support Command, Hawaii
Department of the Army
Fort Shafter, Hawaii 96850

Dear Colonel Right:

Subject: Your Letter of January 20, 1982, on the Environmental Impact Statement for Honolulu II Wells

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 540-5221.

Very truly yours,

[Signature]

RAU HAYASHIDA
Manager and Chief Engineer

Environment Impact Study Corporation
DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU

FOE8-PV

FEB 28 11 PH 82

16 February 1982

Honorable Eileen Anderson
Mayor of the City and County of Honolulu
Honolulu, Hawaii 96813

Dear Mayor Anderson:

Thank you for the opportunity to review the Environmental Impact Statement (EIS) for the Honolulu Surch, Honolulu, Oahu, Hawaii, sent to us on 13 January 1982. Based on our review, we provide the following comments:

1. A Department of the Army permit is not required for this project.
2. The Honolulu Surch site and most of the proposed transmission alignment are not situated in any known flood-prone areas. According to the Flood Insurance Study for Oahu by the Federal Insurance Administration, the area is classified Zone D, or area of unknown but possible flood hazards. A portion of the alignment is outside the limits of, but within the vicinity of Honolulu Stream floodplains, and is designated Zone B2, or area of minimal floodplain. See the attached Flood Insurance Rate Map for the Honolulu area (sheet 1).

Sincerely,

[Signature]

E. A. Yarborough
Major, Corps of Engineers
Deputy District Engineer

CC:
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96813

March 3, 1982

Major Edmund A. Yarborough
Deputy District Engineer
U. S. Army Engineer District,
Honolulu
Department of the Army
Fort Shafter, Hawaii 96858

Dear Major Yarborough:

Subjects: Your letter of February 14, 1982,
   on the Environmental Impact Statement
   (EIS) for Honolulu Surch

Thank you for reviewing the EIS for our proposed water development project. Your letter to the Mayor has been referred to us for reply, and it will be appended to the revised EIS.

We shall indicate in the revised EIS that a Department of Army permit is not required for the project and shall also mention the flood zone designations of the proposed well site and transmission main alignment.

If you have any questions, please contact Lawrence Wang at 548-5551.

Very truly yours,

[Signature]

R. Y. MARGILL
Manager and Chief Engineer

抄送:
Eileen B. Anderson, Mayor
Andrew H. Chang, Managing Director
Environmental Impact Study Corporation
General Comments

There are four critical points in the EIS for the Honolulu Wells and the Waste Water Treatment Plant which require a more thorough discussion and explanation.

1) A specific source of exchange water has not been defined.

2) The project is contingent on a specific agreement between the Board of Water Supply and the Oahu Sugar Co., Ltd., whereby Oahu Sugar agrees to accept the proposed lower quality exchange water. There is no indication in the EIS that Oahu Sugar has agreed to such an arrangement.

3) There are contradictory passages in the report regarding the routing of water from the Honolulu Waste Water Treatment Plant.

4) Some mention needs to be made of the current high pumping in the Honolulu area. This area has the highest concentration of ground-water draft in the State on a per-area basis. Thus, regardless of any water exchange agreement that there would be no net increase in pumping from the Pearl Harbor aquifer, the concentration rather than the total draft may be the overriding factor in justifying the project.

A discussion of the first three points follows:

The first three points listed above become interlocked in the text. On page 1-20 a specific source of exchange water is not defined and no definite agreement appears to have been made between the Board of Water Supply and Oahu Sugar Co., Ltd.:

<table>
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| 1-20 | "Before the Board proceeds with the project, arrangements will be made with Oahu Sugar Company for thee to cut back an equal amount of ground water pumping so that net pumping from the Pearl Harbor aquifer will remain the same. The City will compensate Oahu Sugar for this reduction in pumping by offering water of lower quality in exchange, on a gallon-for-gallon basis. Such water could theoretically exist of treated sewage effluent, spring water, or surface water. At present, treated sewage effluent is the preferred choice."

On page 6-4 there is a question as to the routing of sewage effluent from the Honolulu Waste Water Treatment Plant:

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| 6-4  | "The Honolulu WWTP is the other sewage treatment plant in this area growing area that can furnish clean irrigation water."
It appears from the above statements that the primary source of exchange water could be from the Honolulu WTP, but there has not yet been a definitive agreement. If the effluent from the Honolulu WTP is the likely source of exchange water, then the following statement must be clarified:

"The treated sewage from the Honolulu WTP will be discharged into the ocean by a deep water outfall at Barbers Point. If secondary treatment is required, the treated effluent possibly could be reclamined for irrigation purposes. However, exact plans for any eventual reclamation have not been finalized for the Honolulu WTP."

These critical inconsistencies in the proposed operational plans must be addressed if the EIS is to be fundamentally sound.

In addition to the conflicts presented in the preceding discussion, regarding the reusing of water from the Honolulu WTP, there may be a conflict with the Hawaii State Plan's proposals for water conservation. Policies of the State Plan are stated on page 3-6.

A heuristic re-use and recycling to reduce solid and liquid waste and develop a conservation ethic.

Section (b)(3): "Reclaim and encourage the productive use of run-off water and waste water discharge."

It appears from this EIS that if the EPA will allow primary-treated sewage effluent to be discharged into the ocean (pages 3-5A, 3-5B), then this is the designation of the effluent from the Honolulu WTP. When the plant is at capacity, 25 mgd, this is more than 30% of the total ionic yield of the Pearl Harbor ground water body. The Board of Water Supply should clarify whether only a portion of this effluent is slated for the ocean discharge, or if the ocean discharge is being proposed only for flood-water runoff.

The EIS states that "The project does not appear to be inconsistent with the facility system objectives and policies," which are those in the State Plan listed as sections (b)(2) and (3). The project does appear to be inconsistent with the objectives and policies of the State Plan if the effluent from the Honolulu WTP is to be discharged into the ocean rather than reused.
Page 4-32
Comment
There is reference for Hawaiian Telephone's statement regarding no difficulties in servicing this facility. In addition, the statement in the EIS is rather broad, and doesn't even really refer to the pumping station specifically. "... to the sea area" could refer to wording to specify the facility in question.

Page 4-33
Comment
What is a Department of Education CIP? Should be defined.

Page 4-35
Comment
Increased public costs are mentioned as a possible effect if new medical services are needed for future population growth. Would not such services create increased job opportunities? This socioeconomic effect is not included for medical services, as it is for fire and police services in the preceding paragraphs.

Page 6-4
Comment
"The diluted effluent from Honolulu WWTP will be used in irrigation..." So far the agreement has not been finalized. If the implicit user is Oahu Sugar Co., then the verb should be in the future subjunctive: "No... effluent... would be used..."

Page 6-6
Comment
... about 25 mgd could be supplied by the Honolulu WWTP and about 8 mgd by the Fillmore ZIP.

Page 6-5
Comment
"... discharge into the ocean. Now firm in this number, when it is being presented as if it could be captured and used as a source of exchange water..."

Appendices
Page 1 Comment
"Whichever" is misspelled.

Page 1 Comment
"Lines" is misspelled.
"No rare of endangered..." Should be "No rare or endangered..."

"For water year 1977 (October 1976 to September 1977)..." Should be either "(October 1976 through September 1977)" or "...to October 1977)"

"This water is suitable for domestic use although mineralized." Should be "This water, although mineralized, is suitable for domestic use."

The description in the key for brackish ground-water symbol in Figure 2-6 has "...volcanic aquifer" rather than "volcanic aquifer."

Figure 2-9 needs a legend.

"Manufacturing is modest."

"These particular estimates only would be true when there are..." Shouldn't it be "estimates would be true only when there are..."?

"Potential problems by coordinating construction with Ohau Sugar..." Should be "...by coordinating with Oahu Sugar Co. construction scheduling to avoid conflict..."

"This is discussed in greater depth..." Should be either "at greater depth" or in greater detail.

"...decline in...quality...of the sources used...on sugar cane, as much as these have chloride contents..." Do you mean the sugar cane or the water? Should probably be "...as most of the sources have..."?

"...information on water conservation..."

"...acceptance and cooperation has been good." Should be "...have been good."

"...adopted by industry as well as individuals." Should be "...by industry as well as by individuals."

"...paid a sewer charge based on $0.75..."

"...decreasing withdrawals..." Should be "withdrawals."

"...is shown in Figure 6.1."

Mr. Benjamin L. Jones
District Chief
Water Resources Division
Geological Survey
U. S. Department of the Interior
P. O. Box 50146
Honolulu, Hawaii 96816

Dear Mr. Jones:

Subjects: Your Letter of March 2, 1982 on the Environmental Impact Statement (EIS) for Hoomaluhia Wells

Thank you for reviewing the draft EIS for our proposed water development project. Your letter to the mayor has been referred to us for reply and will be appended to the revised environmental document.

We offer the following information in response to your comments:

1. Until the re-use of treated sewage effluent by Oahu Sugar Company (OSC) is resolved, the matter of exchange cannot be pursued. Therefore, no specific OSC sources are mentioned in the draft EIS for possible exchange.

2. The Hoomaluhia Waste Water Treatment Plant (WWTP) is the preferred source of water to be exchanged with OSC. Although the primary effluent disposal system for the Hoomaluhia WWTP is the ocean outfall, modifications can be made in the future if it is found to be cost effective to accommodate the water exchange program.
3. The proposed water exchange concept is consistent with the Hawaii State Plan since it encourages the re-use of liquid waste and use of runoff water by using lower quality water for irrigation purposes below H-1 Freeway, thus promoting conservation.

4. The water from the Makahilo WWTP could be replaced with effluent from the Honolulu WWTP. The amount of sewage that could be diverted for the water exchange proposal will depend on the amount of sewage that OGC would accept. This information will be incorporated into the ES.

5. Page 3-40 will be corrected to indicate West Beach is located south of Maukini.

6. On page 3-7, sections 1 and 6 refer to the ES for Honolulu WWTP.

7. We concur with your statement that the Kaula Wells will probably experience a drop in head level if the cutback is not at Farr Shaft.

8. The study to determine pumpage feasibilities at lower head levels is being done by John F. King. He concluded that "at low head a unit change in sustainable yield results in much larger loss of storage than the same unit change at high head.

9. The population statistics are based on the State's II-Y population projections, the Board of Water Supply's Water System Standards, and the master plan for Makahilo City.

We cannot conclude any demographic predictions regarding water allotment.

10. We shall revise our statement on page 4-17 to indicate that smoke and ash will not adversely affect mechanical equipment. Our mechanical equipment is maintained to minimize the corrosive effects from smoke and ash.

11. In Chapter 3 of our Rules and Regulations are conditions and actions that may be implemented during periods of "low" groundwater levels.

12. The feasibility of dual systems and alternate systems is being reviewed as part of our conservation program. There are many health and operational problems that must be resolved before such systems can be promoted.

13. The feasibility of re-using treated sewage effluent for agricultural irrigation has been confirmed. However, the pumping problem of using the effluent in OGC's drip irrigation system has to be resolved.

14. The Department of Education's CIP is their capital improvements program which is a planning tool to determine fiscal cost allocations for their construction projects.

15. Pages 4-34 and 4-18 will be revised to reflect your concern that public storage would increase but, at the same time, would provide job opportunities for health care.

16. On page 6-4, the last sentence will be revised to indicate that treated effluent could be used for irrigation instead of the H-1 Freeway.

Although 33 mgd of sewage would be available for re-use, OGC's plan to utilize the effluent is uncertain. The ocean outfall would still be the primary method of disposal.
Mr. Benjamin L. Jones

March 18, 1982

17. The 43 mgd of spring water mentioned on page 6-5 is an estimated amount from which only a portion may be economically developed. This information will be reflected in the revised EIS.

18. We will correct the misspelling of "whichever" on page A-4.

19. Figure A-14 will be corrected to show the depth arrow extending only to the 50% concentration line.

20. The footnote (2) in Table A-7 is correctly located since the figure 214 refers to ppmage.

21. The phrase "with an useful certainty" will be revised to read "with any useful certainty" on page A-52.

22. The data on water demand versus sustainable capacity on page A-56 is presented to show that island-wide demand is approaching the island's sustainable capacity. We had no intention of implying that water demand has dropped.

23. All the typographical errors and editorial revisions that are mentioned in your comments will be corrected in the revised EIS.

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

Very truly yours,

[Signature]

cc: Eileen R. Anderson, Mayor

Andrew I. T. Cheng,

Manager and Chief Engineer

Environmental Impact Study Corp.

January 28, 1982

Honorable Eileen R. Anderson
Mayor, City and County of Honolulu
650 South King Street
Honolulu, HI 96813

Dear Mayor Anderson:

Subject: EIS for Honolulu Wells - Board of Water Supply

We have reviewed the subject environmental impact statement and have no comments to make.

Thank you for the opportunity to review this document.

Sincerely,

[Signature]

Jace P. Kamaz
State Conservationist

cc:

Board of Water Supply, City and County of Honolulu

Environmental Quality Commission, State of Hawaii
Dear Mayor Anderson:

We have reviewed the subject Environmental Impact Statement (EIS) and offer the following comments.

The EIS would be enhanced by including a description of aquatic resources and related impacts upon these resources. (For example, fishes and crustaceans inhabiting the terminal reach of nearby Waiola Stream provide a substantial forage for residents of the Kaa Iwi area. Sedimentation of stream flow at lagoons might lead to a net loss of these resources.) We also urge the Board of Water Supply to consider the cumulative impacts of this and other ongoing water development projects on stream and coastal water quality, recreation, wetland agriculture, aquaculture, and other instream uses, and the biological productivity of Oahu's streams and nearshore waters.

We would appreciate receiving an EIS Preparation Notice for future water development projects so that we may evaluate fish and wildlife resources during the early planning stages and avoid conflicts or delays in project review. Thank you for the opportunity to comment on this EIS.

Sincerely yours,

Effort Kozaka
Project Leader
Office of Environmental Services

cc: Board of Water Supply
     HDFS
     HONU
     EPA, San Francisco

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Save Energy and You Serve America!
HEADQUARTERS
NAVAL HARBOR ENGINEERING SERVICE CENTER
P.O. BOX 8000
PORT HUENURN, CALIFORNIA
02/15/62
002-0092:1
SER 209
10 FEB 62

Reference: Letter dated 12 January 1962, with the subject EIS has been reviewed and the following comments are provided for your information.

1. Water Exchange Agreement (5-2). It is stated that the project will proceed only after a water exchange agreement is settled with the Oahu Sugar Company and the permit for the proposed development and water exchange is approved by the State according to Department of Land and Natural Resources Regulation No. 9.

   Comment: Since publication of the EIS, the future of the sugar industry and the Oahu Sugar Company in particular appears in doubt. Should the Oahu Sugar Company be liquidated in the near future, the project may be abandoned, and the agreement affected. These options and implications must be assessed to determine that no net increase in pollution from the Pearl Harbor area will occur even if Oahu Sugar operations were reduced or phased out.

2. Development Orientations (1-19). The 9.0 mgd of water to be developed at Honolulu would initially serve developments planned for the Kakaako Industrial Park, Makaha, and other areas of the West Oahu Plain. It is unclear how future authorized development will be served.

   Comment: The City & County Development Plans for the Oahu District have encouraged further urban development that will place heavy demands upon the future water supply. Availability of adequate water should be a prerequisite for urban development approvals.

3. Military Requirements. The present estimates for U.S. Navy water needs in the Pearl Harbor area are based upon normal or peacetime conditions.

   Comment: During an emergency or defense buildup, facilities, fleet, and personnel within Pearl Harbor may require heavier water consumption, and this may require stringent conservation by all users.

4. Naval Air Station, Barbers Point Water Supply. The Navy's Barbers Point water supply is the sole source of supply for NAS BAPB. The quality of the water is extremely satisfactory. It is marginal at present and could be adversely affected by the Honolulu Water Supply, especially when fully developed and pumping at the 5,000 mgd operating capacity.

   Comment: It is recommended that a connection be made between the proposed transmission main and the Navy's existing reservoir so that the Honolulu Water Supply can be diverted for use in the event that the Navy's Barbers Point reservoir water source deteriorates in quality to an unacceptable level. Otherwise, the Navy must object to the proposed Honolulu Water Supply, as there is no assurance that the Navy's Barbers Point water source will not be adversely affected.

5. West Loch Reservoir (4-6-68). Among the alternative water sources cited is the West Loch Reservoir. Under this plan, West Loch would be dammed to create a reservoir to capture flood flows from Waikiki Stream. The large storage reservoir in West Loch would make it possible to store the high flows during the rainy months for use during the drier months. The dam of 2,500 feet could provide a 2.3 billion-gallon reservoir.

   Comment: The U.S. Navy is on record as willing to support such a West Loch Reservoir, and it recommends that it be considered as the viable alternative to Honolulu Water Supply. It increases the available fresh water by capturing runoff normally lost to the sea and once installed, would require little manpower or energy for operation and maintenance. Since it would be located in an area controlled by the U.S. Navy, it could be negotiated for rights to part of the water produced, thereby increasing the water available to the Navy.

   Therefore, the U.S. Navy recommends that the City & County of Honolulu reconsider the problem involved with Honolulu Water Supply and address the five major points raised before further considering the project.

   Should the City & County of Honolulu, Board of Water Supply, or consult with representatives wish to discuss the matter further, please contact Lieutenant Commander Robert L. Eldredge (417-8471) to arrange an appointment.

Sincerely,

M. J. DALLAN
CAPTAIN, CEC, U.S. NAVY
FACILITIES ENGINEER
BY DIRECTION OF THE COMMANDER

Copy to:
Board of Water Supply
February 25, 1962

Captain M. M. Dallam
Facilities Engineer
Headquarters, Naval Base
Pearl Harbor
Box 110
Pearl Harbor, Hawaii 96860

Dear Captain Dallam:


Thank you for reviewing the draft EIS for our proposed water development project. Your letter to the Mayor has been referred to us for reply, and it will be appended to the revised environmental document.

We have the following responses to your comments:

1. Comment: Since publication of the EIS, the future of the sugar industry and the Oahu Sugar Company in particular appears in doubt. Should the Oahu Sugar Company pass out of the sugar business or be phased out in the near future and should the attempt be made to increase urban land use of the properties, the picture would change, and the agreement affected. These options and impacts must be assessed to ensure that no net increase in pumping from the Pearl Harbor aquifer would occur even if Oahu Sugar operations were reduced or phased out.

The Pearl Harbor aquifer (Pearl Harbor ground water control area) has a limitation on draft of 225 mgd. Total pumps for that ground water control area cannot exceed that limit no matter what use is proposed in that area.

2. Comment: The City & County Development Plans for the Ewa District have encouraged further urban development that will place heavy demands upon the future water supply. By allowing development to outstrip water supplies, the City & County now is forced to provide new wells. The availability of adequate water should be a prerequisite for urban development.

We have not allowed development to outstrip water supplies. In the Ewa area, we have imposed a moratorium on building until sufficient sources, transmission systems and storage are provided.

3. Comment: During an emergency or defense build-up, facilities, fleet, and personnel within Pearl Harbor may require heavier water consumption, and this may require stringent conservation by all users.

We concur that stringent conservation measures may need to be imposed to stretch our available water supply to meet any emergency or defense build-up at Pearl Harbor.

4. Comment: It is recommended that a connection be made between the proposed transmission main and the Navy’s existing reservoir and that the Honolulu Well water can be diverted for Navy use in the event that the Navy’s Barber’s Point water source deteriorates in quality to an unacceptable level. Otherwise, the Navy must object to the proposed Honolulu Well, as there is no assurance that the Navy’s Barber’s Point water source will not be adversely affected.

We have no objection to making an Interconnection with the Navy sharing in the cost. However, the well project should not affect the Navy wells because the sustainable yield of the basin will be maintained as there will be no net increase in pumpage.

5. Comment: The U.S. Navy is on record as willing to support such a West Loch Reservoir and it recommends that if it be considered as the viable alternative to Honolulu Wells. It increases the available fresh water by capturing runoff normally lost to the sea and needles to the City & County could provide little manpower or energy for operation and little maintenance. Since it would be located to an area controlled by the U.S. Navy, it could then negotiate for rights to part of the water produced, thereby increasing the water available to the Navy.

The proposed West Loch Reservoir is in a conceptual stage and we find that it is not cost effective nor viable at this time. In any event, we will be working closely with the Navy, should we decide to investigate this project further.
February 25, 1982

IF you have any questions, please contact Lawrence Whang at 548-5321.

Very truly yours,

Koichi Hayashi
Manager and Chief Engineer

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS US AIR FORCE
WASHINGTON D.C. 20330

RE: Environmental Impact Statement for the Honolulu Wells

SUBJECT: Office of Environmental Quality Control
500 Kakaako Street, Room 301
Honolulu, HI 96813

1. This office has reviewed the subject EIS and has no comment to render relative to the proposed project.

2. We greatly appreciate your cooperative efforts in keeping the Air Force apprised of your project and thank you for the opportunity to review the document.

KENNETH M. COHEN, Colonel, USAF
Director of Civil Engineering

Cc: Mayor Eileen Anderson
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96813

Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96813
Mr. Hideo Murakami
State Comptroller
Department of Accounting
and General Services
P.O. Box 119
Honolulu, Hawaii 96810

Dear Mr. Murakami:

Subject: Your letter of January 19, 1982, on the Environmental Impact Statement for Honouliuli Wells

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,

Razu Hayashi
Manager and Chief Engineer

cc: Environment Impact Study Corporation
MEMORANDUM

To: Mayor Eileen Anderson
   City and County of Honolulu

Subject: Environmental Impact Statement

HONOLULU, HAWAII 96813

February 22, 1982

Mr. Mayor,

The Department of Agriculture has reviewed the subject Environmental Impact Statement and offers the following comments.

We note that the proposed project is dependent upon arrangements with Oahu Sugar Company "for them to cut back an equal amount of ground water pumped so that net pumping from the Pearl Harbor aquifer will remain the same." As stated on page 4-23, "the City will compensate Oahu Sugar for this reduction in pumping by offering water of lower quality in exchange, on a gallon-for-gallon basis." This raises a question regarding the impacts the proposed water exchange would have on Oahu Sugar Company.

In the Board of Water Supply reply to the Department of Agriculture's concerns (Page 11-13 to 14) is a statement that Board of Water Supply's correspondence with Oahu Sugar Company indicates that Oahu cutback in acreage for urbanization is due to poor water quality at Waimalu. Thus, it would seem that a water exchange might be detrimental to Oahu Sugar Company by providing them lower quality water and thus potentially reducing their yield which varies with irrigation practices, quality of the water, and cane variety. Page 1-20 further states that treated sewage effluent is the preferred choice with water for mixing during 20 plantation sources.

Research by Dr. L. Stephen Lou, Principal Investigator of the Millennial Recycle project found that: " Chlorinated, secondary treated, domestic sewage effluent with N concentrations up to approximately 25 ppm, can be successfully used in furrow irrigation for the entire 3-year crop cycle of sugarcane if the effluent is diluted with fresh water so that the concentration of effluent is 235 or less." (Reusing Water From Sewage by Irrigation: Final Summary of a Dilution Study, Millennial, O'ahu, Hawai'i, Project Bulletin, University of Hawai'i, Water Resources Research Center, No. 32, Feb. 1981). This would mean that Oahu Sugar would have to provide a substantial amount of additional water to mix with effluent if it only receives effluent for its high quality water. From the information provided, this would seem to be an infeasible arrangement for Oahu Sugar Company.

We believe it would be useful for the EIS to differentiate between the approved and planned (without approval) major proposed developments on pages 4-42 through 4-44 and in Table A-3 on page A-65. It is unclear which of the projects are to be located on land already in the urban district, which would require a District boundary amendment, and to how much land would still be unurbanized urban district land which could later be developed and further increase the potential demand for water. While we recognize that the Board of Water Supply does not specify how any land is to be used, the availability of water may indeed be an impetus to the decision by the landowner to urbanize agricultural land.

This Department remains deeply concerned about the secondary impacts that this project may have upon prime agricultural lands in sugarcane production in the Ewa-Kea area.

Thank you for the opportunity to comment.

Jack G. Eagle
Chairman, Board of Agriculture

cc: Board of Water Supply

"Support Hawaiian Agricultural Products"
April 19, 1982

Mr. Jack K. Sono, Chairman
Board of Agriculture
State of Hawaii
P. O. Box 22159
Honolulu, Hawaii 96822

Dear Mr. Sono:


Thank you for reviewing the draft environmental impact statement for our proposed water development project. Your letter to the Mayor which will be appended to the revised environmental impact document, has been referred to us for direct reply.

We offer the following information in response to your comments:

1. Our joint study with the City Department of Public Works, the University of Hawaii, and Oahu Sugar Company indicates that mixing one part of secondary treated sewage effluent with three parts of Wai'apea Ditch water is suitable for surfage irrigation. The amount of water to be exchanged depends upon the amount of Wai'apea Ditch water available for mixing with the treated effluent and the irrigation requirements of fields to be retained in surfage irrigation. Oahu Sugar Company will have to decide how much treated effluent they can use.

A study by the University of Hawaii has indicated that the use of secondary treated sewage effluent in drip irrigation systems is unacceptable since it causes plugging in the tubes. If this problem is resolved, additional water could be exchanged with the plantation. The university is currently working on this problem.

2. Only developments westward of Kualoa Road would be served by the proposed project. The proposed developments listed in Table A-10 that have received full or partial water commitments are:

A. Village Park
B. Nakaoilo
C. Campbell Industrial Park

Mr. Jack K. Sono

D. Gentry Malipo
E. William Town
F. Royal Summit

The six developments with either full or partial water commitments occupy lands that were reserved from agricultural use to urban use. All the other proposed development are on lands presently zoned for agricultural use. Before any additional agricultural unused land can be used for urban purposes, a zone change amendment will be required.

Land use is the responsibility of the City's Planning Department and the State Land Use Commission. We have the responsibility to provide water to service the land uses determined by the City's Development Plans. Although water is an important utility, it does not determine land use; there are many other factors that are considered in setting the land uses covered in the Development Plans.

If you have any questions, please contact Lawrence Wang at 348-3122.

Very truly yours,

Kozo Uyeshita
Manager and Chief Engineer

Oui: Allen B. Anderson, Mayor
Andrew J. T. Chang, Managing Director
Environmental Impact Study Corp.
January 27, 1982

Captain Jerry H. Matsuda
Contract and Engineering Office
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 18, 1982, on the Environmental Impact Statement for Honouliuli Walls

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 Mano at 548-0271.

Very truly yours,

[Signature]

MARIO M. MURAOKA
Manager and Chief Engineer

cc: Board of Water Supply

cc: Environment Impact Study Corp.
April 7, 1982

Mr. Charles G. Clark, Director
Department of Health
State of Hawaii
P. O. Box 2378
Honolulu, Hawaii 96801

Attention: Mr. Melvin K. Kofuuchi

Dear Mr. Clark:

Subject: Your Letter of February 26, 1982, on the Environmental Impact Statement for Honolulu Wells

Thank you for reviewing the environmental impact statement of our proposed water development project. Your letter to the Mayor which will be appended to the revised environmental impact document, has been referred to us for direct reply.

The final construction plans will be submitted to your department for review. We acknowledge that you may impose environmental restrictions on the project.

If you have any questions, please contact Lawrence Wang at 548-5911.

Very truly yours,

[Signature]

[Name]
Manager and Chief Engineer

cc: Eileen N. Anderson, Mayor
Andrew I. T. Chang,
Managing Director
Environment Impact Study Corp.
Hoa. Eileen Anderson  
February 9, 1982  
Page 2

does not confirm the absence of historical, cultural, architectural and/or archaeological resources on the property. If any previously unidentified sites or remains (such as artifacts, shell, bone, or charcoal deposits; human burials, rock or coral alignments, pews, or walls) are encountered, please inform the applicant to stop work and contact our historic sites office at 348-7460 immediately.

Sincerely,

[Signature]

[Name]
Board of Land and Natural Resources and State Historic Preservation Officer

Honoroble Eileen Anderson  
Mayor of Honolulu  
630 Ewa, King Street  
Honolulu, HI 96813

Dear Mayor Anderson:

We have reviewed the EIS for Honolulii Wells and appreciate the opportunity to do so.

The proposed project involves the drilling of a battery of six wells, each having a capacity of 2 mgd for a total of 12 mgd installed capacity. The production capacity is rated at 9 mgd and the intended use is to provide additional municipal water supply for urban development in the Ewa area.

As pointed out in the EIS, the Honolulii Wells are located in the Pearl Harbor Ground Water Control Area administered by the Board of Land and Natural Resources. As such, prior approval of the Board is necessary before the project can proceed. Also, before the Board of Land and Natural Resources can accept and process a water withdrawal permit, a water exchange agreement between the Board of Water Supply and Oahu Sugar Company needs to be worked out between the parties. The object of the agreement would be no net increase in groundwater withdrawal from the Pearl Harbor aquifer.

Our records indicate that this project does not occur on historic properties listed on the Hawaii Register or the National Register of Historic Places or eligible for inclusion on the National Register of Historic Places. Due to the lack of archaeological surveys in the vicinity, we are not aware that significant resources exist in the project area. This
February 24, 1982

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

Dear Mr. Coo:

Subject: Your Letter of February 9, 1982, on the Draft Environmental Impact Statement (EIS) for Honolulu Nalas

Thank you for reviewing the draft EIS for our proposed project. Your letter to the Mayor has been referred to us for reply and will be appended to the revised environmental document.

We have the following response to your comments:

1. A transfer of preserved use will be arranged so that there will be no net increase of pumping from the Pearl Harbor Groundwater Control Area.

2. A clause will be included in the construction contract stating that if any historical, cultural, architectural, and/or archaeological resources are encountered, all work will stop and your Historic Sites Office will be contacted.

If you have any questions, please contact Lawrence Hwang at 548-5121.

Very truly yours,

[Signature]

RASHID NAVASHAID
Manager and Chief Engineer

cc: Eileen R. Anderson, Mayor
    Andrew I. T. Chang, Managing Director
    Environment Impact Study Corporation

February 16, 1982

Ref. No. 4177

The Honorable Eileen R. Anderson
Mayor
City and County of Honolulu
Honolulu, Hawaii 96813

Dear Mayor Anderson:

SUBJECT: Environmental Impact Statement for Honolulu Nalas

We have reviewed the subject document and find that it has adequately assessed the environmental impacts which can be anticipated to result from the proposed project.

Further, we note that the EIS has adequately addressed our comments of December 7, 1981, with regard to Onekawa, policies and priority directions of the Hawaii State Plan.

Thank you for the opportunity to comment on this matter.

Sincerely,

[Signature]

cc: Board of Water Supply
    City and County of Honolulu
    Office of Environmental Safety Control
January 21, 1982

The Honorable Eileen Anderson
Mayor, City and County of Honolulu
639 South King Street
Honolulu, Hawaii 96813

Dear Mayor Anderson:

Environmental Impact Statement
Hoouluuli Wall

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

We have reviewed the document and concluded that we have no substantive suggestions to offer to improve the document.

Very truly yours,

[Ryoichi Higashinuma]
Director of Transportation

cc: Board of Water Supply

February 10, 1982

Dr. Ryoichi Higashinuma, Director
Dept. of Transportation
State of Hawaii
809 Punchbowl Street
Honolulu, Hawaii 96813

Dear Dr. Higashinuma:

Subject: Your Letter of January 21, 1982, on the Environmental Impact Statement for Hoouluuli Wall

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 Wang at 548-5221.

Very truly yours,

[Signature]

For Kazu Kayashima
Manager and Chief Engineer

cc: Environmental Impact Study Corporation
January 25, 1982

Mr. Gordon Y. Furutani
Executive Officer
Land Use Commission
Department of Planning & Economic Development
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Mr. Furutani:


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 Kiang at 548-3721.

Very truly yours,

[Signature]

Ezuru Kiyoshima
Manager and Chief Engineering

cc: Environment Impact Study Corp.

Gordon Y. Furutani
Executive Officer

Honorable Aliena Anderson
Mayor, City and County of Honolulu
630 South King Street
Honolulu, HI 96813

Subject: Environmental Impact Statement Prepared for Honolulu

Dear Mayor Anderson:

Thank you for the opportunity to review the above project. We have no comments regarding the proposal except to confirm that the well sites are located within the State Land Use Agricultural District.

Sincerely,

[Signature]

GORDON Y. FURUTANI
Executive Officer

cc: Board of Water Supply
Mayor Eileen Anderson
City and County of Honolulu
610 South King Street
Honolulu, Hawaii 96871

Dear Mayor Anderson,

The Environmental Center has reviewed the above cited document with the assistance of James Parikh, Hawaii Cooperative Fishery Research Unit; Paul Shindo, Agronomy, and Soil Sciences; Dean C. Cox, Jacqueline H. Miller and David Peterson, Environmental Center. Personnel from other departments with expertise in water resources were also consulted.

The potential impacts of the proposed project that are of greatest concern are of a hydrological nature. Unfortunately, the EIS does not adequately describe the regional hydrology and contains many unsupported assertions. Impacts on the hydrologic regime in turn may create water quality problems.

Hydrology

The total aquifer system from which groundwater will be taken is not well defined by the EIS.

Appendix A (pages A-3, A-7, and A-4) mentions two possible areas, the Pearl Harbor Ground Water Control Area (PHGWCA), and in Koapai area, the other in Wai‘anae area. However, no attempt is made in the EIS to discuss the existence and the importance of the distinction between these hydrologic areas. In relation to the effects of pumping, present or recent facts are indicated for wells in the area in Table A-3, page 2-72, and the locations of the wells are shown in Figures 2-A, page 2-21, but the locations and levels are not contained in an isopachic map.

The hydrologic separation between the Koapai and Wai‘anae areas results primarily from a prism of sediments unconformably overlying the Wai‘anae aquifer and underlying the Koapai aquifer. Figure 2-A, however, shows only an "unconformity" in a generalized form, far from accurately mapped. Figure 2-5 indicates the "unconformity" as an inclined surface, sloping downward to the east and southeast and implies that only brackish and

Salt water can be found in the Wai‘anae aquifer. However, depending on the location of the section line used to draw the geologic cross-section, it is likely that fresh water exists in the Wai‘anae aquifer as well.

The EIS appropriately indicates that the proposed development would have an impact on the brackish groundwater resources of the area if there were not existing and existing wells. It also indicates that, in spite of the exchanges in the form of water exchanges, these impacts would be significant or slight, depending on the location of the wells. The DEIS further indicates that the existing wells have an impact on the distances between the proposed and existing wells. It does not seem to recognize all of the much greater influence of the existing wells on the distances between the two aquifers.

The distribution of the effects of the draft of the proposed wells will depend, of course, on whether the draft is taken at the Koapai aquifer alone or at both the Koapai and Wai‘anae aquifers. The distribution of the effects of the reduction in draft from existing wells resulting from the proposed water exchanges will depend upon which of the two aquifers are tapped by the wells whose draft will be reduced. As stated above, the water level will affect the amount of water recharged to either both of the aquifers. The changes in recharge will depend on the areas in which the changes in recharge will occur relative to the boundary between the areas recharging the two aquifers.

There is simply no way in which the impacts of the proposed project can be discussed intelligently without reference to the existence and spatial relations of the two aquifers.

References

Discussion on pages 2-17 and A-32 state the potential for entering the brackish transition zone in areas lying towards the coast. If the project wells tap the Koapai aquifer, and salt water may be observed in Koapai and Wai‘anae wells with a consequent increase in dissolved solids levels. Although the water quality data in Tables 2-3 and A-1 indicate relative low chloride concentrations in these wells, total dissolved solids (TDS) levels do not exceed the EPA recommended secondary limit of 500 ppm and may exceed the limit if transition zone mixing is increased.

The water quality of these and other neighboring wells is a serious cause for concern, particularly on 5 of the 30 wells, or 20% of the group. No clarification is given as to whether the water has been sampled because they were originally drilled too deep or because they have gradually experienced increased dissolved solids levels with time.
The DEIS (pages 4-11 through 4-16) uses a general approach in discussing potential effects on the quantity and quality characteristics of neighboring wells, stating that page 4-123 the "new wells have been placed hydrologically to have the least effect on other wells in the vicinity." It would be helpful if those wells most likely to be affected by the change in pumpage location could be addressed more specifically. Objective assumptions and procedures used in the hydrogeological planning process, including a single map indicating all well locations with respect to the regional potentiometric surface, would also assist in understanding the impact assessment.

We encourage the close monitoring of neighboring wells to identify quantity and quality impacts (pages 4-11 and 4-16), so that modifications in well operation can be quickly implemented. The pumping of all project wells at a continuous rate, as opposed to alternating discharges between wells (pages 1-19, 1-20), is also strongly recommended to prevent accelerated mixing in the transition zone.

**Water Budget**

Assuming that all groundwater withdrawal occurs in the same volcanic aquifer, the water exchange proposal assumes no net increase in pumpage. However, the potential for reduced recharge does exist. If Oahu Sugar elects to use drip irrigation during the application of exchange water provided by DEIS, the secondary recharge that has historically occurred will be reduced considerably.

From the text given on page A-16, it can be deduced that the existing water demands in the DEIS are high, and may already exceed the groundwater supply which includes recharge from surface irrigation (approximately 50 percent of water applied). If drip irrigation becomes the alternate mode of application, average annual groundwater replenishment will be curtailed accordingly, possibly well below the water demands foreseen for the end of this century. Perhaps a discussion of this possible shortfall should be included in the secondary impacts section of Chapter 6.

The map of Appendix 3 does not show those areas set aside for drip irrigation, and these designated for conventional furrow methods. Economics, and the difficulties associated with the application of irrigation through drip irrigation, will likely dictate where each respective form of irrigation can take place.


The inference on page A-16 that most recharge from rainfall occurs above the 10-inch islet area can be questioned. Recent field research by personnel from the Water Resources Research Center (WRRC) suggests that significant recharge occurs primarily in those regions above the 50-inch islet and possibly higher. This conclusion is reached from studies of accumulated precipitation on the dry side of this rainfall area.

**Bibliography**

The discussion on pages 2-11 and 2-12 mentions terrestrial flora and fauna but says nothing about aquatic species. If reduced flows, increased dilution or other effects on stream life on Waialua Stream or the lower reaches of Hoohuli Stream are possible, then it is worth considering what life forms exist there.

To reduce dilution over the 2,000 feet of transmission line construction adjacent to Hoohuli Stream, precautionary grading techniques, as mentioned on page 4-2, should be included. In the interest of avoiding deleterious effects on fauna in the lowest reaches of the stream, construction of the transmission line during the dry season is suggested.

Yours truly,

[Signature]

Asst. Gen. M. C. Cox
Director

cc Office of Environmental Quality Control James Parikh Paul D. H. Miller David Peterson Water Resources Research Center
March 19, 1982

Dr. Doak C. Cox, Director
Environmental Center
University of Hawaii at Manoa
2550 Campus Road, Honolulu
Honolulu, Hawaii 96822

Dear Dr. Cox:


Thank you for reviewing the draft EIS for our proposed water development project. Your letter to the Mayor has been referred to us for reply and will be appended to the revised environmental document.

We offer the following information in response to your comments:

1. The basalt aquifer system from which groundwater will be taken is not well defined in the EIS.

   This section will be rewritten incorporating data from Mr. John Hall's 1980 Report on Southern Oahu.

2. Appendix A (pages A-4, A-7, and A-8) mentions two geologic areas in the Pearl Harbor Ground Water Control Area (PHGCCA). One in Koolau Lanes, the other in Molokai Lanes. However, no attempt is made to discuss the existence and the importance of the distinction between these geologic areas in relation to the effects of pumping. Our present or recent heads are indicated for wells in the area in Table 1-1, page 1-8, and the location of the wells are shown in Figure 2-7, page 2-8, but the locations and heads are not combined in an geologic map.

   A discussion on the existence and the importance between the two geologic areas in the Pearl Harbor Ground Water Control Area will be included in the revised EIS.

   Figure 2-7 will be revised to indicate the approximate boundary of the two geologic areas.

3. The hydrologic separation between the Koolau and Molokai Lanes results essentially from a group of arcuate unconformities underlying the Molokai Lanes. Figure 3-4, however, shows only an "unconformity" in a generalized form, far from accurately mapped. Figure 3-4 indicates the "unconformity" as an inclined surface, dipping downward toward the east and northeast, and implies that only fresh and salt water can be found in the Molokai aquifer. However, depending on the location of the section line used to draw the geologic cross-section, it is likely that fresh water exists in the Molokai Lanes as well.

   Figure 2-4 shows the unconformity as lying west of the sites of the proposed wells, suggesting that the wells will pump the Koolau aquifer alone. However, in a letter from the USDA to the BUI dated December 10, 1978, pages 21-42, through 21-43, the depth of the unconformity is estimated at about 100 feet below sea level, well above the 500-foot depth below sea level shown at the site of the proposed wells in Figure 2-4. If the boundary is at a shallower depth, the potential for withdrawing groundwater from the Molokai aquifer as well as the Koolau aquifer is enhanced.

   We concur with your interpretation of Figures 2-4 and 3-4. Figures 2-4 and 3-4 will be deleted and replaced with a generalized cross-section (attached). The USGS cross-section reveals a fault running through the center of the section. Our attached cross-section shows the Molokan surface projecting to roughly 500 feet below sea level instead of 200 feet below sea level as indicated on the USGS section.

   Therefore, it is unlikely for our proposed wells to pump through the Koolau aquifer and into the Molokai basin aquifer.

4. The EIS appropriately indicates the very grave impact that the proposed development would have on the coral groundwater resources of the area if there were not offsetting measures in the form of water exchanges. It also indicates that in spite of the exchanges, there will be some impacts. As stated on page 4-11, these impacts will be relative, insignificant, or of no existing wells and possibly negligible at others. The EIS further suggests the differences will be in part related to the distance between the...
proposed and existing wells. It does not seem to recognize at all the much greater influence of the separation between the two aquifers.

The distribution of the effects of the draft of the proposed wells will depend, of course, on whether they tap the Buena aquifer alone or both aquifers and the Buena aquifer as well. The distribution of the effects of the reduction in drafts from existing wells resulting from the proposed water exchanges will depend upon which of the two aquifers are tapped by the wells whose drafts will be reduced. As we will show later, the water exchanges may affect the quantity and quality of water exchanged to either both of the two aquifers. The distribution of the recharge effects will depend on the areas in which the changes in recharge will occur relative to the boundary between the areas recharging the two aquifers.

There is simply no way in which the impacts of the proposed project can be assessed intelligently without reference to the existence and spatial relations of the two aquifers.

As mentioned previously, a discussion on the existence and spatial relations of the two aquifers will be included in the revised EIS.

Also, as indicated in the attached cross-section, it is unlikely that we will tap into the Hualalai aquifer. Should the Hualalai aquifer be tapped, an exchange of water must occur to maintain equilibrium conditions.

5. Discussions on pages 2-17 and 2-18 state that potential water levels include the bottom of the Halloa transition zone in areas lying towards the west. If the project wells tap the Buena zone, such effects may be observed in Kula 7 and Recessa wells with a consequent increase in dissolved solids levels. Although the water quality reports of Tables 2-2 and 2-3 indicate relatively high chloride concentrations for these wells, total dissolved solids (TDS) levels far under the EIS recommended secondary limit of 100 ppm, and may exceed the limits of transition-zone mixing increased.

We concur with your interpretation.

6. The water quality of these and other neighboring wells is a serious cause for concern, particularly in the light of discussions given in Appendix A to which it is stated (pages 2-13, 2-14) that "other than the well yields show a general decline in chloride concentration, owing to the salinity of the deeper wells in the group." The clarification is given as to whether the wells have been sealed because they were originally drilled too deep or because they have gradually experienced increased dissolved solids levels with time.

The wells were sealed because they were drilled too deep (about 400 feet) and experienced high chloride levels. Most of the wells in the particular area were drilled about 100 feet deep and did not experience excessive chloride levels.

7. The EIS (pages 6-12 through 6-15) uses a general approach in discussing potential effects on the quantity and quality characteristics of neighboring wells, stating that (page 6-15) the "new wells have not been hydro-logically identified to have the least effect on other wells in the vicinity." It would be helpful if these wells were likely to be affected by the changes in pumping location could be addressed more specifically. Objective assumptions and procedures used in the hydrogeological planning process, including a single map indicating all well locations with respect to the regional potentiometric surfaces, would also assist in understanding the impact assessment.

On pages 6-15, the EIS mentions that Kula Wells 1, Kula Wells II, and Oahu Sugar's two shafts may be affected by passage from the proposed wells. Attached as two project contacts will be affected for inclusion in the revised EIS.

8. We encourage the close monitoring of neighboring wells to identify quantity and quality impacts (pages 6-13 and 6-14) so that modifications in well operation can be quickly identified. The pumping of all project wells at a continuous rate, as opposed to alternating discharge between wells (pages 6-15, 6-16), is also strongly recommended to prevent accelerated mixing in the transition zone.
We concur with your recommendation. Nearby wells that are monitored on a regular basis include our Kainu Waia I and Kainu Waia II.

9. Assuming that all groundwater withdrawal occurs in the area where it is pumped, the water exchange proposed will not increase in pumping. However, the potential for reduced recharge does exist. If Oahu Sugar elects to use drip irrigation during the application of exchange water provided by DWR, the secondary recharge that has historically occurred under furrow irrigation will be reduced considerably.

The sustainable yield will have to be re-evaluated and exchange would have to occur on that basis.

10. From the text given on page 4-14, it can be deduced that existing water demands in the PHHRCA already approach and may already exceed the groundwater supply which includes exchange from furrow irrigation (approximately 50 percent of water applied). If drip irrigation becomes the alternate sole of application, average annual groundwater replenishment will be curtailed accordingly, possibly well below the water demands forecast for the end of this century. Perhaps a discussion of this possible shortage should be included in the secondary impacts section of Chapter 4.

As we indicated, should Oahu Sugar Company convert all of their fields to drip irrigation, a re-evaluation of the sustainable yield in the Pearl Harbor Ground Water Control Area will be required. Since exchange would occur on whatever sustainable yield is established by the state, we feel that a discussion of any secondary effects is premature.

11. The map of Appendix J does not show those areas set aside for drip irrigation and those designated for conventional furrow methods. Economics, and the difficulties associated with the application of exchange through drip irrigation, will likely dictate where each respective form of irrigation can take place.

Oahu Sugar has plans of converting all of their fields to drip irrigation. Until the use of sewage effluent in drip irrigation is received, any discussion with Oahu Sugar Company on the use of sewage effluent would be meaningless.


We will cite the reference in the revised RIS.

13. The reference on page 4-13 that most recharge from rainfall occurs above the 40-inch isohyet area can be questioned. Recent research by personnel from the Water Resources Research Center (WRC) suggests that significant recharge occurs primarily in those regions above the 40-inch isohyet and possibly higher. This conclusion is reached from studies of accumulated snowmass on soil on the dry side of this rainfall level.

We will mention WRC's findings in the revised RIS.

14. A realistic assessment of the water budget in the PHHA should account for a future reduction in the sugar cane industry. If sugar cane production is phased out, irrigation demands will probably be greatly reduced, thus reducing valuable ditch imports and lowering secondary recharge. Similarly, the gradual conversion of urban areas onto the Koai Plain will reduce areas of recharge from all agricultural sources, including the areas of pineapple cultivation.

Since the Sugar Company's future is uncertain, it would be inappropriate to ask any assistant at this time. Furthermore, since the Sugar Company pumps over 80 percent of the ground water from the basin, any reduction in the sugar cane industry should be accompanied by a similar reduction in pumping which, in turn, may cancel any need to adjust for any reduction in recharge.

15. The discussion on pages 3-21 and 4-13 mentions terrestrial flora and fauna but says nothing about aquatic species. If reduced flows, increased pollution or any other effects on stream life on Wailua Stream or the lower reaches of Hanalei Stream are possible, then it is worth considering what life forms exist there.
Dr. Doak C. Cox

-7-

March 19, 1982

The proposed walls are sited near to Honouliuli Stream. Honouliuli Stream is an intermittent stream accommodating only storm flows. The USGS only has a crest-stage partial-record station on Honouliuli Stream. The station measures peak stages of floods occurring between inspections.

No consideration was given to life forms in the lower reaches of Honouliuli Stream since the water at the mouth of the stream is attributable to tidal fluctuations and not streamflow.

16. To reduce siltation over the 2,000 feet of transmission line construction adjacent to Honouliuli Stream, precautionary grading techniques, as mentioned on page 4-2, should be heavily emphasized. In the interest of avoiding deleterious effects on fauna in the lowest reaches of the stream, construction of the transmission line during the dry season is suggested.

All necessary grading precautions will be taken to minimize erosion and siltation from the construction activities and will conform to pertinent governmental regulations.

If you have any questions, please contact Lawrence Whang at 546-5221.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

Attach.

cc: Eileen R. Anderson, Mayor
Andrew I. T. Chang, Managing Director

Environment Impact Study Corporation

12-29
February 3, 1982

Dear Mr. Suna:

Subject: Your letter of January 21, 1982,
On The Environmental Impact Statement
For Honouliuli Wells

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 Waibang at 548-3221.

Very truly yours,

Franklin Y. K. Suna
Director

cc: Environment Impact Study Corporation

Mayor Eileen Anderson
City and County of Honolulu
630 South King Street
Honolulu, Hawaii 96813

Dear Mayor Anderson:

Subject: Honouliuli Wells, Honolulu, Oahu
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 Leeward region of Oahu. The construction of these six wells 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. Suna
Director

cc: Board of Water Supply
January 21, 1982

Honorable Eileen Anderson, Mayor
City and County of Honolulu
630 S. King Street
Honolulu, HI 96813

Dear Mayor Anderson:

SUBJECT: Environmental Impact Statement
         Honolulu Wells

The Department of Education has no comments to offer on the subject EIS at this time. We do thank you, however, for the opportunity to review the project.

Sincerely,

[Signature]

[Name]
Superintendent

cc: Mr. James Edington
Board of Water Supply

AN EQUAL OPPORTUNITY EMPLOYER

February 2, 1982

Dr. Dennis H. Thompson
Superintendent
Department of Education
State of Hawaii
P.O. Box 2348
Honolulu, Hawaii 96804

Dear Dr. Thompson:

Subject: Your Letter of January 21, 1982, on the Environmental Impact Statement for Honolulu Wells

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 Wang at 544-3321.

Very truly yours,

[Signature]

[Name]
Manager and Chief Engineer

CC: Environment Impact Study Corporation
March 3, 1982

Dr. L. Stephan Lau, Director
Water Resources Research Center
University of Hawaii at Manoa
2540 Dole Street, Honolulu 96822
Koolau, Hawaii 96822

Attention: Mr. Edwin T. Murakayashi

DEAR DR. LAU:

SUBJECT: Your Letter of February 12, 1982, on the Environmental Impact Statement for Honouliuli Wastewater Treatment Plant at Manoa

Thank you for reviewing the draft environmental impact statement (EIS) for our proposed water development project. Your letter has been referred to us for reply and it will be appended to the revised environmental document.

We have the following response to your comments:

1. P. 4-6 Wastewater Effluents. The EIS estimates that 25 mgd of sewage effluent will be available for exchange. In this projection to the year 2000 or 2001 Current (1981) figures indicate about 10.1 mgd total which consists of 2.1 mgd from Milliken and 10.0 mgd combined flow (20 mgd into Honouliuli) from Pearl City, Waipahu, Pacific Palisades, Don Beach, Barbers Pt. Rd., Hauula, and Iroquois Pt. The impression is that 25 mgd will be available immediately. The time frame should be clarified.

2. In the water exchange for sewage effluent irrigation, sugarcane is the only crop mentioned. Perhaps the discussion should be broader, particularly considering the present tenacious position of sugarcane production by Pacific Sugar Co. Effluent irrigation of foreign crops, which remove a large portion of the nutrients, can be used for ground water recharge.

3. Is it possible to state a definite exchange of water in each development phase 1, 2, etc.? 7

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

Sincerely,

Edwin T. Murakayashi
EIS Coordinator

EHH
cc: T. S. Fok
Env. Center, UH
H. Eno
BSG

AN EQUAL OPPORTUNITY EMPLOYER
2. In the water exchange for sewage effluent irrigation, sugar cane is the only crop mentioned. Perhaps the discussion should be broader, particularly considering the present tenuous position of sugar cane production by Oahu Sugar Co. Effluent irrigation of forage crops, which remove a large portion of the nutrients, can be used for ground water recharging.

We will mention that the treated sewage effluent can also be used to irrigate forage crops.

3. Is it possible to state a definite exchange of water in each development phase I, II, etc.? We have no commitment on the possible exchange of water with Oahu Sugar Company and therefore cannot state a definite water exchange for each development phase.

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

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Eileen R. Anderson, Mayor
Andrew I. T. Chang, Managing Director
Environment Impact Study Corporation
February 22, 1982

Kazu Hayashida
Board of Water Supply
City and County of Honolulu
Honolulu, Hawaii 96813

SUBJECT: Environmental Impact Statement for Honouliuli Wells

Dear Mr. Hayashida:

We have reviewed the subject statement and offer the following comments for your consideration:

1. **POPULATION FIGURES**

   The EIS refers to population figures gathered in 1978. However, the State Department of Planning and Economic Development has published the 1980 data book which gives more recent population figures. We recommend that the population be discussed using the new figures.

2. **TABLE 1-1 (page 1-11)**

   Under the column for operational capacity, the EIS indicates that the total capacity is 20.91 mgd. The discussion on page 1-10 indicates that the actual average pumpage is 15.90 mgd plus five percent. Five percent of the 15.90 mgd is 819,000 mgd/year which totals to 17.1 mgd. Therefore, we question how 20.91 mgd was derived. A discussion is recommended.

3. **AQUATIC WILDLIFE (page 2-3)**

   The EIS does not discuss the existence of any aquatic wildlife in the Makaha or Honouliuli Streams and what the effect of pumping water would have on the aquatic fauna. A discussion is warranted.

4. **SECTION 3**

   The environmental impact statement should discuss the project in relation to the State Environmental Policy Act, Chapter 314, Hawaii Revised Statutes.

5. **SURFACE WATER (page 4-13)**

   The EIS does not indicate whether any monitoring will be done to detect any changes in stream flows and what impact flow changes will have on the aquatic environment. A discussion is strongly recommended.

6. **POPULATION (page 4-15)**

   The per capita water demand should be given.

7. **PAGE 4-16**

   The EIS indicates that 5 mgd will be used for 12,000 proposed units. However, we note that the Ewa areas have more than the proposed 12,000 units. Therefore, the proposed action will not accommodate the anticipated as indicated by the City and County of Honolulu General Plan. If anything, the proposed action would encourage further development and new sources will be required. Therefore, the EIS should discuss how the 6 mgd will be allocated.

8. **PAGE 4-27**

   The EIS should recognize that the capacity of R-1 for the Ewa area is about 90,000 vehicles. By 1985, your figures indicate that the traffic will exceed this capacity.

9. **GROWTH**

   Since water is a key factor in growth, it becomes one of the best instruments for land use planning. However, there seems to be an implicit assumption that water must be provided to the developments rather than also using water as a method to control growth. Consequently, the dilemma results when developments are approved and the water is not available.

10. **SURFACE WATER (page 6-21)**

    The EIS proposes using surface waters from Kahanamoku and Punalu'u Stream as alternatives to the action. The EIS should note that both streams are included in the Nationwide Rivers Inventory which recognizes the scenic and historic value of the stream.
March 24, 1982

Mr. George A. E. Yuen, Director
State Department of Health
P. O. Box 3578
Honolulu, Hawaii 96801

Attention: Mr. Melvin K. Nosu

Dear Mr. Yuen:

Subjects Your Letter of February 22, 1982, on the Environmental Impact Statement (EIS) for Honolulu Wells

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

We offer the following in response to your comments:

1. POPULATION FIGURES
   We will update the population figures in our revised EIS.

2. TABLE 1-1 (page 1-11)
   The discussion on page 1-10 does refer to the 16.30 mgd as the allowable pumpage within the Pearl Harbor Ground Water Control Area. The 20.31 mgd in Table 1-1 is the total operational capacity which includes the 4.61 mgd from Waianae sources located outside the designated area.
   We agree that the five percent increase stated as such is unclear. However, the 27.1 mgd is not a part of the present operational capacity. The additional 10,000 gpd cannot be included until a formal application is cleared by the State.

3. AQUATIC WILDLIFE (page 2-31)
   As explained on page 4-10, pumping operations would not disrupt the present environmental conditions of the stream. The proposed well is anticipated to have no impact on Waikiki Stream. Honolulu Stream is an intermittent stream used primarily to accommodate flood flows. Any aquatic life would be found at the mouth of the stream and is dependent upon tidal influences.

Sincerely,

Milton K. Nosu
Director
Office of Environmental Quality Control

CC: Mayor Eileen Anderson
4. SECTION 3

It was the intent of this EIS to serve the purpose of the State's Environmental Policy. It has been a great success and it is a great opportunity for the State's future.

5. SURFACE WATER (page 4-10)

A gaging station for Honolua Stream is maintained by the U.S. Geological Survey (page 2-11). The station is a gage station where only one record station that measures peak flows between inspections. As mentioned previously, Honolua Stream is an intermittent stream that is generally dry except for flood flows.

6. POPULATION (page 4-15)

The per capita water demand will be added to the revision.

7. PAGE 4-26

The EIS indicates that a new and efficient distribution system could support approximately 2,000 units of water for the population. Honolua has an alternative to meet the projected demand as envisioned by the Development Plan for the area.

8. PAGE 4-27

The H-1 capacity for the Ewa area will be added to the revision.

9. GROWTH

The assumption is rather explicit where water will be provided in concurrence with the General and Development Plans. The Board of Water Supply has continuously operated within its means to provide this service (page 3-6). However, where demand has exceeded the available supply, we have imposed moratoria on the issuance of water service in those areas such as in the Leeward District.

10. SURFACE WATER (page 6-21)

The stream will be noted as such in the revised EIS.

11. ALTERNATIVES

In essence, the basic concept of this project is to increase the efficiency of current infrastructure. The proposed arrangements (1-10, 4-3) with Oahu Sugar Company for substituting lower quality water in exchange for a very efficient method of conservation. Since water conservation (4-18 to 4-24) is an on-going activity, it seems inappropriate for it to be listed as an alternative.

12. SHORT-TERM USES VS. LONG-TERM PRODUCTIVITY

The decrease in demand is due to the cumulative effect of pumps from all of the wells in the basin. As mentioned earlier, the proposed project will not increase demand in the basin; it anticipates exchanging water of a lower quality with water of a higher quality with Oahu Sugar Company on a gallon-for-gallon basis.

If you have any questions, please contact Lawrence Wang at 532-5211.

Very truly yours,

E. Ira Hing
Manager and Chief Engineer

Eileen M. Anderson, Mayor
ENVIRONMENTAL IMPACT STUDY CORP.
TO: Mr. Kazu Hayashida, Manager and Chief Engineer
Board of Water Supply

SUBJECT: Honolulu Wells Environmental Impact Statement

As presently proposed, the assessment is based on the City's General Plan and the Hawaii State Plan, both of which furnish very broad development guidelines. The assessment does not reflect provisions contained in the Eva Development Plan (Ordinance No. 81-40), adopted in November 1981. Nor does it reflect proposed changes to the 1977 Oahu General Plan that will soon be submitted to the Planning Commission.

Public projects, in particular those that involve construction of new potable water sources with potential for opening up of large scale land development projects, may well stimulate or induce immediate and long-term effects. An updated assessment of the project in terms of development plans policies and identification of possible conflicts with current and proposed plans may be necessary.

Ralph Kawanoto
Ralph Kawanoto
Planner

APPROVED:

Willard T. Chow
Manager and Chief Engineer

CO: Environment Impact Study Corporation
January 16, 1982

Honorable Eileen Anderson, Mayor
City and County of Honolulu
620 South King Street
Honolulu, Hawaii 96813

Dear Mayor Anderson:

Subject: Honolulu Water Resources

This is to advise you that the Board of Water Supply has reviewed your letter of January 15, 1982, on the Environmental Impact Statement (EIS) for Honolulu Water Resources, Honolulu, Hawaii, T&D-22-0111-PR-1.

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

If you have any questions, please contact Lawrence Chang at 548-3221.

Sincerely,

JOSEPH K. CONANT
Manager and Chief Engineer

cc: Board of Water Supply

January 22, 1982

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

FROM: KARU KAYASHIDA
BOARD OF WATER SUPPLY


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 Chang at 548-3221.

Karu Kayashida
Manager and Chief Engineer

cc: Environment Impact Study Corp
MEMORANDUM

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

FROM: MICHAEL M. MCELROY, DIRECTOR

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR
HONOLULU WELLS, HONOULULU, OAHU, HAWAII

We have reviewed the subject EIS and find that it adequately addresses the proposed project as to: (1) anticipated environmental impacts, (2) mitigative measures to minimize adverse impacts, and (3) alternatives to the proposed project.

Thank you for the opportunity to review this EIS.

If you have any questions or comments, please call John Machol of our staff at 523-4077.

MICHAEL M. MCELROY
Director of Land Utilization

MMM:sl

February 5, 1982
January 28, 1982

MEMORANDUM

TO: HONORABLE EILEEN R. ANDERSON, MAYOR
VIA: ANDREW I. Y. CHANG, MANAGING DIRECTOR
FROM: ROBERT K. MASUDA, DIRECTOR
SUBJECT: ENVIRONMENTAL IMPACT STATEMENT FOR HONOLULU WELLS

We have reviewed the Environmental Impact Statement for Honolulu Wells and have no comments.

Thank you for the opportunity to comment on this Environmental Impact Statement.

cc: Board of Water Supply

TO: MR. ROBERT K. MASUDA
DIRECTOR
DEPT. OF PARKS AND RECREATION
FROM: KAZU NAKASHIDA
BOARD OF WATER SUPPLY
SUBJECT: YOUR LETTER OF JANUARY 28, 1982, ON THE ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR HONOLULU WELLS

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 Wang at 318-3329.

KAZU NAKASHIDA
Manager and Chief Engineer

cc: Environment Impact Study Corporation
E20105

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU

MEMORANDUM
TO: HONORABLE EILEEN R. ANDERSON, MAYOR
FROM: MICHAEL J. CHIAH, DIRECTOR AND CHIEF ENGINEER
SUBJECT: EIS FOR HONOLULU WELLS, HONOLULU, OAHU, HAWAII

January 18, 1982

Honorable Eileen R. Anderson
-2-
January 18, 1982

Cane Sugar Company and the Board of Water Supply (page 6-2) involving the use of sewage effluent (page 6-4) will require our formal concurrence.

MICHAEL J. CHIAH
Director and Chief Engineer

We have reviewed the Subject EIS and have the following comments.

1. The Honolulu wastewater treatment plant (page 2-41) was put into operation in January 1982. It provides preliminary treatment. Primary treatment will be provided at a later date. An exception from secondary treatment (page 2-55) has been received from EPA but the conditions of the exception are unsatisfactory and will be appealed.

2. Even if secondary treatment (page 2-55) may not be required, secondary effluent could be made available for irrigation purposes under certain conditions. As stated in the EIS, plans for reclamation for irrigation purposes have not been finalized and are still flexible.

3. The sewer service charge levied against non-residential users is $0.59 per 1,000 gallons of metered water usage as of July 1, 1981. On July 1, 1980 it was $0.45 per 1,000 gallons (page 2-23). The suspended solids surcharge is of very little consequence except for food and fruit processors. The present $$$ charge on water consumption is a more prominent factor in motivating water conservation than the sewer service charges since they directly affect residential and non-residential users.

4. We are in favor of the reuse of wastewater effluent especially for irrigation purposes. Any water exchange program between
February 9, 1982

TO: DR. MICHAEL J. CHAN
DIRECTOR AND CHIEF ENGINEER
DEPARTMENT OF PUBLIC WORKS

FROM: KAU HAYASHIDA
BOARD OF WATER SUPPLY

SUBJECT: YOUR MEMORANDUM OF JANUARY 18, 1982, ON THE
EIS FOR KONUKUHI TREATMENT PLANT, OAHU

Thank you for reviewing the environmental impact
statement for our proposed project. We will append your
memorandum to the revised environmental document.

In response to your comments we offer the following:

1. Page 2-49 will be corrected to indicate that
   the Honolulu Wastewater Treatment Plant was
   placed into operation in January 1982 and
   provides preliminary treatment. Primary
   treatment will be provided at a later date.

2. Page 2-55 will be corrected to indicate that
   an exception from secondary treatment was
   received from EPA, but the conditions of the
   exception will be appealed. We will also note
   that secondary treated effluent could still be
   made available for irrigation under certain
   conditions.

3. Page 4-22 will be revised to indicate that
   the suspended solids surcharge affects food
   and fruit processors. We concurred that our
   water rates would have a more motivating
   impact on water conservation than your sewer
   service charges.

4. Any water exchange program involving the use of
   sewage effluent will be coordinated with you
   for your concurrence.

If you have any questions, please contact Lawrence
Wang at 548-3222.

KAU HAYASHIDA
Manager and Chief Engineer

#01 Environment Impact Study Corporation
February 8, 1982

MEMORANDUM

TO: HONORABLE EILEEN ANDERSON, MAYOR
    CITY AND COUNTY OF HONOLULU

VIA: ANDREW I. T. CHANG, MANAGING DIRECTOR

FROM: ROY A. PARKER, DIRECTOR

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT FOR THE HOUNOULULU WELS PROJECT

We have reviewed the environmental impact statement for the Honouliuli Wells project and have no comments.

ROY A. PARKER

cc: Board of Water Supply
January 25, 1982

TO: HONORABLE KILEEN R. ANDERSON, MAYOR
VIA: MR. ANDREW T. T. CHANG, MANAGING DIRECTOR
FROM: ROY H. TANUI
DIRECTOR AND BUILDING SUPERINTENDENT

SUBJECT: HONOLULU WELL
ENVIRONMENTAL IMPACT STATEMENT

We have reviewed the subject environmental impact statement and have no comments.

ROY H. TANUI
Director and Building Superintendent

HiJo
City J. Kekaha
Board of Water Supply

February 10, 1982

TO: MR. ROY H. TANUI, DIRECTOR AND BUILDING SUPERINTENDENT
BUILDING DEPARTMENT
FROM: KAZU HAYASHIDA
BOARD OF WATER SUPPLY

SUBJECT: YOUR LETTER OF JANUARY 25, 1982, ON THE ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR HONOLULU WELLS

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 Wain at 548-3532.

KAZU HAYASHIDA
Manager and Chief Engineer

COI: Environment Impact Study Corporation
March 25, 1982

Mr. Richard L. O'Connell,
Manager
Environmental Department
Hawaiian Electric Company, Inc.
Box 2758
Honolulu, Hawaii 96840

Dear Mr. O'Connell:

Subject: Your Letter of February 9, 1982, on the Environmental Impact Statement for Nonoulii Wells

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

We have the following response to your letter:

1. Section 2.IV.B.1 (page 3-57), Electricity - the environmental document will be corrected to reflect that HECO will have a generating capacity of 1,217 megawatts instead of 1,227 megawatts, after the Nonoulii #6 facility goes on line.

2. Section 4.II.B.2.e. (page 4-31), Electricity - It appears that the electricity use rate of 1,400 kilowatt hours (kwh)/month/unit is too high - assuming a unit equals 3.2 persons. Also, the annual energy consumption of 21,600,000 kwh/year for 12,000 units is too low.

3. Section 6.V.H.2. (page 6-5), Pearl Harbor Springs - As one of the alternate water sources for sugar cane irrigation, the BMS proposes to utilize the springs located at Kalaoa, Wai'anae, and Waianae in exchange for better quality water. Thu Wai'anae Springs may be one of the sources of fresh water presently supplying cooling water to HECO's Wai'anae Power Plant. If it is a source, this exchange will affect the Wai'anae Power Plant.

Sincerely,

Richard L. O'Connell
Manager, Environmental Department

/c/ KAZU HAYASHIDA
Manager and Chief Engineer
January 25, 1982

Mayor Elion Anderson
City and County of Honolulu
600 South King Street
Honolulu, Hawaii 96813

Dear Mayor Anderson:

Environmental Impact Statement (EIS)
Honolulu, Hawaii

We have reviewed the above EIS and have no further comments to offer.

The comments contained therein pertaining to the availability of Hawaiian Telephone Company facilities are satisfactory.

Thank you for the opportunity to review and comment.

Sincerely,

Richard Mau
Engineering and Construction
Staff Manager

For: Board of Water Supply

February 10, 1982

Mr. Richard Mau
Hawaiian Telephone Company
P.O. Box 2290
Honolulu, Hawaii 96811

Dear Mr. Mau:

Wells

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 Wang at 548-3151.

Very truly yours,

L. P. D. D. (Signature)

Manager and Chief Engineer

cc: Environment Impact Study Corporation
OAHU SUGAR COMPANY, LIMITED
P.O. BOX 420
HONOLULU, HAWAII 96817
TELEPHONE 577-3517

Board of Water Supply
City & County of Honolulu
636 South Beretania Street
Honolulu, Hawaii 96813

RE: COMMENTS ON "ENVIRONMENTAL IMPACT STATEMENT, MONUWALE WELLS"

February 17, 1982

Gentlemen:

We have reviewed the above-mentioned Environmental Impact Statement sent under your cover letter of January 12, 1982. The following is a list of our comments:

USE OF SEWAGE EFFLUENT

Oahu Sugar Company currently has an agreement with the City and County to accept sewage effluent on a trial basis from the Milliken Sewage Treatment Plant. The technology of utilizing sewage effluent is not perfected at this time and the suggestion that Oahu Sugar Company could accept up to an additional 9 MGD of effluent in exchange for a reduction in the amount of conditionally certified pumping seems premature. Oahu Sugar Company does not have adequate furrow irrigated cane land to accept up to 9 MGD of sewage effluent.

EXCHANGE OF DESIGNATIONS WITH OAHU SUGAR COMPANY

On page 1-20 of the E.I.S., it is stated that "The City will compensate Oahu Sugar Company for this reduction in pumping by offering water of lower quality in exchange, on a gallon-for-gallon basis". This proposition is obviously very unfair.

On one hand, the City receives a gallon of potable water. On the other hand, Oahu Sugar Company is asked to give up a gallon of water relatively free from turbidity problems and very acceptable for use in drip irrigation systems and is then asked to accept in exchange "lower quality water" such as "treated sewage effluent, spring water or surface water". In regards to sewage effluent, the report states on page 4-25 that, "Presently, the primary problem is that diluted effluent clogs the holes in drip irrigation tubes over time, limiting its use for drip irrigation".

USE OF POTABLE WATER BY OAHU SUGAR COMPANY

On page 6-3 of the E.I.S., it is stated that "Oahu Sugar Company uses approximately 40 - 50 MGD of domestic quality water for sugar cane irrigation. The B.W.S. would trade water of a lower quality for this potable water on a one-to-one basis". This statement is extremely misleading and, additionally, the amount of domestic quality water is overstated.

The following is a tabulation of chloride concentration in Oahu Sugar Company wells with the amount of daily average conditionally certified pumping:

<table>
<thead>
<tr>
<th>Well</th>
<th><strong>Chloride (ppm)</strong></th>
<th>Conditional Certification (Daily Avg. MGD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP1</td>
<td>205</td>
<td>1.641</td>
</tr>
<tr>
<td>WP2 &amp; 2B</td>
<td>206</td>
<td>5.360</td>
</tr>
<tr>
<td>WP2C &amp; 4C</td>
<td>410</td>
<td>6.135</td>
</tr>
<tr>
<td>WP4A &amp; B</td>
<td>395</td>
<td>7.035</td>
</tr>
<tr>
<td>WP5</td>
<td>356</td>
<td>10.509</td>
</tr>
<tr>
<td>WP6A &amp; B</td>
<td>1,462</td>
<td>14.011</td>
</tr>
<tr>
<td>WP8A - C</td>
<td>287</td>
<td>14.699</td>
</tr>
<tr>
<td>WP17A</td>
<td>+34</td>
<td>3.135</td>
</tr>
<tr>
<td>WP17B</td>
<td>+34</td>
<td>3.135</td>
</tr>
<tr>
<td>EP2</td>
<td>+231</td>
<td>1.559</td>
</tr>
<tr>
<td>EP3</td>
<td>705</td>
<td>3.262</td>
</tr>
<tr>
<td>EP4</td>
<td>561</td>
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<td>402</td>
<td>8.514</td>
</tr>
<tr>
<td>EP8</td>
<td>402</td>
<td>8.514</td>
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<tr>
<td>EP10</td>
<td>759</td>
<td>8.514</td>
</tr>
<tr>
<td>EP11</td>
<td>851</td>
<td>12.150</td>
</tr>
<tr>
<td>EP12 &amp; 13</td>
<td>855</td>
<td>14.613</td>
</tr>
<tr>
<td>EP13 &amp; 14</td>
<td>240</td>
<td>14.613</td>
</tr>
</tbody>
</table>

Total 115,000 MGD

* Domestic quality water (i.e., less than 250 ppm)
** From Oahu Sugar Company's "Water Management Plan for Phoenix"

October 2, 1981
It can be seen from this tabulation that the total amount of
domestic quality water (i.e. < 250 ppm chlorides) pumped by Oahu
Sugar Company is only 7,168 MGD or about 6.2 per cent of the
total. Even if we assume that you added 20 MGD of "pure"
Haleiwa water, the total "domestic" water is on the order of
33 MGD which is less than the 40 - 50 MGD stated in the report.
Haleiwa water which meets domestic standards for chlorides
probably does not meet other domestic quality standards.

CONSTRUCTION COST ESTIMATE

The construction cost estimate presented in Table 1-5 does not
include a number of items which may be applicable to this project.
The following list addresses a number of these items:

1. Cost of obtaining land and easements from the Campbell
   Estate.
2. Reimbursement to Oahu Sugar Company for loss of production
   of lands taken out of cultivation.
3. Cost of providing facilities to deliver "lower quality
   water" to Oahu Sugar Company fields.
4. Reimbursement to Oahu Sugar Company for the value of
   underdeveloped facilities it may have to retire to attain
   the cutback in pumping anticipated by the project.
5. Reimbursement to Oahu Sugar Company for new facilities
   it may have to install in existing pumping stations to
   attain the cutback in pumping (throttling valves, smaller
   pumps, controls, etc.).
6. Reimbursement to Oahu Sugar Company for special filtration
   systems or special management devices it may have to
   install to properly manage treated sewage effluent.

EWA FUMPS

The proposed project will almost certainly have a deleterious
effect on Oahu Sugar Company's Ewa pumps. The proposed project
is located "hydrologically upstream" from the Ewa Pumps. Assuming
that the project is built, how does the City and County propose
to assort the shadow effect that the proposed wells will have
on the Ewa pumps?

USE OF BRACKISH WATER FOR IRRIGATION

On page 4-14 of the E.I.S. it is stated that "...chloride contents
well below 1,000 ppm, which is the upper limit tolerated by sugar
sugar...". It should be noted that a chloride content of 1,000 ppm
does not represent an absolute demarcation between non-water
quality limited growth and dead cases. Reports prepared by
industry agriculturalists infer progressive declines in production
related to increases in the chloride concentration of the
irrigation water.

CANE LAND

The report refers to two acres of cane land being taken for the
project. Oahu Sugar Company objects to the taking of any cane
land whenever possible and wonders if non-cane land sites were
considered for the project.

CERTIFICATION

On page 1-6 of the E.I.S. the report states "Existing wells in
this area were certified by July 1, 1980...". It should be
added here that the wells were conditionally certified.

Very truly yours,

David W. Ballew
President and Senior Manager

CP:MO
cc: J. Loomis, anfro
March 25, 1982

Mr. David N. Ballese
President and Senior Manager
Oahu Sugar Company, Limited
P.O. Box 40
Wahiawa, Hawaii 96787

Dear Mr. Ballese:

Subject: Your Letter of February 17, 1982, on the Draft Environmental Impact Statement (EIS) for Honouliuli Waihiki

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

We offer the following response to your comments:

USE OF SEWAGE EFFLUENT

We will indicate in the EIS that the actual quantity of water to be exchanged will be dependent upon the need and ability of Oahu Sugar Company (OSC) to utilize lower quality water for irrigation.

EXCHANGE OF DESIGNATIONS WITH OAHU SUGAR COMPANY

Any exchange arrangement would have to be on an agreed basis. We agree that a gallon-for-gallon exchange should consider other factors so that any exchange would be on an equitable basis.

USE OF POTABLE WATER BY OAHU SUGAR COMPANY

The EIS will be corrected to show that about 7 mg/l. instead of 60-200 mg/l. of the water pumped by OSC meet the acceptable chloride concentration levels for drinking water.

CONSTRUCTION COST ESTIMATE

We will indicate in Table 1-5 that the associated costs to convey lower quality water to OSC’s fields are not included.

Mr. David N. Ballese

March 25, 1992

DNA PUMPS

We concur that the proposed Honouliuli Wells may cause a shadow effect on your DNA pumps. Therefore any exchange agreement must include and consider the effects on your DNA pumps.

USE OF RAW WATERS FOR IRRIGATION

The EIS will note that a chloride content of 1,000 ppm does not represent an absolute disqualification between non-water quality limited growth and dead cane. We will also note the inference from reports by sugar industry agriculturalists that production progressively declines relative to increases in the chloride concentration of the irrigation water.

CANE LAND

We will clarify in the EIS that up to two acres may be needed for the well facility. We are making every effort to site the control station and wells in locations where loss of cane land will be minimized.

CERTIFICATION

We will correct the EIS to indicate that OSC’s wells were conditionally certified.

If you have any questions, please contact Lawrence Khang at 568-5121.

Very truly yours,

Raulo Bayaniida
Manager and Chief Engineer

CO: Environment Impact Study Corp.
February 9, 1982

Mr. Francis Tanaka  
c/o PRI  
P.O. Box 3379  
Honolulu, Hawaii  96842  

Dear Mr. Tanaka:

Subject: Your Telephone Request Of February 3, 1982,  
On The Environmental Impact Statement For  
Honouliuli Wells

We forward a copy of the environmental impact statement for  
Honouliuli Wells as requested.

If you have any comments on the document, we would  
appreciate receiving them by February 22, 1982.

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

Very truly yours,

Kazu Hayashida  
Manager and Chief Engineer

Enc.
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APPENDIX A

THE PEARL HARBOR GROUND WATER CONTROL AREA (PHGWCA)
APPENDIX A

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APPENDIX A

THE PEARL HARBOR GROUND WATER CONTROL AREA (PHGWCA)

I. INTRODUCTION

A. The Pearl Harbor Ground Water Control Area

In 1959 the State of Hawaii Legislature passed the Ground Water Use Act (Chapter 177, Hawaii Revised Statutes, amended 1961) which gives the State Board of Land and Natural Resources (Board; BLNR) the authority to regulate the use of ground water in areas designated by the Board as being endangered or likely to become endangered by excessive or improper use. In July 1979 the Department of Land and Natural Resources (DLNR) promulgated Regulation No. 9 which implements the Ground Water Use Act. Finally, on September 28, 1979 the BLNR approved of the first "Designated Ground Water Control Area."

Designation of such an area means that the Board finds that "the ground water must be regulated and protected for best utilization, conservation, and protection in order to prevent threat of exhaustion, depletion, waste, pollution, or deterioration by salt encroachment or an area in which the Board finds that the ground water must be regulated and protected in order to protect the ground water re-
or deterioration by 'salt encroachment'' [A.1].

The first such area is termed the Pearl Harbor Ground Water Control Area (PHGWCA). It consists of the Ewa Judicial District and the Wahiawa Judicial District (124,687 acres). Please refer to Figure A-1. The official effective date of the area was 90 days prior to September 28, 1979, or June 30, 1979.

B. DLNR Chapter 166 of Title 13 [On May 8, 1981, Regulation 9 was repealed and replaced with Chapter 166 of Title 13.]

The guiding principle of Chapter 166 of Title 13 is to realize the most beneficial uses of the State's ground water resources in regulating, limiting, and apportioning the uses of ground water in the best interest of the people of the State. No person within the ground water control area may make any use of the water within that area, except in compliance with Chapter 166 of Title 13. Individual household uses of ground water are exempt from regulation, but report of such uses must be filed with the Board. Existing ground water uses which are lawful and beneficial may be preserved and continued if such uses are properly declared to and certified by the Board. However, the right to such preserved uses may be completely or partly lost to nonuse. All new ground water withdrawals will be strictly regulated by the issuance
of permits to use ground water and permits to supply ground water.

Between September 28, 1979 and January 2, 1980 existing users were required to declare their pumpage and location of ground water sources to DLNR. Following this declaration period is a certification period which will elapse on July 3, 1980. If certification is to be made, the Board shall issue a certificate which shall include a description of the beneficial uses preserved and a statement of the maximum daily and annual withdrawal preserved for each well.

Within a designated ground water control area, no preserved existing use of water may be modified by increasing the quantity of water used or by substantially changing the purpose or manner of the beneficial use, or the time of taking of water, or by changing the point of diversion of the water, unless authorized by the Board.

However, any municipal corporation or person supplying a municipal corporation may increase its water use from a designated ground water control area by 100,000 gallons per day or 5% of the average per day use during the year immediately prior to the date of ground water control area designation, whichever amount is greater.
Each user who comes under the Chapter 166 of Title 13 will be given a permit to operate at the stated pumpage for a given amount of time, not to exceed 50 years. It is anticipated that most users will be certified for considerably less than 50 years initially [A.2].

C. Relation to Other Study Boundaries

The PHGWCA contains the Wahiawa Water District, Pearl Harbor Water District, and the Ewa portion of the Ewa-Waianae Water District of the Board of Water Supply (BWS), City and County of Honolulu. Refer to Figure A-2. The Manager and Chief Engineer of the BWS may limit the amount of water drawn from any well covered under the BWS Rules and Regulations if there is a reasonable basis to expect that overdraft will occur, except in a designated ground water control area, which is regulated by DLNR.

In various other hydrologic reports and studies the Pearl Harbor aquifer is alternately referred to as the "Pearl Harbor area" or "Pearl Harbor basin." These terms, as well as others in use, are discussed below.

1. In 1964 a study (conducted by F. N. Visher and J. P. Mink) on the basal ground water in southern Oahu was published [A.3]. The authors
noted that the basal aquifer underlying southern Oahu was virtually continuous, but could be divided into several "isopiestic areas".

Each such area or compartment is characterized by having an artesian head higher or lower than that in adjacent areas. The head in each area depends on the amount of recharge, the height and depth of the caprock and its ability to prevent seaward escape of the water, and the depth and character of the deep valley fill separating the areas. As can be seen in Figure A-1, two isopiestic areas lie within what was termed the "Pearl Harbor area." These two areas may be said to roughly comprise the Pearl Harbor aquifer. Several other isopiestic areas made up the "Honolulu area". The two isopiestic areas located within the PHGWCA are referred to as the Waianae and Koolau aquifers. The demarcation between these two areas has been approximated as lying along the exposed surface contact of the Koolau and Waianae lavas. This barrier is an erosional unconformity, consisting of weathered zone and accumulations of alluvium, separating the lower, older Waianae volcanic series from the younger Koolau series. The

A-7
FIGURE A-3
ISOPIESTIC AREAS

SOURCE: (A.3)
head drop immediately west of the unconformity, in the Waianae aquifer, has been estimated at two to two-and-a-half feet. However, the unconformity is merely an impediment to the hydraulic continuity that exists between these two aquifers.

2. In 1977 another study was published, conducted by K. J. Takasaki in cooperation with the Hawaii State Department of Health [A.4]. This study presented a map of the approximate ground water areas on Oahu, as shown in Figure A-4. As can be seen, the PHGWCA encompasses three major areas according to this study - the Schofield high-level water body, a portion of the basal aquifer, and dike impounded water in the Ewa region. In addition, along the coast there is a sedimentary aquifer containing brackish water.

3. In 1979 another government report was published. This study was conducted by Ronald L. Soross and Charles J. Ewart [A.5]. The entire study area, "Pearl Harbor Area", lies within the PHGWCA and essentially corresponds with the Pearl Harbor aquifer, as defined on page A-36. Refer to Figure A-5.

4. Finally, in 1980 a new privately-conducted report was prepared [A.6]. Prepared by Sam Hirota, Inc. for Amfac, the study area is made
NOTE: ONLY PORTIONS APPLICABLE TO PROJECT ARE SHOWN

SOURCE: (A.4) A-10

FIGURE A-4
"PEARL HARBOR BASAL WATER"
up of the "Pearl Harbor Basin" and, as shown in Figure A-6, essentially contains the Schofield high-level water body and a portion of the basal aquifer.

II. PHYSICAL CHARACTERISTICS OF PEARL HARBOR GROUND WATER CONTROL AREA

A. Geology [A.7]

The PHGWCA encompasses portions of the Koolau Range, the Waianae Range, and the Schofield Plateau, as well as the entire Ewa Plain. The Koolau Range and the Schofield Plateau consist primarily of lava flows from the Koolau Volcanic Series. The Waianae Range consists of lava flows of the Waianae Volcanic Series. An important characteristic of these lava flow formations is their high permeability.

In the Ewa Plain area both of these volcanic series are covered by cap rock made up of marine sediments and alluvium. This formation is less permeable than the basaltic lavas. The caprock extends seaward from the vicinity of Farrington Highway. Please refer to Figure A-7.

B. Soils [A.8]

There are five main soil associations within the PHGWCA. Refer to Figure A-8. The Ewa Plain and the area immediately surrounding Pearl Harbor
PEARL HARBOR GROUND WATER CONTROL AREA (PHGWCA) BOUNDARY

1. Lualualei-Fill Land - Ewa Association
2. Helemano-Wahiawa Association
3. Tropohumults-Dystrandepts Association
4. Rough Mountainous Land - Kapaa Association
5. Rock Land - Stony Steep Land Association
6. Lolekaa-Waikane Association

FIGURE A-8
SOIL ASSOCIATIONS

SOURCE: A.B.
A-15
consists of the Lualualei-Fill Land - Ewa Association. This association consists of deep, nearly level to moderately sloping, well-drained soils that have a fine textured or moderately fine textured subsoil or underlying material. This association also includes areas of fill land. The Waianae Range soils consist primarily of the Tropohumults-Dystrandepts Association. This association consists of gently sloping to very steep, well-drained soils that are underlain by soft weathered rock, volcanic ash, or colluvium, on narrow ridges and side slopes.

The Schofield Plateau consists of the Helemano-Wahiawa Association. This association consists of deep, nearly level to moderately sloping, well-drained soils that have a fine textured subsoil. The portion of the Koolau Range contained within the PHGWCA consists of the Rough Mountainous Land - Kapaa Association and the Lolekaa - Waikane Association. The Rough Mountainous Land - Kapaa Association consists of very steep land broken by numerous drainageways and deep, well-drained soils that have a fine textured or moderately fine textured subsoil. These soils are found in gulches and on narrow ridges. The Lolekaa-Waikane Association consists of deep, nearly level to very steep, well-drained soils that have a dominantly fine
textured subsoil. These soils are found on upland terraces and alluvial fans.

C. Rainfall [A.9]

Annual rainfall in the PEGWCA averages 20 inches along the coast but increases to about 40 inches on the Schofield Plateau. Within the PEGWCA, the upper Waianae Range receives 50 inches per year while the Koolau Range receives between 50-250 inches of rainfall per year. Please refer to Figure A-9. Recent research by personnel from the Water Resources Research Center (WRRC) suggests that significant recharge occurs primarily in those regions above the 60-inch isohyst and possibly higher. This conclusion is reached from studies of accumulated manganese in soil on the dry side of this rainfall level.

D. Impermeable Areas

Areas in which virtually no rainfall percolates to the basal ground water aquifer can be found within the PEGWCA. They are primarily urban areas and natural caprock areas along the coastal plain. Please refer to Figure A-10.

E. Aquifers

The lava flows form a virtually continuous aquifer in southern Oahu, although the aquifer is divided into compartments, or isopiestic areas.
Note: Although rainfall recharge areas are shown only within the PHGWCA (Pearl Harbor Ground Water Control Area), recharge occurs throughout the island above the 50-inch rainfall isohyet.

Source: (A-9)
Refer to Figure A-3. These are areas defined by the elevations to which water will rise in artesian wells or wells penetrating confined aquifers. They are determined by water pressure and the elevation of the aquifer. There are several isopiestic areas in the Honolulu area and two in the Pearl Harbor area.

One is in the immediate vicinity of Pearl Harbor, north to about Waiakakalaua Stream and west to the contact between the Koolau and Waianae Volcanic Series. Another isopiestic area lies in the area of the Ewa Plain.

Where the Waianae Volcanic Series and the Koolau Volcanic Series meet an erosional unconformity exists, presumably because of the presence of buried soil that had formed from the Waianae rocks. This erosional unconformity acts as a partial barrier to the free flow of ground water between the two sets of rocks.

The PHGWCA also contains most or all of the Schofield high-level water body. This is a zone of high-level water, 2-3 miles wide underlying Schofield Barracks and the town of Wahiawa. The elevation of the water table in the central portion of the Schofield high-level water body varies between 270 and 285 feet above sea level. The water, as far as is presently known, is confined to the region between the valley
of Waikakalaua Stream on the south and Poamoho Stream on the north [A.10]. On either side of the high-level water body exists basal ground water. Note Figure A-11. Leakage from the confined zone contributes a substantial portion of the recharge that sustains the basal water lens.

F. Land Use

1. Existing

Existing land use within the PHGWCSA is shown in Figure A-12. The area contains urban uses, military, agriculture, and forest reserve. Refer to Table A-1 for a breakdown of the acreages of existing land use in 1978. Of the total acreage listed for agriculture, approximately 55% (19,000+) acres were in sugar cane.

2. Proposed

Proposed land use within the PHGWCA may be approximated in a number of different ways. The General Plan of the City and County of Honolulu roughly divides the island into population centers which connote various land uses [A.11]. Figure A-13, from the General Plan, shows part of the Primary Urban Center, the Secondary Urban Center, and three Urban-Fringe areas within the PHGWCA.
SECTION A-A

GROUND WATER OCCURRENCE IN WAIALUA, SCHOFIELD, AND PEARL HARBOR AREAS, OAHU

SOURCE: A.37

FIGURE A-11
<table>
<thead>
<tr>
<th>Urban</th>
<th>Agricultural</th>
<th>Vacant Usable</th>
<th>Other (2)</th>
<th>Total Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
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<tr>
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</tr>
<tr>
<td>Industrial</td>
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<tr>
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<tr>
<td>Hotel</td>
<td>0</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>8,360.8</strong></td>
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</table>

**Ewa Judicial District Subtotal (1)**

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<th>Urban</th>
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<th>Vacant Usable</th>
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<tr>
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<td>Multifamily</td>
<td>36.7</td>
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<td>Industrial</td>
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<tr>
<td>Commercial</td>
<td>57.6</td>
<td></td>
<td></td>
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<tr>
<td>Hotel</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>919.6</strong></td>
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**Wahiawa Judicial District Subtotal (3)**

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<th>Vacant Usable</th>
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</thead>
<tbody>
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<td>Residential</td>
<td>5,173.4</td>
<td>34,741.5</td>
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<td>Multifamily</td>
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<td></td>
<td></td>
<td><strong>9,280.4</strong></td>
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</table>

**Pearl Harbor Ground Water Control Area Total**

(1) Census tracts 73.00 through 89.03 inclusive.
(2) Includes government lands (including military), churches, dormitories, and wastelands, for example.
(3) Census tracts 90.00 through 95.05 inclusive.

Source: Department of General Planning, City and County of Honolulu, Table 82.
More specifically, the Land Use Forecast for Oahu, 1975-1985 [A.12] predicted Residential Land (acres) and Hotel Floor Area (square feet) for 1985, based on residential densities and density trends current in 1974. These are presented in Table A-2.

Finally, there are several specific major developments proposed within the PHGWCA. These are presented in Table A-3. In terms of agricultural lands, Oahu Sugar Company estimates that it will decrease its sugar cane acreage in the near future from the present 18,300 acres to 15,000 acres through 1996, when its lease agreements with Campbell Estate elapse [A.13]. Regardless of the future land use proposed for the area, total pumping for the PHGWCA cannot exceed 225 mgd.

III. HYDROLOGICAL CHARACTERISTICS OF THE PEARL HARBOR AQUIFER

A. Typical Hawaiian Aquifers

The volcanic rocks of Oahu and their residual soils have a very great capacity to absorb and percolate waters, and consequently, only a relatively small proportion of the rainfall runs off to the sea. Most of it infiltrates into the ground, creating
TABLE A-2

1985 LAND USE FORECAST:
RESIDENTIAL LAND AND HOTEL FLOOR AREA

<table>
<thead>
<tr>
<th></th>
<th>Residential Land (Acres)</th>
<th>Hotel Floor Area (square feet)</th>
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<tr>
<td>Ewa Judicial District(1)</td>
<td>5,595</td>
<td>296,500</td>
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<tr>
<td>Wahiawa Judicial District(2)</td>
<td>1,092</td>
<td>19,600</td>
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<tr>
<td><strong>TOTALS</strong></td>
<td><strong>6,687</strong></td>
<td><strong>316,100</strong></td>
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</tbody>
</table>

(1) Census tracts 73 through 89 inclusive.
(2) Census tracts 90 through 95 inclusive.

TABLE A-3
MAJOR PROPOSED DEVELOPMENTS
PEARL HARBOR GROUND WATER CONTROL AREA, OAHU, HAWAII

<table>
<thead>
<tr>
<th>Location/Proposal</th>
<th>Type of Development</th>
<th>Estimated Completion Date</th>
<th>Acreage</th>
<th>Dwelling Units</th>
<th>Estimated Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waipahu-Crestview Village Park</td>
<td>Housing 2/</td>
<td>1985</td>
<td>316</td>
<td>1,745</td>
<td>5,600</td>
</tr>
<tr>
<td>Ewa-Makakilo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Makakilo</td>
<td>Housing 2/</td>
<td>1995</td>
<td>373</td>
<td>3,693</td>
<td>11,800</td>
</tr>
<tr>
<td>West Beach</td>
<td>Housing 2/</td>
<td>2000</td>
<td>640</td>
<td>1,680</td>
<td>33,000</td>
</tr>
<tr>
<td>West Beach</td>
<td>Resort</td>
<td>1995</td>
<td></td>
<td>7,520</td>
<td>35,300</td>
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<tr>
<td>Campbell Industrial Park</td>
<td>Employment</td>
<td>2000</td>
<td>1,486</td>
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<tr>
<td>Honolulu WWFP</td>
<td>Utility</td>
<td>1982</td>
<td>51</td>
<td></td>
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<tr>
<td>Barbers Point Deep</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Water Harbor</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>West Oahu College</td>
<td>Port Employment</td>
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<td>330</td>
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<tr>
<td>Ewa Marina Community</td>
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<tr>
<td></td>
<td>Recreation</td>
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<td>1,098</td>
<td>7,200</td>
<td>23,040</td>
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<tr>
<td></td>
<td>&amp; Housing 2/</td>
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</tr>
<tr>
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<tr>
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<td></td>
<td>Recovery</td>
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<td>NA</td>
<td>NA</td>
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</tr>
<tr>
<td>Pearl Harbor-Schofield Gentry/Maipo</td>
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<td>510</td>
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<td>11,800</td>
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<td>Waialua Ridge</td>
<td>Employment</td>
<td>1985</td>
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<td></td>
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<tr>
<td>Waialua Industrial Park</td>
<td>Housing</td>
<td>NA</td>
<td>1,300</td>
<td>NA</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mililani Town</td>
<td>Employment</td>
<td>NA</td>
<td>63</td>
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<tr>
<td>Royal Summit</td>
<td>Housing</td>
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<td>476</td>
<td>NA</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>NA</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

1/ Population estimates based on: 3.2 persons per dwelling unit and 1.8 persons per hotel room.
2/ Including parks, schools and commercial areas.
3/ According to the West Beach Project Draft EIS, June, 1980.

Note: Refer to Figure A-23 for approximate development locations.
the large ground water bodies on which Oahu depends for its water supply.

Three characteristic types of ground water have been recognized, the most extensive being the basal fresh water that floats on sea water under much of the southern and northern portions of the island. Less widespread, but of singular importance in some areas, is ground water restrained between impermeable vertical rock structures called dikes.

This water is called "dike water" or "high-level water". Dikes are the remnant conduits through which lava traveled to the earth's surface. They consist of nearly vertical slabs of dense, massive rock, generally a few feet thick, that extend for considerable distances and intrude other lavas. Normal permeable lavas containing water occur between them. This water is of excellent quality and cannot be endangered by saline contamination, because it is sealed off from the sea.

The third type of ground water, which is of minor significance on Oahu, is ground water held up, or "perched", on horizontal impermeable beds such as volcanic ash.

Dikes and other structural features are concealed by lava flows forming the Schofield Plateau. These contain high-level ground water, standing at levels of
approximately 275 feet above sea level. The natural discharge from this high-level reservoir is subsurface, as it is concealed by the lava flows overlying the impounding structural features. A part of the discharge moves southward into the Pearl Harbor basal aquifer.

The fresh basal ground water floats on sea water as a lens-shaped body, commonly called a Ghyben-Herzberg Lens. The depth of the 50% salt water concentration point below sea level is 40 times the height of the water table above sea level. Refer to Figure A-14.

The lens is a dynamic system through which fresh water moves from an area of recharge to points or zones of discharge, and the energy involved in this movement affects the shape of the lens and the depth of the fresh water. In the practical matter of water supplies in the fresh water lens, the most important factors are the rate of recharge of fresh water, permeability of the rock that contain the water and control its movement, and effects of mixing of the fresh water with the sea water in which the lens floats.

In an aquifer of a given uniform permeability, the thickness of the lens varies with the amount of water moving through it; that is, the thickness increases as the rate of recharge increases. Where a fixed rate of recharge occurs, the lens is thinner in an aquifer having high permeability than in one.
GHYSEN-HERZBERG LENS OF FRESH WATER WITHIN AN OCEANIC ISLAND (1/40)

FIGURE A-14
having low permeability. The thickness of the lens may also be affected by relatively impermeable "caprock" deposits that overlie the aquifer above and below sea level and separated from the sea water. The caprock on the aquifer retards the escape of sea water from the lens and causes the thickness of fresh water to be greater than it would be if the deposits were absent.

Seasonal changes in the thickness of the lens caused by fluctuations in recharge, pumping, and the action of the tides keeps the fresh water-salt water interface (transition zone) constantly in motion. The thickness of the transition zone is determined by two factors: (1) the rate at which mixing is taking place; and (2) the rate at which the transition zone water is discharged at the shoreline.

Under natural conditions, the most variable factor is likely to be the rate of transition zone water movement to the points of discharge. The rate is determined by seasonal and long-term variation in the rate of recharge to the fresh water lens. A decrease in recharge shrinks the lens and reduces the amount of water moving through it. This causes the transition zone to thicken.

However, under conditions of artificial pumping, the first factor (mixing rate) is likely to be the
most variable factor. Artificial discharge from the lens, such as heavy pumping from a well that amounts to a considerable part of the total supply, causes marked changes in the system. The well intercepts water that formerly moved to the shore.

If the rate of withdrawal is constant, the transition zone can be expected to become thicker toward the coast, where velocities are reduced, and to become thinner inland, where velocities are increased. If pumping is intermittent, however, the resultant alternate thickening and thinning of the lens will increase the rate of mixing and cause the transition zone to thicken throughout the area influenced by the well. Refer to Figure A-15.

Rainfall above the 50-inch isohyet is the principal source of recharge to the fresh water aquifers on Oahu. In addition, the basal aquifer is recharged by return irrigation water in areas of sugar cane cultivation, except where irrigation takes place over caprock. Such irrigation water may consist of water from wells drilled within the basal aquifer, surface runoff diverted from streams, or high-level water transported from the Koolau Range via the Waiahole Ditch. Finally, water may flow from one aquifer to another and thus act as a source of recharge.
- Schematic diagram showing effect of pumping on the thickness of the transition zone.

FIGURE A-15
EFFECT OF PUMPING

SOURCE: (A.3) A-34
Not all of the rainfall infiltrates into the ground water aquifers. On Oahu it is estimated that, in general, 36% of the rainfall on the island percolates to recharge the ground water aquifers, about 22% is lost to surface runoff and 41% is lost through evapotranspiration [A.14]. In areas of sugar cane irrigation, approximately one-half of the applied furrow irrigation water infiltrates to recharge the aquifer.

Changes in the rate of recharge greatly affect the height and depth of the fresh water body relative to sea level. Under conditions of no recharge of fresh water, the fresh water lens will decay as shown in Figure A-16a. As the lens decays, every unit decline in head, is accompanied by about a 40-fold upward movement of the transition zone. Conversely, an increase in the rate of recharge will cause a thickening of the fresh water lens and a seaward displacement of the salt water, as shown in Figure A-16b, if all other conditions remain the same.

In addition to the circulation of sea water produced by thickening and thinning of the fresh water lens, sea water also continually moves into the island, thus providing the salt water component of the transition zone that is discharged into the
CROSS-SECTION OF AN IDEALIZED ELONGATE ISLAND IN TWO DIFFERENT CONDITIONS:

A DECAYING LENS
B THICKENING LENS

SOURCE: (A.3)
the island, thus providing the salt water component of the transition zone that is discharged into the fresh water at the margins of the island. Because of these factors, the height of the upper surface of the fresh water body relative to mean sea level is of value in determining the magnitude of changes in the thickness of the fresh water body under equilibrium conditions.

B. Pearl Harbor Aquifer

1. Boundary and Capacity

The Pearl Harbor basal aquifer is bounded on the south by the caprock of the Ewa Plain. The western boundary is abruptly terminated along a line passing up Makaiwa Gulch to the southern Waianae rift zone. Its northern boundary is the structural feature that impounds the Schofield high-level water body. The eastern boundary is delineated by the rift zone of the Koolau range. Refer to Figure 1-8.

It should be noted that in actuality, aquifers of all Southern Oahu from Manoa Valley to the Waianae Mountains and from the caprock wedge to the Koolau and Wahiawa high-level zones are hydraulically connected. In the preparation of hydrologic studies of Southern Oahu,
arbitrary delineation of the Pearl Harbor aquifer, resembling the above boundaries has been used. As the boundaries are not standardized, comparisons of computed hydrologic budgets are difficult. Owing to uncertainties regarding the value of the storage coefficient, and the movement of the bottom of the fresh water lens, changes in storage cannot be determined with adequate precision.

Two recent studies provide an estimate of aquifer capacity. One, a joint effort of the U. S. Geological Survey and the State Division of Water and Land Development (Department of Land and Natural Resources), states that the area underlain by the fresh water lens is estimated to be 120 square miles and the storage coefficient is assumed to be 0.10 [A.15]. Thus, storage capacity is approximately 1500-2000 billion gallons. Another study, privately conducted by Sam Hirota, Inc. for Amfac, estimates the "existing lens volume" of the "Pearl Harbor Basin" at 1400 billion gallons.

The amount of storage is also indicated by the effects of pumping on head levels. The seasonal fluctuation may be as much as a third
of the average head, indicating a substantial but apparently safe temporary annual depletion of storage [A.16]. Another indication of the magnitude of storage is the length of time required for water levels to adjust fully to long-term changes in rainfall. For example, the time lag is about 9 months in the main aquifer in southern Oahu [A.17].

2. Recharge
   a. Rainfall

   Rainfall in the Koolau Range is the principal source of the fresh basal ground water in southern Oahu. The Waianae Range, because of low rainfall, is an area of little recharge. In 1971 Hirashima determined the long-term annual average rainfall over 90 square miles of drainage area (PHGWCA minus the Schofield high-level water body and Ewa Plain) to be 83.3 inches, or 355 mgd [A.18]. Of this, 47 mgd, or 13%, was lost to direct runoff. The exact amount of infiltration or evapotranspiration was not calculated, however.

   A recent study conducted by Sam Hirota, Inc. for Amfac concluded that rainfall in the PHGWCA, including the Schofield high
level water body but minus Ewa Plain, averages 430 mgd [A.19]. Of this, it is asserted that 212 mgd (49%) is lost to evapotranspiration, 67 mgd (16%) is lost to surface runoff, and 151 mgd (35%) recharges the aquifer.

In summary, the general infiltration figure for Oahu (given on page A-35) is 36% and the Amfac study indicates 35% infiltration. Using the "inflow method" the BWS estimates that up to 20 mgd infiltrates in the Ewa area, 197 mgd infiltrates in the Pearl Harbor area, for a total recharge of 217 mgd from rainfall.

DLNR estimates rainfall recharge of 210 mgd over the entire PHGWCA [A.20]. In comparison, the USGS uses the "outflow method" to estimate rainfall recharge of the Pearl Harbor basal aquifer at 205 mgd [A.21].

b. Irrigation Water

Large amounts of water are applied to sugar cane fields overlying the basal aquifer in the PHGWCA. Because of the generally high permeability of the soils,
approximately one-half of the furrow irrigation water applied infiltrates to recharge the aquifer.

Between 1974 and 1978, Oahu Sugar Company pumped an average of 128 mgd. In addition, 27 mgd was taken from Waiahole Ditch, for a total of about 155 mgd.

During this time, Oahu Sugar had 11,400 acres in furrow irrigation and 6,900 acres in drip irrigation [A.22]. Drip irrigation makes a negligible contribution to recharge (less than 20%).

It is generally agreed that of the total water applied, approximately 30 mgd of the pumped water and 15 mgd of the Waiahole Ditch water percolated to recharge the aquifer, for a total of 45 mgd.

c. Water from Adjacent Aquifers

The Pearl Harbor aquifer also receives recharge from adjacent aquifers or isopiestic areas. Two isopiestic areas east of the Pearl Harbor aquifer are considered to be tributary to the Pearl Harbor aquifer [A.23a], as is the Schofield high-level water body.
DLNR estimates that 15 mgd residual subsurface flow enters the Pearl Harbor aquifer from the east [A.20]. In 1976 Dale and Takasaki tentatively estimated that up to 115 mgd flows underground from the Schofield high-level water body to the Pearl Harbor basal aquifer [A.23b]. However, the BWS estimates this figure to be closer to 13 mgd at present.

d. Summary

The BWS estimates total recharge to the Pearl Harbor aquifer to be approximately 275 mgd, shown in Table A-4, and the USGS estimates it at 250 mgd. In comparison, DLNR estimates total recharge of the PHGWCA at 270 mgd.

3. Discharge

Ground water discharge includes withdrawals from wells and shafts, and to a lesser degree, coastal plain leakage. Most of the discharges from wells and shafts have been measured for many years. Where it occurs at distinct springs, leakage in the Pearl Harbor area has been measured, but diffuse seeps that occur in the Pearl Harbor area have not been measured.
<table>
<thead>
<tr>
<th>Source</th>
<th>Estimated Recharge (mgd)</th>
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<td></td>
<td>BWS</td>
</tr>
<tr>
<td>Rainfall</td>
<td>217</td>
</tr>
<tr>
<td>Furrow irrigation</td>
<td>45</td>
</tr>
<tr>
<td>Subsurface flow from east</td>
<td>-</td>
</tr>
<tr>
<td>Subsurface flow from north</td>
<td>13</td>
</tr>
<tr>
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<td>275</td>
</tr>
</tbody>
</table>

* For entire PHGWCA, not just basal aquifer.
a. **Withdrawals**

Ground water withdrawals from the PHGWCA from 1970 to 1978 are shown in Table A-5. Of the BWS total for 1978, it is estimated that 22.01 mgd served the Pearl Harbor and Ewa areas, 7.1 mgd served the Wahiawa area, 4.0 mgd was exported to Waianae, and 42.41 mgd was exported to Honolulu. Approximately 61% of the water withdrawn from the area was thus exported. Between 1974 and 1978, the BWS estimates that approximately 226 mgd was taken annually from the PHGWCA. Of this, approximately 11 mgd was from the Schofield high-level water body and 215 mgd was taken from the Pearl Harbor aquifer.

b. **Spring Flow**

Where basal water is not confined by caprock, the normal discharge into the sea is along the shore at or slightly below sea level. This flow is diffuse and cannot be accurately measured in many locations. In southern Oahu the seaward flow of the water is blocked by caprock, but some discharge takes place over the top or into the caprock. Only the discharge above
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>BWS</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Local Use</td>
<td>20.56</td>
<td>21.21</td>
<td>22.00</td>
<td>26.23</td>
<td>24.52</td>
<td>30.25</td>
<td>29.76</td>
<td>29.50</td>
<td>29.11</td>
</tr>
<tr>
<td>Export to Waianae</td>
<td>2.00</td>
<td>2.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Export to Honolulu</td>
<td>13.46</td>
<td>26.20</td>
<td>31.28</td>
<td>33.60</td>
<td>34.07</td>
<td>31.83</td>
<td>39.68</td>
<td>40.41</td>
<td>42.41</td>
</tr>
<tr>
<td>TOTAL</td>
<td>36.02</td>
<td>49.41</td>
<td>56.28</td>
<td>62.83</td>
<td>61.59</td>
<td>65.08</td>
<td>72.47</td>
<td>73.91</td>
<td>75.52</td>
</tr>
<tr>
<td>SUGAR PLANTATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oahu Sugar (1)</td>
<td>66.78</td>
<td>62.84</td>
<td>61.01</td>
<td>61.29</td>
<td>39.74</td>
<td>49.93</td>
<td>55.46</td>
<td>61.89</td>
<td>63.18</td>
</tr>
<tr>
<td>Bwa Plantation (2)</td>
<td>87.28</td>
<td>84.84</td>
<td>78.21</td>
<td>81.36</td>
<td>71.23</td>
<td>69.39</td>
<td>77.62</td>
<td>81.95</td>
<td>69.36</td>
</tr>
<tr>
<td>TOTAL</td>
<td>154.06</td>
<td>147.68</td>
<td>139.22</td>
<td>142.65</td>
<td>110.97</td>
<td>119.32</td>
<td>133.08</td>
<td>143.84</td>
<td>132.54</td>
</tr>
<tr>
<td>NAVY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARMY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>5.06</td>
<td>4.63</td>
<td>5.50</td>
<td>5.89</td>
<td>5.20</td>
<td>5.58</td>
<td>4.70</td>
<td>4.75</td>
<td>4.37</td>
</tr>
<tr>
<td>PRIVATE (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>2.00</td>
<td>1.70</td>
<td>1.70</td>
<td>3.50</td>
<td>3.50</td>
<td>4.50</td>
<td>4.50</td>
<td>4.70</td>
<td>3.50</td>
</tr>
<tr>
<td>GRAND TOTAL</td>
<td>222.57</td>
<td>222.87</td>
<td>224.09</td>
<td>238.30</td>
<td>203.00</td>
<td>217.59</td>
<td>238.07</td>
<td>244.79</td>
<td>228.17</td>
</tr>
</tbody>
</table>

(1) Exclude Waiahole Tunnel & Ditch and Waikole Stream & Springs.
(2) Exclude Shallow Caprock Wells.
(3) Exclude H.E.Co. Tunnel, Watercress Wells and Spring.

Source: [A.24] A-45
sea level at springs flowing over the top or through openings in the caprock can be readily observed and studied.

Natural discharge from the Pearl Harbor aquifer portion of the PHGWCA is: (1) via springs fringing Pearl Harbor; and (2) in the Ewa portion, west of the Koolau-Waianae unconformity, is unseen and probably seeps through the caprock below sea level [A.25].

The present zone of active discharge includes the five major Pearl Harbor springs at Kalauao, Waiau, Waimano, Waiawa, and Waiele. The largest measurable ground water flow occurs in these areas, but ground water also escapes along the shore in the intervals between the major springs and in the channels of streams that are cut below the basal water level.

Spring discharge estimated by the USGS from 1970 to 1978 is shown in Table A-6.

c. **Summary**

Artificial withdrawal and natural spring discharge from the Pearl Harbor aquifer total 264-275 mgd, based on estimates shown in Table A-7. (Compare with Table A-4.)
<table>
<thead>
<tr>
<th>Year</th>
<th>Average Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>67</td>
</tr>
<tr>
<td>1971</td>
<td>80</td>
</tr>
<tr>
<td>1972</td>
<td>66</td>
</tr>
<tr>
<td>1973</td>
<td>52</td>
</tr>
<tr>
<td>1974</td>
<td>67</td>
</tr>
<tr>
<td>1975</td>
<td>67</td>
</tr>
<tr>
<td>1976</td>
<td>56</td>
</tr>
<tr>
<td>1977</td>
<td>50</td>
</tr>
</tbody>
</table>

Source: [A.28]
<table>
<thead>
<tr>
<th>Estimated Discharge (mgd)</th>
<th>BWS</th>
<th>DLNR</th>
<th>USGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wells and Shafts</td>
<td>215(1)</td>
<td>214(2)</td>
<td>220(3)</td>
</tr>
<tr>
<td>Free flow and leakage</td>
<td>55(4)</td>
<td>50</td>
<td>55(5)</td>
</tr>
<tr>
<td>Pearl Harbor Springs</td>
<td>(25)</td>
<td>(25)(6)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>(301)</td>
<td>(25)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>270</strong></td>
<td><strong>264</strong></td>
<td><strong>275</strong></td>
</tr>
</tbody>
</table>

(1) Average 1974-1978, excluding pumpage from Schofield high-level aquifer [A.24].

(2) Average 1975-1979, excluding pumpage from Schofield high-level aquifer [A.26a]. To facilitate comparison with Table A-4, add 11 mgd pumpage from the Schofield aquifer to this figure to obtain discharge for the entire PHGWA (275 mgd).

(3) Average 1970-1975, excluding pumpage from Schofield high-level aquifer [A.5] and including 1 mgd pumpage from Pearl Harbor Springs [A.21].

(4) Includes 12 mgd pumpage for cane irrigation.


(6) 1977; includes 1 mgd pumpage from Pearl Harbor Springs [A.20], p. 17.
Using the "inflow method," BWS and DLNR estimate an excess of about 5 mgd and a deficit of about 5 mgd, respectively. Using the "outflow method," USGS estimates a deficit of 25 mgd. Utilizing the more conservative USGS calculations, the DLNR concluded that 225 mgd is the mean maximum yield that may be normally pumped from the PHGWCA without impairing spring discharges. This decision considered the fact that increased conversion from furrow irrigation to drip irrigation would decrease recharge to the aquifer from irrigation return.

4. Long-term Trends in the Aquifer
   a. Storage

   Based on the aquifer area and storage coefficient given on page A-38, a recent government study suggests that the water volume withdrawn from Pearl Harbor aquifer storage between 1910 and 1977 was approximately 9.3 billion gallons per year, or an average of 25 mgd [A.26b].

   Results from the Amfac study, on the other hand, postulate that storage is
decreasing by approximately 7 billion gallons per year, or 19 mgd [A.27].

b. Basal Water Head

In general, heads in the Pearl Harbor aquifer have been declining since the 1880's. Of five wells located within one-half mile of the shore of Pearl Harbor and monitored from 1910 to 1979, all exhibited a long-term decline in head [A.29]. Rates of decline varied from 0.06 to 0.14 feet per year and averaged about 0.09 feet per year. This implies that the fresh water lens has thinned at a rate of 3.7 feet per year, or 41 times the average head decline of 0.09 foot [A.30]*.

Basal water head contours represent the surface to which the basal water would rise if tapped by a well. Contours based on measurements taken in 1958, 1967, and

* It should be noted, however, that these data and conclusions largely pertain to operational or drawdown heads, as the monitor wells are influenced by the production wells around them. The May 31, 1958 measurements were taken at the end of a 4-month period when no water was pumped for irrigation (due to a strike) and these data
1978 indicate that head dropped evenly throughout the area, so that the pattern and gradient are generally unchanged [A.31]. Refer to Figures A-17 to A-18.

c. **Chloride Content**

The chloride concentration of the water from any particular well, shaft, or spring in the Pearl Harbor aquifer is often dependent upon: (1) the quality of recharging water; (2) the rate of discharge of the well and nearby wells; and (3) the position and depth of the wells relative to the fresh, brackish transition, and saline zones.

The chloride content of recharging water from Waiahole Ditch is less than 20 ppm, whereas recharge water from the wells ranges from less than 250 ppm to perhaps as much as 800 ppm [A.32]. Annual means of monthly chloride concentrations from long-term records of four wells within one-half mile of Pearl Harbor and one well field near Makakilo have been graphed and results vary [A.33].


Explanations:
- Ground-water head contour in feet, above mean sea level, dashed where uncertain.

Figure A-17
Basal water head contours
BASAL-WATER HEAD CONTOURS BASED ON MEASUREMENTS ON JANUARY 11, 1978.

BASAL-WATER HEAD CONTOURS BASED ON MEASUREMENTS ON AUGUST 9, 1978.

EXPLANATION

= Ground-water head contour in feet, above mean sea level, dashed where uncertain.

FIGURE A-18
BASAL WATER HEAD CONTOURS
Graphs from the wells near Waipahu and Honouliuli indicate no significant trends. However, the long-term chloride record of the wells near Pearl City and Waiau show a general increase since the 1940's. This probably reflects: (1) a thinning of the basal lens; and (2) a thickening or migration inland of the brackish transition zone.

d. Rainfall/Infiltration

Annual and seasonal variations in precipitation will affect the quantity of water available at any time. Extensive rainfall records have been maintained over the years, and while "wet" and "dry" cycles may occur, they cannot be predicted with any useful certainty [A.34]. During a drought, more water will be pumped from ground water sources than would even be normally replenished by rainfall or surface water. This need to rely on ground water not only reduces the amount of accumulated storage, but there also may be long-term effects on the water supply.
e. Discharge

Total annual discharge from the Pearl Harbor aquifer has been steady since 1910, averaging about 275 mgd (per the USGS, Table A-7). However, withdrawals from wells have increased from 140 mgd in 1910 to 240 mgd in 1977, and spring discharge has decreased from 140 mgd in 1910 to 50 mgd in 1977 [A.35]. Refer to Figure A-19. Dividing the Pearl Harbor aquifer into four sub-areas, a government study revealed that pumpage from the Aiea and Waipahu sub-areas has not changed significantly since 1910 [A.36]. Refer to Figure A-20. Pumpage from the Ewa sub-area has shown a slow and steady increase, and pumpage from the Pearl City sub-area has shown a 5-fold increase since about 1950.

IV. DEMAND VERSUS SUPPLY

A. Existing

Within the PHGWCA existing demand may be summarized as follows:

<table>
<thead>
<tr>
<th>Land Use</th>
<th>1978 Withdrawal (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban (BWS)</td>
<td>75.5</td>
</tr>
<tr>
<td>Agriculture (Sugar)</td>
<td>132.5</td>
</tr>
<tr>
<td>Military</td>
<td>15.6</td>
</tr>
<tr>
<td>Other (Private)</td>
<td>3.5</td>
</tr>
</tbody>
</table>

A-55
(Refer to Table A-5 for a more detailed breakdown.) Major wells within the Pearl Harbor aquifer are shown in Figure A-21.

Sustainable capacity of the aquifers within the PHGWCA is estimated to be 200-245 mgd for the Pearl Harbor aquifer and is not applicable for the Schofield high-level water body. Refer to Figure A-22.

Sustainable capacity for the island of Oahu is estimated at 480-630 mgd [A.37]. Total water use on Oahu (pumpage plus surface water) in 1975 was 470 mgd. Refer to Table A-8. Thus, water use in the PHGWCA and island-wide is approaching sustainable yield of the ground water sources.

B. Future

Based on the BWS Domestic Consumption Guidelines (Table A-9), water demand of major proposed developments in the PHGWCA is shown in Table A-10. The approximate locations of these developments are shown in Figure A-23. Adding this additional future demand of 27 mgd to the 1978 pumpage rate of 228 mgd will result in a total demand of approximately 255 mgd in the PHGWCA by the year 2000. (Demand for sugar operations is anticipated to remain as is.)

Thus, demand will theoretically exceed maximum estimated sustainable yield in the PHGWCA by 10 ±
ESTIMATED SUSTAINABLE YIELD OF GROUND WATER ON OAHU
### TABLE A-8
TOTAL WATER DEMAND
OAHU, 1975

<table>
<thead>
<tr>
<th>Water Use</th>
<th>Amount (mgd)(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal</td>
<td></td>
</tr>
<tr>
<td>Board of Water Supply</td>
<td>130</td>
</tr>
<tr>
<td>Others</td>
<td>5</td>
</tr>
<tr>
<td>Industrial (1)</td>
<td></td>
</tr>
<tr>
<td>Agricultural</td>
<td></td>
</tr>
<tr>
<td>Sugar cane</td>
<td>50</td>
</tr>
<tr>
<td>Diversified crops</td>
<td>240</td>
</tr>
<tr>
<td>Military (2)</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>470</td>
</tr>
</tbody>
</table>

(1) Self-supplied.
(2) Includes municipal use.
(3) Groundwater, surface water, springs, and caprock sources.

Source: [A.38]
<table>
<thead>
<tr>
<th>Zoning</th>
<th>Average Daily Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td></td>
</tr>
<tr>
<td>1. Single Family - or duplex</td>
<td>500 gal/unit</td>
</tr>
<tr>
<td></td>
<td>2500 gal/acre</td>
</tr>
<tr>
<td>2. Multi-family low rise</td>
<td>400 gal/unit</td>
</tr>
<tr>
<td></td>
<td>4000 gal/acre</td>
</tr>
<tr>
<td>3. Multi-family high rise</td>
<td>300 gal/unit</td>
</tr>
<tr>
<td></td>
<td>3000 gal/acre</td>
</tr>
<tr>
<td>Commercial</td>
<td></td>
</tr>
<tr>
<td>Commercial/Industrial mix</td>
<td>100 gal/1000 sq. ft.</td>
</tr>
<tr>
<td>Commercial/Residential mix</td>
<td>120 gal/1000 sq. ft.</td>
</tr>
<tr>
<td>Resort</td>
<td></td>
</tr>
<tr>
<td>Light Industry</td>
<td>350 gal/unit</td>
</tr>
<tr>
<td></td>
<td>4000 gal/acre</td>
</tr>
<tr>
<td>Schools, Parks</td>
<td>4000 gal/acre</td>
</tr>
<tr>
<td></td>
<td>60 gal/student</td>
</tr>
</tbody>
</table>

The guidelines for water consumption may be revised by the Manager based on variable factors that influence water consumption rates to insure an adequate system.

<table>
<thead>
<tr>
<th>Location/Proposal</th>
<th>Type of Development</th>
<th>Estimated Completion Date</th>
<th>Acreage</th>
<th>Dwelling Units</th>
<th>Estimated Consumption (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waipahu-Crestview</td>
<td>Housing</td>
<td>1985</td>
<td>316</td>
<td>1,745</td>
<td>0.94</td>
</tr>
<tr>
<td>Village Park 3</td>
<td>Housing</td>
<td>1995</td>
<td>373</td>
<td>3,693</td>
<td>1.90</td>
</tr>
<tr>
<td>Ewa-Makakilo</td>
<td>Housing</td>
<td>2000</td>
<td>640</td>
<td>1,680</td>
<td>4.5 Potable +</td>
</tr>
<tr>
<td>Makakilo 3/</td>
<td>Housing</td>
<td>1995</td>
<td>7,520</td>
<td>1.0 Irrigation</td>
<td></td>
</tr>
<tr>
<td>West Beach</td>
<td>Resort</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Campbell Industrial Park 3/</td>
<td>Employment</td>
<td>2000</td>
<td>1,486</td>
<td>-</td>
<td>7.78</td>
</tr>
<tr>
<td>Honouliuli WWTP</td>
<td>Utility</td>
<td>1982</td>
<td>51</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Sarbers Point Deep</td>
<td>Port Employment</td>
<td>2000</td>
<td>330</td>
<td>-</td>
<td>0.06 (Phase I)</td>
</tr>
<tr>
<td>Water Harbor</td>
<td>Education</td>
<td>NA</td>
<td>200</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>West Oahu College</td>
<td>Recreation</td>
<td>1990</td>
<td>1,098</td>
<td>7,200</td>
<td>3.65</td>
</tr>
<tr>
<td>Ewa Marina Community</td>
<td>&amp; Housing</td>
<td>NA</td>
<td>200</td>
<td>NA</td>
<td>0.50</td>
</tr>
<tr>
<td>Ewa Newtown</td>
<td>Housing</td>
<td>NA</td>
<td>200</td>
<td>NA</td>
<td>0.50</td>
</tr>
<tr>
<td>HPOWER</td>
<td>Solid Waste Recovery</td>
<td>NA</td>
<td>NA</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearl Harbor - Wahiawa</td>
<td>Housing</td>
<td>1985</td>
<td>510</td>
<td>3,700</td>
<td>1.05</td>
</tr>
<tr>
<td>Gentry/Waipio 3/</td>
<td>Employment</td>
<td>1985</td>
<td>1,300</td>
<td>NA</td>
<td>3.25</td>
</tr>
<tr>
<td></td>
<td>Housing</td>
<td>NA</td>
<td>NA</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Employment</td>
<td>NA</td>
<td>63</td>
<td>-</td>
<td>0.25</td>
</tr>
<tr>
<td>Waiawa Ridge</td>
<td>Housing</td>
<td>NA</td>
<td>476</td>
<td>NA</td>
<td>1.19</td>
</tr>
<tr>
<td>Waiawa Industrial Park</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mililani Town 3/</td>
<td>Housing</td>
<td>1985</td>
<td>138</td>
<td>600</td>
<td>0.30</td>
</tr>
<tr>
<td>Royal Summit 3/</td>
<td>Housing</td>
<td>1985</td>
<td>138</td>
<td>600</td>
<td>0.30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>27.37 (+)</td>
</tr>
</tbody>
</table>

NA Not Available

1/ Potential projects, not necessarily approved.

2/ Water consumption estimates based on WMS Consumption Guideline (Table A-8) and proposed land use for each development.

3/ Developments that have received full or partial water commitments.
FIGURE A-23
PROPOSED DEVELOPMENTS PHGWCA

* POTENTIAL H POWER SITES

MAILE

NANAKULI

PARRINGTON HWY.

WEST BEACH

CAMPBELL INDUSTRIAL PARK

BARBERS PT HARBOUR

EWA MARINA COMMUNITY

EWA BEACH

EWA HONOLULU WWTR

VILLAGE PARK

WAIPAHU

WEST OAHU COLLEGE

MAKAI EXPANSION

WAIIWA INDUSTRIAL PARK

WAIIWA RIDGE

WAIPO GENTRY

MLILANI TOWN EXPANSION

WAIKANE

WAIIKA
mgd. However, since approximately 44 mgd is presently exported to the Honolulu and Waianae areas, demand could be met by the existing supply if alternate water sources could be developed for the areas presently served by export, as well as within the PHGWCA.

A number of alternatives are possible. They include:

1. **New Water Sources**

   Presently, studies are underway to determine the feasibility of developing new water sources in the Waianae region, for example. It is anticipated that 6 mgd of water may be available in Makaha and Waianae valleys. If so, then export from the PHGWCA could be reduced by up to 6 mgd. Other alternative water sources, including water exchange and desalinization, are discussed in Section 6 of this EIS.

2. **Conservation**

   One way in which projected demand could be reduced, rather than "met", would be to enforce across-the-board conservation policies. It has been estimated that potential reduction of about 35 mgd in projected demand on Oahu could be achieved by holding per capita water consumption at 1975 levels [A.39]. If per capita
consumption could be reduced by 25% under 1975 levels, most existing domestic water systems would be adequate with minor additions through the year 2000 [A.40]. Methods of achieving conservation are discussed in Section 4 of this EIS.

An example of how a large conservation effort might be carried out is presented below, along with potential impacts on municipal wastewater treatment facilities [A.41]:

A comprehensive environmental management plan for the San Francisco Bay Area was recently completed by the Association of Bay Area Governments, an association of nine California counties. The plan included a recommendation that a "moderate level" of water conservation be implemented throughout the region.

A moderate conservation program was defined as one that emphasized retrofit of water-saving devices in existing structures, and building in water-saving devices in new structures. Shower flow restrictors and toilet tank volume displacement bottles would be installed in existing homes.

A-66
New homes would be fitted with low-flow shower heads, low flush-volume toilets, faucet flow controls with mixers, shower cutoff valves, pressure regulators, and hot water pipe insulation. In California, State legislation already exists requiring the installation of low flush-volume toilets in new construction.

It was estimated that retrofit of water-saving devices in existing homes would save about 9 gallons per capita per day. However, it was expected that if the devices were distributed to homeowners without charge, but installation was voluntary, they would only be installed in 15-30% of the homes. Thus, the actual average saving in existing homes would be 1.7 gallons per capita per day.

It was assumed that all new structures would be fitted with water-saving devices, with an expected water savings of 16.6 gallons per capita per day. In addition to the savings resulting from installation of devices, it was estimated that a further overall saving of 5% would result from
informational programs designed to increase public awareness of the need for conservation.

It was anticipated that implementation of the program described above would reduce water demand in the Bay Area by about 160 mgd by the year 2000 (this assumed regional population growth from 4.6 million in 1975 to 6.1 million in the year 2000). It was also realized that if this were true, there would be a decrease in the projected flow of municipal wastewater. This impact of conservation was also studied.

Results of a theoretical analysis of the effects of water conservation on existing wastewater facilities led to the conclusion that, within the expected range of water saving (10-20%), effects would be fairly minor. Conservation-induced flow variations would be relatively small compared to variations caused by other factors. In general, it appears that water conservation programs would not cause any major problems at existing plants and might

A-68
actually improve performance and extend the time to reach design capacity.

Results also indicated that the capital cost of a new facility designed to treat wastewater for a 10-year period, assuming implementation of a water savings program, would be less than for a similar facility assuming no water saving. Operation costs would also be slightly less. It should be noted, however, that if wet-weather flows far exceed dry-weather flows, the need to provide hydraulic capacity for those large flows would eliminate the opportunity for cost savings.

Conception and implementation of a conservation program of this magnitude on Oahu would probably require an initial decision as to which level of government would have jurisdiction, as well as which agency should become the lead agency.
REFERENCES TO APPENDIX A


[A.21] Ibid. [A.20], p. 13.


Board of Water Supply, City and County of Honolulu. January 7, 1980. Letter to George S. Morikuchi, Department of General Planning, City and County of Honolulu.

Op. Cit. [A.3], p. 35.


Ibid.

Op. Cit. [A.37]

Op. Cit. [A.37]

APPENDIX B

GLOSSARY
APPENDIX B

GLOSSARY

1. **Alkalic Basalt**: Lava rock rich in the alkaline elements of sodium and potassium and undersaturated in silica.

2. **Aquifer**: A saturated underground body of rock or similar material capable of storing water and transmitting it to wells or springs.

3. **Caprock**: Relatively impermeable soil and alluvial deposits with some marine sediment, including poorly sorted gravel, sand, and silt washed down from the mountains.

4. **Class 2 Waters**: Waters which are used for recreational purposes, propagation of fish and other aquatic life, and agricultural and industrial water supplies.

5. **Cone of Depression**: The area in the aquifer around a well from which water has been removed by pumping.

6. **Discharge**: This term refers to both pumpage of ground water and natural free flow of ground water from the aquifer (springs, tunnels, and seepage).

7. **Draft**: Discharge or pumpage from a well or shaft.

8. **Drawdown**: The distance from the original water surface to the lowered surface of water in a well, due to pumping.

9. **Ground Water**: Water that occurs beneath the land surface and completely fills all pore spaces of the rock material in which it occurs.
10. **Head**: The elevation of the water table above sea level.

11. **Inflow Method**: A method used to derive ground water recharge whereby natural recharge is computed by subtracting direct surface runoff and evapotranspiration from inflow (rainfall and subsurface flows). This method is also known as a hydrologic budget. Adding irrigation return to the computed natural recharge yields total recharge.

12. **Isopiestic Area**: An area characterized as having an artesian head higher or lower than that in adjacent areas. In the vicinity of Honolulu, such areas are separated by relatively impermeable natural fill extending far below sea level in ancient valleys.

13. **Maximum Capacity**: This refers to the maximum capacity of the well pumps. A maximum capacity of 12 mgd means that if the pump were to be operated for 24 hours, the maximum water that could be withdrawn would be 12 mg.

14. **Outflow Method**: A method used to derive ground water recharge whereby total recharge (the sum of natural and artificial recharge) is equal to the total discharge less the amount of water taken from storage. Subtracting irrigation return from the computed total recharge yields natural recharge.
15. **Pumpage**: Forcible outflow pumped from a water source; artificial discharge.

16. **Recharge**: Rainfall or other water which infiltrates the earth and replenishes ground water bodies.

17. **Sustainable Capacity (Sustainable Yield)**: This refers to the rate at which water may be withdrawn from a well without causing any degradation of water quality or quantity within the aquifer. This term is also used to refer to the combined impact of several wells or water sources on the entire aquifer of an area.

18. **Tholeiitic Basalt**: Lava rock saturated in silica and relatively low in the alkalic elements (of sodium and potassium).

19. **Unconformity**: A surface of separation between two rock outcrops or groups of rocks, marking a period of nondeposition and/or erosion.

20. **Water Table**: The upper limit of the fresh water basal lens.
APPENDIX C

SURFACE FLOW RECHARGE
APPENDIX C

SURFACE FLOW RECHARGE

A recent study suggests that surface flow from the streams into the Pearl Harbor area could be diverted through recharge areas [C.1]. The following discussion is taken from that study:

Average annual direct runoff from the 90-square mile Pearl Harbor area is 47.27 mgd. Natural recharge is greatest in the uplands, where average direct annual runoff in streams in the 800 and 400 foot altitudes is 29 and 38 mgd, respectively. Because streams are flashy and have a wide range of recharge, only 60% of the average annual runoff can be economically diverted through ditches to recharge areas, or 28.36 mgd. The diversion may be increased slightly if reservoirs are used in conjunction with ditches to temporarily detain flows in excess of ditch capacity. Practical tests are needed to determine the advantages and disadvantages of different types of recharge structures, such as a reservoir or basin, large diameter deep shafts, deep wells, or combinations of all these structures.

One problem with this scheme is the sediment load carried by the surface waters. High flows must be used if recharge is to be effective, but flows must not be so high as to cause clogging of recharge facilities with sediment or woodland debris.

C-1
Another problem involves water quality. Diversion of water from a stream may prevent the water quality in the stream from meeting State water quality standards. Application of minimum flow standards to streams, which would effectively restrict diversion of stream waters, may be necessary and desirable to protect water quality [C.2].

REFERENCES


APPENDIX D

WATER QUALITY STANDARDS
APPENDIX D

WATER QUALITY STANDARDS

"4. Basic Water Quality Criteria Applicable to All Waters

All water shall be free of substances attributable to domestic, industrial, or other controllable sources of pollutants and subject to verification by monitoring as may be prescribed by the Director of Health, as follows:

(A) Materials that will settle to form objectionable sludge or bottom deposits.

(B) Floating debris, oil, grease, scum, or other floating materials.

(C) Substances in amounts sufficient to produce taste or odor in the water or detectable off flavor in the flesh of fish, or in amounts sufficient to produce objectionable color, turbidity, or other conditions in the receiving waters.

(D) High temperatures; biocides; pathogenic organisms; toxic, radioactive, corrosive, or other deleterious substances at levels or in combinations sufficient to be toxic or harmful to human, animal, plant, or aquatic life, or in amounts sufficient to interfere with any beneficial use of the water. To identify the actual or potential effects of a discharge, as a minimum, a phytoplankton bioassay test or a 96-hour bioassay or both shall be required. The methods and test parameters shall be specified by the Director according to established procedures in Section 9 of this Chapter, provided that modifications may be prescribed to meet conditions specific to the disposal situation. Survival of test organisms shall not be less than that in controls which utilize appropriate experimental

Public Health Regulations 37-A, Department of Health, State of Hawai'i. These are the new water quality standards, which went into effect on December 7, 1979.
water. Field monitoring may be further required to insure conformance with this standard as long as a discharge or a suspected discharge is occurring.

(E) Substances or conditions or combinations thereof in concentrations which produce undesirable aquatic life.

(F) Soil particles resulting from erosion on land involved in earthwork, such as the construction of public works; highways; subdivisions; recreational, commercial or industrial developments; or the cultivation and management of agricultural lands. This standard shall be deemed met upon a showing that the land on which the erosion occurred or is occurring is being managed in accordance with soil and water conservation district and the Director of Health, and that a comprehensive conservation program is being actively pursued, or that the discharge has received the best degree of treatment or control, and that the severity of impact of the residual soil reaching the receiving body of water is deemed to be acceptable.

"5.3 Criteria

(B.) Streams

(1) Water Column Criteria for Streams

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Geometric mean not to exceed the given value</th>
<th>Not to exceed the given value more than 10% of the time</th>
<th>Not to exceed the given value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Kjedahl Nitrogen (ug N/l)</td>
<td>250.0*</td>
<td>520.0*</td>
<td>800.0*</td>
</tr>
<tr>
<td>Nitrate + Nitrate Nitrogen (ug (NO₃ + NO₂-N)/l)</td>
<td>180.0**</td>
<td>380.0**</td>
<td>600.0**</td>
</tr>
<tr>
<td>Total Phosphorus (ug P/l)</td>
<td>50.0*</td>
<td>100.0*</td>
<td>150.0*</td>
</tr>
<tr>
<td></td>
<td>30.0**</td>
<td>60.0**</td>
<td>80.0**</td>
</tr>
</tbody>
</table>

D-2
<table>
<thead>
<tr>
<th>Total Non-filterable Residue (ug/l)</th>
<th>20,000.0*</th>
<th>50,000.0*</th>
<th>80,000.0*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbidity (Nephelometric Turbidity Units)</td>
<td>5.0*</td>
<td>15.0*</td>
<td>25.0*</td>
</tr>
<tr>
<td></td>
<td>10,000.0**</td>
<td>30,000.0**</td>
<td>55,000.0**</td>
</tr>
<tr>
<td></td>
<td>2.0**</td>
<td>5.5**</td>
<td>10.0**</td>
</tr>
</tbody>
</table>

* Wet Season - November 1 through April 30.

** Dry Season - May 1 through October 31.

pH Units shall not deviate more than 0.5 units from ambient conditions and shall not be lower than 5.5 nor higher than 8.0.

Dissolved Oxygen - Not less than 80% saturation.

Temperature - Shall not vary more than 1°C from ambient conditions.

Specific Conductance - Not more than 300 micromhos/cm.

(2) **Bottom Criteria For Streams**

(a) Episodic deposits of flood-borne soil sediment shall not occur in quantities exceeding an equivalent thickness of 5 mm. (0.20 inch) over hard bottoms 24 hours after a heavy rainstorm.

(b) Episodic deposits of flood-borne soil sediment shall not occur in quantities exceeding an equivalent thickness of 10 mm. (0.40 inch) over soft bottoms 24 hours after a heavy rainstorm.

(c) In soft bottom material in pool sections of streams, oxidation-reduction potential (Eh) in the top 10 cm (4 inches) shall not be less than +100 mv.

(d) In soft bottom material in pool sections of streams, no more than 50% of the grain size distribution of sediment shall be smaller than 0.125 mm (0.005 inch) in diameter.
(e) The Director of Health shall prescribe the appropriate parameters, measures and criteria for monitoring stream bottom biological communities including their habitat, which may be affected by proposed actions. Permanent benchmark stations may be required where necessary for monitoring purposes. The water quality criteria for this subsection shall be deemed to be met if time series surveys of benchmark stations indicate no relative changes in the relevant biological communities, as noted by biological community indicators or by indicator organisms which may be applicable to the specific site."

Note: The abbreviation "ug" refers to "microgram". One miligram ("mg") equals 1,000 micrograms.
APPENDIX E

SAFE DRINKING WATER ACT, 1974

STATE DEPARTMENT OF HEALTH, CHAPTER 49,
POTABLE WATER SYSTEMS

All references to Chapter 49, Public Health Regulations (PHR) are amended to read Chapter 20, Title 11, Administrative Rules which is the current state regulation for potable water systems. Chapter 49, PHR was revised as Chapter 20, Title 11, Administrative Rules on December 26, 1981.
APPENDIX E

SAFE DRINKING WATER ACT, 1974

The Safe Drinking Water Act of 1974 (P.L. 93-523) designates the Federal Government (Environmental Protection Agency or EPA) with the primary responsibility of establishing national standards. The states are responsible for enforcing the standards and otherwise supervising public water supply systems and sources of drinking water. A public water system is defined as providing piped water for human consumption and as having at least 15 service connections or regularly serving at least 25 people.

This Act provides for:

- Establishment of primary regulations for the protection of the public health;
- Establishment of secondary regulations relating to the taste, odor, and appearance of drinking water;
- Measures to protect underground drinking water sources;
- Research and studies regarding health, economic, and technological problems of drinking water supplies. Specifically required are studies of viruses in drinking water and contamination by cancer-causing chemicals;
- A survey of the quality and availability of rural water supplies;
- Aid to the States to improve drinking water programs through technical assistance, training of personnel, and grant support;
- Citizen suits against any party believed to be in violation of the Act;
- Record-keeping, inspection, issuance of regulations, and judicial review;

- A 15-member National Drinking Water Advisory Council to advise the EPA Administrator on scientific and other responsibilities under the Act;

- A requirement that the Secretary of Health, Education, and Welfare ensure that standards for bottled drinking water conform to the primary regulations established under the Act - or to publish reasons for not doing so;


Primary standards were designed to provide maximum feasible protection of the public health, utilizing the best treatment methods generally available, with cost as a consideration. The standards are ultimately to include maximum contaminant levels, treatment techniques, and criteria for operation, maintenance, siting, and intake of public water supply systems.

Secondary standards will also be prescribed for taste, odor, and appearance of drinking water, including sodium and total dissolved solids in the water. Secondary standards are to be enforced at the discretion of the individual states.

STATE DEPARTMENT OF HEALTH, CHAPTER 49, POTABLE WATER SYSTEMS

These regulations were adopted by virtue of Chapter 340E, Hawaii Revised Statutes, the purpose being to establish drinking water quality standards. These standards
are based on standards and guidelines developed due to enactment of the Safe Drinking Water Act (P.L. 93-523). It sets the parameters for inorganic and organic chemicals and for such factors as turbidity and coliforms. Inorganic and organic chemicals and coliforms are monitored by the State Department of Health and turbidity is monitored by the County.
APPENDIX F

SPECIES CHECKLISTS
APPENDIX F
SPECIES CHECKLISTS
CHECKLIST OF FLORA

The following is a checklist of flora observed in the vicinity of the proposed Honouliuli Wells and transmission line in May, 1979. All species are considered exotic; that is, species introduced after the western discovery of the islands. No rare or endangered species of plants were seen at the site, or are believed to exist on or near the site.

The site is presently dominated by shrub species, with cultivated sugar cane in the surrounding areas. Species in the checklist are presented in alphabetical order according to families and subcategorized beneath each family are the genus and species classifications.

Status symbols are as follows:

X exotic; i.e., species of accidental or deliberate introduction after the western discovery of the islands.
# CHECKLIST OF FLORA

**PROPOSED HONOLULU WELLS**

**KUNIA, OAHU, HAWAII**

<table>
<thead>
<tr>
<th>SCIENTIFIC NAME</th>
<th>COMMON NAME</th>
<th>STATUS</th>
<th>RELATIVE ABUNDANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AMARANTHACEAE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amaranthus spinosus L.</td>
<td>Spiny Amaranth</td>
<td>X</td>
<td>C</td>
</tr>
<tr>
<td><strong>CONVOLVULACEAE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ipomoea arborescens (Humb. &amp; Bonpl. ex Willd.) G. Don</td>
<td>Palo blanco</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>Ipomoea forsteri</td>
<td>Morning glory</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td><strong>GRAMINEAE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brachiaria mutica (Forsk.) Stapf</td>
<td>California grass</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>Chloris inflata Link.</td>
<td>Swollen finger grass</td>
<td>X</td>
<td>C</td>
</tr>
<tr>
<td>Paspalum dilatatum (Poir.)</td>
<td>Dallis grass</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>Saccharum officinarum L.</td>
<td>Sugar cane</td>
<td>X</td>
<td>A</td>
</tr>
<tr>
<td><strong>LEGUMINOSEAE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leucaena leucocephala (Lam.) de Wit.</td>
<td>Koa-haole</td>
<td>X</td>
<td>C</td>
</tr>
<tr>
<td>Prosopis pallida (Humb. &amp; Bonpl. ex Willd.) HBK.</td>
<td>Kiawe</td>
<td>X</td>
<td>C</td>
</tr>
</tbody>
</table>

F-2
<table>
<thead>
<tr>
<th>SCIENTIFIC NAME</th>
<th>COMMON NAME</th>
<th>STATUS</th>
<th>RELATIVE ABUNDANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PASSIFLORACEAE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passiflora mollissima (HBK.) Bailey</td>
<td>Banana pokak</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>PLANTAGINACEAE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plantago major L.</td>
<td>Broad-leaved plaintain</td>
<td>X</td>
<td>U</td>
</tr>
</tbody>
</table>

Where:  A - abundant,  C - common,  O - occasional,  U - uncommon,  R - rare
CHECKLIST OF FAUNA

The following is a checklist of fauna seen or believed probable at the site. The only endemic species that probably frequents the site is the Hawaiian owl, or pueo. No rare or endangered species of avifauna were seen or are believed to be present at the site or adjacent areas.

Avifauna seen or believed present and mammalian species believed present are common and found throughout the State. Significant impacts to fauna communities and species' populations are not expected.

Species in the checklist are presented in alphabetical order according to families, and subcategorized beneath each family are the genus and species classifications.

Status symbols are as follows:

X exotic; i.e., species of accidental or deliberate introduction after the western discovery of the islands

E endemic to the Hawaiian Islands; i.e., occurring naturally nowhere else in the world
### CHECKLIST OF FAUNA

**PROPOSED HONOLULU WELLS**

**KUNIA, OAHU, HAWAII**

<table>
<thead>
<tr>
<th>SCIENTIFIC NAME</th>
<th>COMMON NAME</th>
<th>STATUS</th>
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</thead>
<tbody>
<tr>
<td><strong>A. CLASS AVES</strong></td>
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</tr>
<tr>
<td><strong>COLUMBIDAE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Geopelia striata</td>
<td>Barred dove</td>
<td>X</td>
</tr>
<tr>
<td>Streptopelia chinensis chinensis</td>
<td>Lace-necked dove</td>
<td>X</td>
</tr>
<tr>
<td><strong>FRINGILLIDAE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardinalis cardinalis</td>
<td>Cardinal</td>
<td>X</td>
</tr>
<tr>
<td>Carpodacus mexicanus frontalis</td>
<td>House finch</td>
<td>X</td>
</tr>
<tr>
<td>* Paroaria coronata</td>
<td>Red-crested cardinal</td>
<td>X</td>
</tr>
<tr>
<td>Passer domesticus</td>
<td>House sparrow</td>
<td>X</td>
</tr>
<tr>
<td><strong>MIMIDAE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Mimus polyglottus</td>
<td>Mockingbird</td>
<td>X</td>
</tr>
<tr>
<td><strong>STRIGIDAE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asio flammeus sandwichensis</td>
<td>Hawaiian short-eared owl; pueo</td>
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</tr>
</tbody>
</table>

F-5
<table>
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<tr>
<th>SCIENTIFIC NAME</th>
<th>COMMON NAME</th>
<th>STATUS</th>
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</thead>
<tbody>
<tr>
<td>Acridotheres tristis</td>
<td>Common mynah</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. CLASS MAMMALIA</td>
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</tr>
<tr>
<td>MURIDAE</td>
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<tr>
<td>Mus musculus</td>
<td>House mouse</td>
<td>X</td>
</tr>
<tr>
<td>domesticus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rattus exulans</td>
<td>Polynesian rat</td>
<td>X</td>
</tr>
<tr>
<td>Rattus norvegicus</td>
<td>Brown rat</td>
<td>X</td>
</tr>
<tr>
<td>Rattus rattus</td>
<td>Black rat</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td>VIVERRIDAE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herpestes auropunctatus</td>
<td>Mongoose</td>
<td>X</td>
</tr>
</tbody>
</table>

* Species observed during site reconnaissance
APPENDIX G

BOARD OF WATER SUPPLY, CITY AND COUNTY OF HONOLULU

RULES AND REGULATIONS
APPENDIX G

BOARD OF WATER SUPPLY, CITY AND COUNTY OF HONOLULU

RULES AND REGULATIONS

Section 3-313: Utilization of Well Water.

1. All water wells shall be operated in a manner that will readily and effectively prevent wastage and pollution of water. The Manager may exclude high-level tunnels from the provisions of this section if it is specifically determined in each case that wastage of water therefrom cannot be reasonably corrected.

2. The Manager may limit the amount of water drawn from any well covered under these Rules and Regulations if there is a reasonable basis to expect that the overdraft will:

   a. Cause or bring about overdraft conditions; or

   b. Excessively lower the ambient groundwater table; or

   c. Cause or bring about excessive salt water intrusion, excessive mineralization, or other degradation of water quality, which may render a domestic water source unfit for such purposes; or

   d. Interfere with the operations of existing established water sources.

3. If the Manager proposes to limit draft from any well, he shall inform the Owner of sufficient facts
and reasons upon which his limitation is based, and afford
the Owner an opportunity for informal hearing before taking
action.

4. This rule shall apply to all areas of the City except in "designated groundwater areas" established by
the State of Hawaii, Department of Land and Natural Re-
sources, pursuant to Chapter 177, Hawaii Revised Statutes,
as amended.
APPENDIX H

PRIORITY RECOMMENDATIONS OF THE STATE WATER COMMISSION

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 INCREASED 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.

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 I

SUMMARY OF HOUSEHOLD WATER-SAVING DEVICES

AND

CITY AND COUNTY ORDINANCE No. 79-27
### APPENDIX I

**SUMMARY OF HOUSEHOLD WATER-SAVING DEVICES**

<table>
<thead>
<tr>
<th>Device</th>
<th>Water Use Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>gpd</td>
</tr>
<tr>
<td>Toilet improvements</td>
<td>7.5-17.5</td>
</tr>
<tr>
<td>Faucet aerators</td>
<td>0-0.5</td>
</tr>
<tr>
<td>Flow limit valves, all fittings</td>
<td>0-0.5</td>
</tr>
<tr>
<td>Shower flow limiting</td>
<td>0-7.5</td>
</tr>
<tr>
<td>Pressure-reducing valves</td>
<td>0-16</td>
</tr>
<tr>
<td>Metering</td>
<td>0</td>
</tr>
<tr>
<td>Septic tanks</td>
<td>35</td>
</tr>
<tr>
<td>Improved clothes washers</td>
<td>0-8</td>
</tr>
<tr>
<td>Improved dishwashers</td>
<td>0-6</td>
</tr>
<tr>
<td>Hot water pipe insulation</td>
<td>0-6</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>70</td>
</tr>
</tbody>
</table>

ORDINANCE NO. 79-27

BILL NO. 2 (1979)
(Draft No. 3)

A BILL FOR AN ORDINANCE TO AMEND CHAPTER 19, H.C.R. 1969, AS AMENDED, ENTITLED "PLUMBING CODE", BY ADDING A NEW ITEM (46a) RELATING TO WATER CONSERVATION.

BE IT ORDAINED by the People of the City and County of Honolulu:

SECTION 1. Section 19-4.1, Chapter 19 thereof is hereby amended by adding a new item (46a) to read as follows:

(46a) Adding Section 1010.
Section 1010 is added to read:

Section 1010. Water Conservation.

(a) Water supply faucets or valves shall be provided with approved flow control devices which limit flow to a maximum three (3) gallons per minute.

Exceptions:

1. Hose bibs or valves not used for a designated fixture or equipment.
2. Hose bibs, faucets or valves serving fixed demand, timing or water level control appliances, equipment or holding structures such as water closets, pools, automatic washers and other similar equipment.
3. Emergency showers.

(b) Tank-type water closets discharging more than 3.5 gallons per flush shall be provided with approved volume limiting devices or methods which will limit the discharge to 3.5 gallons per flush. When a satisfactory performance of the water closet cannot be obtained with 3.5 gallons or less per flush, the Administrative Authority may approve a larger discharge.

(c) Any new installation using potable water for cooling equipment at a rate exceeding one (11) gallon per minute, or operating more than ten (10) hours in a twenty-four (24) hour period, shall be designed to recirculate or reuse the cooling water.

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Any existing installation using potable water for cooling equipment shall be exempt except where an expansion to the system requires additional water usage.

SECTION 2. Effective Date. This ordinance shall take effect six (6) months after its approval.

INTRODUCED BY:

DATE OF INTRODUCTION:
January 10, 1979
Honolulu, Hawaii

APPROVED AS TO FORM & LEGALITY:

APPROVED this day of
May, 1979.

FRANK P. FALE, Mayor
City and County of Honolulu

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APPENDIX J

PROPOSED HONOLULU EFFLUENT
REUSE AREAS