EXECUTIVE CHAMBERS

HONOLULU

JOHN WAIHEE
GOVERNOR

April 26, 1989

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OFC. OF ENVIRON.
QUALITY CONTROL

The Honorable Hugh Y. Ono
Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear ~~Mr. Ono~~: Hugh

Based upon the recommendation of the Office of Environmental Quality Control, I am pleased to accept the Final Supplemental Environmental Impact Statement for the Hilo Wastewater Treatment and Conveyance Facilities, Hilo District, South Hilo, Hawaii, as satisfactory fulfillment of the requirements of Chapter 343, Hawaii Revised Statutes. This environmental impact statement will be a useful tool in the process of deciding whether the action described therein should be allowed to proceed. My acceptance of the statement is an affirmation of the adequacy of that statement under applicable laws and does not constitute an endorsement of the proposed action.

When the decision is made regarding the proposed action itself, I expect the proposing agency to weigh carefully whether the societal benefits justify the environmental impacts which will likely occur. These impacts are adequately described in the statement, and, together with the comments made by reviewers, provide a useful analysis of the proposed action.

With kindest regards,

Sincerely,

JOHN WAIHEE

cc: Office of Environmental Quality Control

Final Supplemental
Environmental Impact Statement

HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES

HILO DISTRICT, SOUTH HILO, HAWAII

PREPARED FOR:

County of Hawaii
Department of Public Works

Hugh Y. Ono
Chief Engineer

PREPARED BY:

M&E Pacific, Inc.
Engineers and Architects
1001 Bishop Street
Honolulu, Hawaii 96813

FEBRUARY 1989

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

No substantive changes have been made in the supplemental environmental impact statement. Minor changes have been made throughout the document to clarify meaning, update figures or correct errors.

Letters containing comments on the Draft Supplemental EIS and the letters of response are contained in a new Chapter VIII.

SUMMARY

DESCRIPTION OF THE ACTION

The County of Hawaii proposes to construct a new sewage treatment plant that will provide secondary treatment at a site near the east end of the runway at Hilo Airport; a pump station at the site of the existing sewage treatment plant, and force and gravity mains connecting the treatment plant and the pump station. This action is proposed in the 1988 update of the 1980 Hilo Wastewater Management Plan for the Hilo District, South Hilo, Hawaii. This Draft Supplemental Environmental Impact Statement (DSEIS) has been prepared to describe and assess the environmental impacts that are expected to occur due to these changes from the original EIS signed and accepted in September 1980.

The purpose of the planning effort and the proposed project is to meet the requirements of the Federal Clean Water Act and state regulations. The federal law requires all municipal wastewater point discharges to receive secondary treatment, as defined by EPA guidelines, prior to discharge into receiving waters.

Since the existing Hilo Wastewater Treatment Plant provides primary treatment, the County of Hawaii, in September 1979, filed an application with the U.S. Environmental Protection Agency (EPA) requesting a waiver from the secondary treatment provisions as allowed in Section 301(h) of the Clean Water Act. In September 1987 EPA denied the waiver. As a result of the denial, EPA and the State Department of Health required the County to revise the Municipal Compliance Plan with enforcement action to be administered by the courts.

SIGNIFICANT BENEFICIAL AND ADVERSE IMPACTS

Construction of the new facilities will result in improvements to the quality of the waters in Hilo Bay (Pepeekeo Point to Leleiwi Point) and a modern sewage treatment plant located in a more suitable area than the present facility. The effluent will receive secondary treatment before it is discharged into the bay. The old sewage treatment plant will be removed and replaced with a new pump station. Existing problems with odors at the old plant at Puhi Bay will be eliminated, as well as the potential hazard of destruction by a tsunami. Part of the land occupied by the existing plant will become available for recreational use.

No significant long-term adverse environmental impacts are anticipated. The proposed site is in a previously disturbed area zoned for industrial use. It contains no threatened or endangered plant or animal species and no significant archaeological sites. There will be unavoidable short-term adverse environmental impacts common to construction activities, such as noise, dust, and traffic disruption.

PROPOSED MITIGATION MEASURES

Traffic disruption along roadways will, in some instances, probably restrict traffic to a single lane pattern, with vehicular speeds reduced accordingly. Construction vehicular traffic, generated by disposal of excavated material and other construction-related activities, will be scheduled during off-peak hours and regulated to minimize interruptions to normal traffic flow.

Fugitive dust will be controlled as much as possible through watering and other measures as appropriate. Noise levels from machinery and motors will be limited to conform with state and county regulations. Construction hours will be regulated also, to reduce impacts.

ALTERNATIVES CONSIDERED

Several alternatives and subalternatives for sewage treatment and disposal were evaluated for the updated Hilo Wastewater Management Plan. The major constraints in selecting alternatives are statutory and regulatory. These include the federal law which requires all municipal point discharges to receive a minimum of secondary treatment prior to discharge; compliance with state receiving water quality standards; federal regulations defining secondary treatment; and the state administrative rules for water pollution control.

The major alternative choices relating to upgrading facilities to meet secondary treatment standards and their advantages and drawbacks are described in Chapter V. The alternatives are as follows:

- o Upgrade the existing sewage treatment plant at Puhi Bay or build a new plant at a different location. Utilizing the existing site was not favored because the site is within the tsunami inundation zone; there is insufficient space for an expanded secondary facility; untreated sewage would be discharged into Hilo Bay during the period of construction, and it is too near residences.

- o Alternative sites for location of a new plant. The sites were considered: a site south of the airport near the present county landfill, designated in the 1980 facilities plan; Wainaku Mill; and the selected site at the east end of runway at Hilo airport. The Citizens Advisory Group recommended the selected site.

- o Route of sewer mains between new plant and pump station. Three routes are presently being pursued for the alignment of the force main/gravity discharge. The alignment preferred by the county is along existing roads and sparsely occupied areas adjacent to the Hilo Airport runway. The alternative route runs northeast along Kalanianaole Avenue. Route selection is still unresolved.

- o Level of treatment to be provided. Secondary treatment of sewage is required by federal law. The only acceptable alternative is tertiary treatment which requires extensive, highly complex mechanical and electrical equipment and a high operational cost. This alternative was discounted because the incremental degree of tertiary treatment over that of secondary is very costly and provides no increased benefit.

  Four methods of achieving secondary treatment levels were evaluated during facilities planning. These methods are: biotower/solids contactor (B/SC), rotating biological contactor (RBC), activated sludge (AS), and sequential batch reactor (SBR). Criteria used in the evaluation of the alternatives include costs, both capital and annual O&M; the extent of operator attention and control required; precedents, i.e., extent of use in other communities and operating experiences; and degree of odors, nuisance insects, and other environmental impacts.

  Solids generated from the treatment processes require separate treatment processes: thickening, digestion, and dewatering, before being disposed. Alternative processes were evaluated in the following sections, utilizing the same criteria as for secondary treatment processes above.

- o Effluent disinfection methods. The three disinfection processes which are deemed most appropriate for the Hilo facility are chlorination, ozonation, and ultraviolet radiation. Chlorination/dechlorination is recommended.

- o Effluent disposal methods. Effluent disposal alternatives considered in 1980 and again in 1988 include ocean outfall disposal (existing method of disposal), injection wells, and reclamation and wastewater reuse. Continued use of the existing ocean outfall is favored over injection wells or reclamation and reuse at the present time. If a viable alternative for effluent reuse can be developed, the system can accommodate this alternate disposal method.

- o Solids disposal methods. The two alternatives available for disposal of sludge, are incineration or landfill. Incineration was considered in the 1980 Facilities Plan and rejected because of high capital and O&M costs. The 1988 Plan continues to recommend disposal by landfill.

- o No project. If there is no project, the existing plant will continue in operation. The county will not be able to meet EPA and state requirements and will violate the court order imposed upon it, thus subjecting the county to additional enforcement action and heavy fines.

Grant monies will not be received and spent. Existing odor problems with the old sewage treatment plant can be expected to continue.

UNRESOLVED ISSUES

The only unresolved issues are the alignment of the new force main that will convey wastewater from the pump station to the new treatment plant and the gravity discharge main to convey the treated effluent to the outfall and responsibility for hook-up charges. The three alternative routes are described in Chapter II. The alignment will be selected upon completion of an engineering evaluation of the three alternatives. Various methods of financial assistance for hook-up charges are presently being investigated by the County of Hawaii.

COMPATIBILITY WITH LAND USE PLANS AND POLICIES

The proposed action to build a new secondary treatment plant, pump station and sewer main is consistent with both State and County objectives and policies to improve water quality and provide sewerage facilities to support physical and economic activities.

The site of the proposed sewage treatment plant is in an area zoned for industrial use. The plant, pump station, and other appurtenant structures will be designed and built to conform to all county building codes and standards.

REQUIRED PERMITS AND APPROVALS

Permits, reviews and approvals for the proposed action are as follows:

Federal Aviation Agency	Clearance for construction
Department of Health	NPDES Discharge Permit Zone of Mixing Authority to Construct or Modify a facility: and Permit to Operate (air quality)
Hawaii County	Special Management Area Permit Grading, Grubbing & Stockpiling Permits Building Permit

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CHAPTER I

INTRODUCTION

A. BACKGROUND

This Draft Supplemental Environmental Impact Statement (DSEIS) has been prepared in compliance with the provisions of Subchapter 10 of Chapter 200, Title 11, Administrative Rules, Environmental Impact Statements, Department of Health. This Subchapter requires that a supplemental statement be prepared whenever there is a major change in the size, scope, location, and/or timing of the action described in the original EIS.

The original Revised Environmental Impact Statement (former designation–presently defined as Final Environmental Impact Statement in Chapter 200-11) for the Hilo Wastewater Management Plan for the Hilo District, South Hilo, Hawaii, was signed and accepted in September 1980. The Hilo Wastewater Management Plan is a comprehensive planning document that addresses all aspects of wastewater infrastructure for the Hilo District, including sewerage system improvements and treatment plant improvements. Since this document was prepared, several changes have been made to the planned system. This Draft Supplemental EIS incorporates the 1980 EIS by references and addresses changes in the design and location of the proposed wastewater treatment plant, pump station, sewer mains, and liquids handling system.

B. PURPOSE

The purpose of the planning effort and the proposed project is to meet the goals of the Federal Clean Water Act and state regulations. Construction of the new facilities will result in improvements to the quality of the waters in Hilo Bay and a modern sewage treatment plant located in a more suitable area than the present facility. The effluent will receive secondary treatment before it is discharged into the bay. Existing problems with odors at the old plant at Puhi Bay will be eliminated.

The Wastewater Management Plan, also called a facilities plan, takes into account both engineering and environmental impact factors. Wastewater management planning analyzes point source discharge requirements, the impact of alternative actions on water quality, and the cost-effectiveness of the facilities in meeting water quality goals. Specific guidelines for these plans have been promulgated by the Environmental Protection Agency (EPA), and those guidelines govern the scope and direction of the facilities plan.

C. PROJECT HISTORY

The construction of the existing Hilo wastewater treatment facility located at Puhi Bay in the district of Keaukaha was completed in July, 1965. Subsequent to this, Public Law 92-500 was enacted by Congress. The law requires all municipal wastewater point discharges to receive secondary treatment, as defined by EPA guidelines, prior to discharge into receiving waters.

Since the existing Hilo Wastewater Treatment Plant (WWTP) provides primary treatment, the County of Hawaii, in September 1979, filed an application with EPA requesting a waiver from the secondary treatment provisions as allowed in Section 301(h) of the Clean Water Act. Aside from a request by EPA for additional data which was provided in September 1986, the county did not receive a response to its petition until September 1987 at which time notification of denial was received. As a result of the denial, EPA and the Department of Health required the county to revise the Municipal Compliance Plan with enforcement action to be administered by the courts.

During this latter period, the County Administration and County Council determined that it would be prudent and in the best interest of the county and the community to begin efforts toward design and construction of a new relocated wastewater facility providing secondary treatment. This position was affirmed by the adoption of County Resolution No. 318-87 on July 22, 1987, authorizing the county to apply for such state and federal grants available for the planning, design and construction for such a facility. Based on this decision to relocate, the county recognized that a review of the 1980 Facilities Plan would be appropriate. Consequently, a consulting engineer firm was selected for the assignment with specific instructions to investigate alternative wastewater management plans. To assist the consultant in this task, the mayor of the county formed a Citizens Advisory Group (CAG) comprised of members representing a cross-section of the public and private community.

The resulting plan described in this DSEIS addresses not only the physical environment and the impact of waste flows on aquatic ecosystems, but also social and economic factors. Land use, demographic, and financial factors and their effects on the selection of the wastewater management system are discussed.

CHAPTER II

PROJECT DESCRIPTION

A. LOCATION

The Hilo study area (Figures II-1 and II-2) is located on the northeastern portion of the island of Hawaii, often called the Big Island, and lies on the lower eastern slopes of Mauna Loa. The study area--encompassing approximately 56 square miles--includes the existing City of Hilo and immediately adjacent areas, as delineated in the 1980 Facilities Plan. Also indicated on Figure II-2 is the service area which delineates the tributary collection areas. The adjacent areas are either serviced by another sewerage system (Paukaa-Papaikou system) to the north or are zoned for conservation or agriculture uses. The adjacent southerly district of Puna is basically agriculture with scattered, isolated towns.

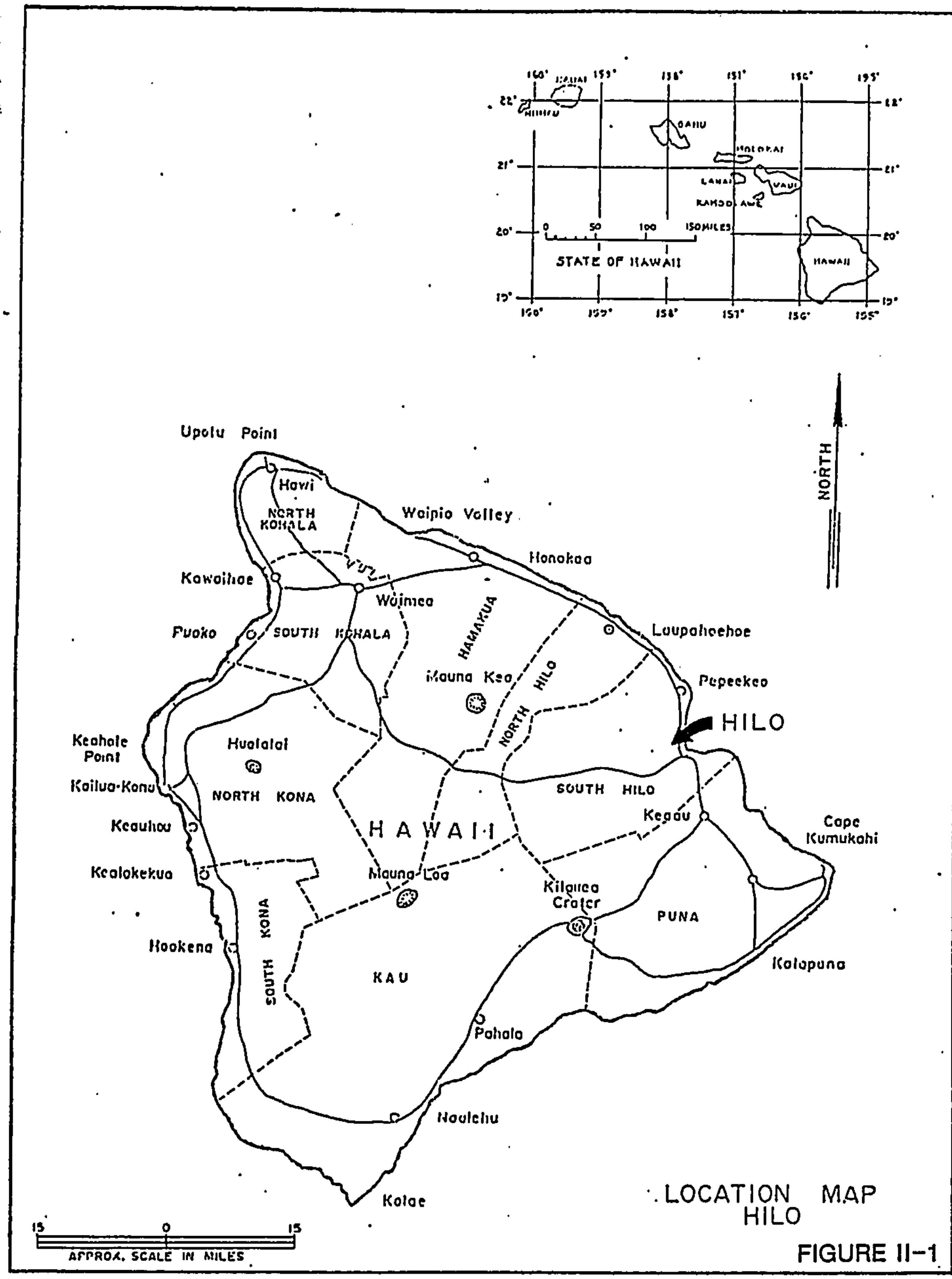
Hilo is the county seat and the principal center of government, transportation, and commerce. Hilo Bay, which is part of the study area, includes one of two major deep-water harbors on the island, while General Lyman Field and Keahole Airports are the major air terminals.

B. EXISTING WASTEWATER FACILITIES

The major treatment facility in the service area is the municipal Hilo Wastewater Treatment Plant (WWTP) located near the industrial area fronting Puhi Bay (Figure II-3). This facility provides primary treatment to the sewered portions of Hilo. Approximately 2,500 residents, 350 commercial establishment, 12 hotel complexes, and 6 schools are presently served by the existing treatment facility.

There are no major industrial dischargers into the municipal system. Small industrial dischargers include food processing and commercial sales establishments and restaurants. There are also no "heavy" industrial establishments, such as chemical processing plants and steel refineries, in the service area. The only dischargers discharging identifiable quantities of toxic pollutants are medical facilities (Hilo hospital). The discharge of toxic pollutants from these institutions, however, is intermittent and relatively insignificant.

Treatment facilities include a screening unit, grit chamber and grit removal unit, two 85-foot-diameter primary clarifiers, and 60-foot-diameter primary and secondary anaerobic digestion tanks. Solids dewatering is accomplished by two centrifugation units. Chlorinated effluent is discharged through a 48-inch outfall extending 4,500 feet into 56 feet of water. Primary effluent discharge was permitted under the National Pollutant Discharge Elimination System (NPDES), Permit No. HI0020176, until the denial of the Section 301(h) waiver application in 1987.



LOCATION MAP
HILO

FIGURE II-1

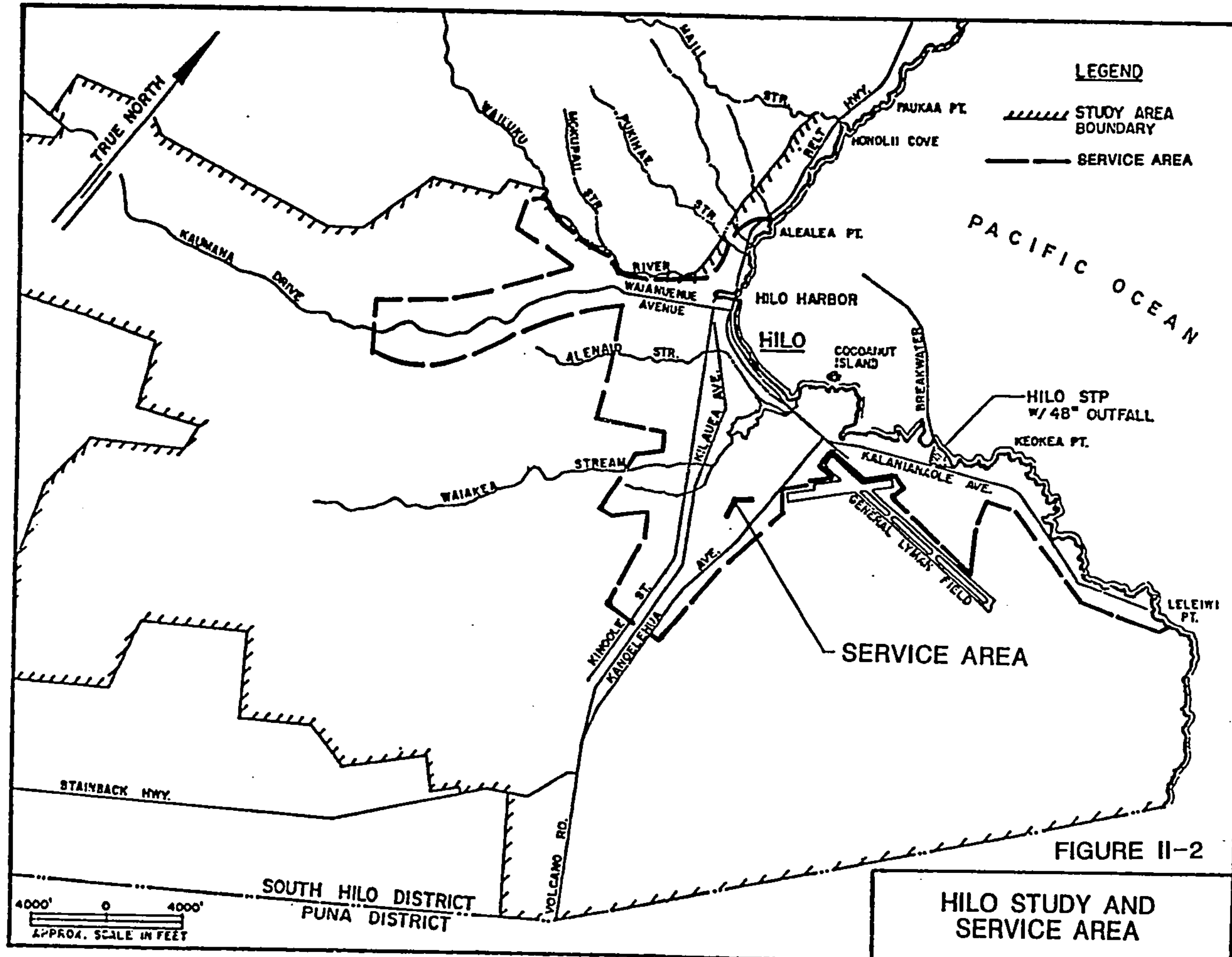


FIGURE II-2

HILO STUDY AND SERVICE AREA

Sewage flows, primarily from domestic, resort, and commercial sources, are conveyed to the treatment facility by a series of six pump stations, force mains, and interceptor sewers. Large interceptor sewers are constructed at low elevations near the coastline. Flow velocities in collection sewers and interceptors range from 3 to 8 feet per second. Flows in force mains have a minimum velocity of 3 feet per second.

CHARACTERISTICS OF SEWAGE

The Hilo WWTP receives influent wastewater that is primarily domestic. The influent is relatively dilute. Even with repairs to the collection system, the projected influent of 161 mg/L of five-day biochemical oxygen demand (BOD_5) and 147 mg/L of suspended solids (SS) is considered to be relatively mild. Toxicity testing has indicated that other than trace levels of chromium, copper, lead, and zinc, heavy metals and organic chemicals were well below the limits of detection (Ultra Chem Laboratories, 1979). The minute traces present corroborate the domestic nature of the sewage. The trace levels detected are disassociated from plumbing pipes and solder, cleansers, personal hygiene products, and other household products.

SLUDGE DISPOSAL

The present sludge disposal practice employed by the county is to convey dewatered sludge to the municipal sanitary landfill. A specially designated area at the landfill is allocated for the sludge. Dewatered sludge is buried in trenches approximately five feet deep.

The municipal sanitary landfill is located approximately three miles south of the treatment facility in the airport industrial area. The anticipated life of the landfill is 40 to 50 years.

C. EXISTING AND PROJECTED FLOWS

Average daily flows to the existing Hilo treatment plant for the calendar year 1987 ranged from 3.05 to 4.81 mgd; the overall average being 3.91 mgd. Average daily flows from the existing collection system, excluding infiltration, (average dry weather flow [ADWF]) have been estimated to be 2.22 mgd. The difference between these figures represents an estimate of the infiltration into the existing collection system. The relatively high volumes of infiltration result in relatively low average BOD_5 and SS concentrations: 107 and 97 mg/l, respectively. When adjusted for infiltration, assuming the infiltration has essentially zero BOD_5 and SS, the projected concentrations of BOD_5 and SS are 161 and 147 mg/l.

Future flows are based on the expanded sewerage collection system and population growth.

The 20-year design average flow for the Hilo area is approximately 6.5 mgd. However, the 1981 amendments to the Clean Water Act limit grant assistance for treatment plant reserve capacity. Therefore, federal funding will be based on capacity necessary to serve existing needs with a cut-off date of September 30, 1990 for reserve capacity. This means that any capacity beyond this date would not be grant eligible. Given this limitation on funding for reserve capacity and considering the fact that sewer construction and lateral hookup normally lag sewage flow generation, the most cost-effective plan for Hilo is to construct a facility to satisfy its near future needs and to later implement a facilities expansion, if and when it is required.

When considering the 40-year design flows (design average flow of approximately 7.8 mgd for the Hilo area), it is prudent to construct the facility in two stages, the first being 5.0 mgd. This is near the 5.5 mgd flow which is the estimated existing need as of the September 1990 cut-off date for reserve capacity and would adequately satisfy Hilo's needs.

A comparison of the proposed 5.0 mgd facility with the existing 7.0 mgd existing facility is a further justification in support of a smaller facility. The existing Hilo municipal wastewater facility is a good example of projected growth which failed to materialize.

For these reasons, the design average dry weather flow (ADWF) of 5.0 mgd and a corresponding peak wet weather flow (PWWF) of 13.0 mgd are used in the plan. All subsequent discussion of alternatives is based on these flows.

D. OVERVIEW OF THE WASTEWATER MANAGEMENT PLAN

Several wastewater management studies for the Hilo area have been developed, the most prominent being the *Hilo Sewer System Study* by Belt, Collins & Associates in 1963. Planning concepts presented in that study form the basis for the development of the existing sewer system in Hilo.

Since earlier plans were developed, technological advances have occurred, priorities and regulations have changed, and more stringent environmental standards have evolved. For these reasons, a reevaluation of the overall wastewater management plan was conducted in the 1980 Facilities Plan.

This 1988 Facilities Plan constitutes a further update to maintain consistency with new regulatory changes, technology and growth projections. The basic issue in this reevaluation is the location of the treatment facility. The present site is located in an area prone to tsunami flooding and damage and selection was predicated on an earlier plan by others for the protection of Hilo from tsunami inundation. This plan, developed by the U.S. Corps of Engineers, included the construction of a continuous tsunami barrier fronting the city of Hilo, including the treatment plant. Subsequent to the construction of the plant, however, plans for this barrier were abandoned for financial and aesthetic reasons.

Several regulatory constraints regarding tsunami inundation must be considered in the planning and designing of the treatment facility.

First, the EPA design guide for treatment facilities contains the following restrictions applicable to facilities located in coastal areas:

1. The facility shall remain fully operational during a 25-year tsunami.

2. Structural, electrical, and mechanical components of the treatment works shall be protected from physical damage from a 100-year tsunami.

Second, conformance to Hawaii County's Safety Hazard Regulations requires that the lowest occupied floor of any structure be 16 feet above mean sea level. This requirement would increase the cost of the treatment facility.

Third, the proposed sites are within the Special Management Area which places additional constraints on planning and construction.

ALTERNATIVE WASTEWATER MANAGEMENT CONCEPTS

Two major wastewater management concepts were considered to illustrate the impact of tsunami inundation on the site selection. These are as follows:

Concept 1: Update the existing facility to a 5.0 mgd secondary treatment plant and incorporate tsunami protection measures at the present site.

Concept 2: Abandon the existing plant and construct a new 5.0 mgd secondary plant in an area outside the tsunami-prone zone.

Factors which favored the selection of Concept 2 include the following:

- Lack of sufficient space at existing site for expanded secondary facility.
- Cost comparison between the two schemes.
- Reliability with regard to damage from tsunami.
- In Concept 1, untreated sewage will be discharged into Hilo Bay during the period of construction. For Concept 2, the existing facility can be utilized until such time that the proposed system is functional.

- The berm, which is required for Concept 1, would be unfavorable from an aesthetic standpoint.
- The existing treatment plant site can be converted to additional coastline park site.
- Odors from present plant to nearby residents.

Based on these factors, Concept 2 was selected.

ALTERNATIVE SITES & SCREENING OF ALTERNATIVES PROCESS

With the County Administration and County Council's determination that it would be prudent and in the best interest of the county and the community to begin efforts toward design and construction of a new relocated wastewater facility, a Citizens Advisory Group (CAG) was formulated as a means of obtaining community input throughout the planning, design, and construction phases of the project. Composed of key community and government officials, the first objective of this advisory group was to select a site for the new wastewater facility. The three sites considered include:

1980 Facilities Plan site. This was the site selected in the 1980 Facilities Plan (Figure II-3). Located south of the airport near the present county landfill and a proposed Hawaiian Home Lands development site, this site offers advantages for sludge disposal, but would involve major construction impacts in terms of pump station and force main routing. Impacts on the current landowner, the State of Hawaii, would be minimal.

Wainaku Mill site. Located by the old Wainaku Mill which might involve conflicts with its proposed designation as a historic site. An associated new outfall would also be required due to its remote location and distance from the existing outfall. Impacts on current landowners would be substantial due to the fact that all available lands in this area are privately owned.

East end of Hilo Airport runway. Located at the east end of the airport on state-owned land. Features which makes this a desirable site is its relatively remote location and expansion capability. The compatibility of the adjacent Hilo Airport and this wastewater facilities plant provides a mutually beneficial relationship which prevents future incompatible developments.

Considering these and other pertinent information such as cost and basic site-specific information, the preferred alternative selected by the CAG was the site at the east end of Hilo Airport runway. Factors which played a major role in the selection process include:


TRUE NORTH
EXISTING STP
1980 FAC PLAN STP
Kuhio Bay
Waiakea
Hoolulu Park
Mokaoku
Naval Electronic Facility
DISTRICTS
U = URBAN
R = RURAL
A = AGRICULTURAL
C = CONSERVATION
FIGURE II-3
1980 FACILITIES PLAN WASTEWATER TREATMENT PLANT SITE

- Remote location of the site relative to present and future developments will minimize impacts on adjacent sites. A planned buffer area around the site will be incorporated into the design to reduce odor concerns.

- Expansion capability for both plant and effluent disposal alternatives. Although presently not a viable option at the site, the potential for these alternatives does exist.

- Compatible use of adjacent parcels of land.

- Least costly of the three options with the minimum amount of construction impact.

- Plant site located beyond the tsunami inundation zone.

Selection of an alternative requires additional facilities to convey raw sewage to the plant and the treated effluent to the outfall. In addition to these changes to the 1980 Facilities Plan, a different method of sewage treatment is also recommended. These are discussed below.

E. RECOMMENDED WASTEWATER MANAGEMENT SYSTEM

The recommended facility consists of five components: a new pump station, force main, treatment plant, and gravity main, and the existing outfall. Each of these is described in the following sections. The locations of the recommended facilities are shown in Figure II-4. The system utilizes lands in Tax Map Keys 2-1-12:09 and 2-1-13:02, 04, and 143.

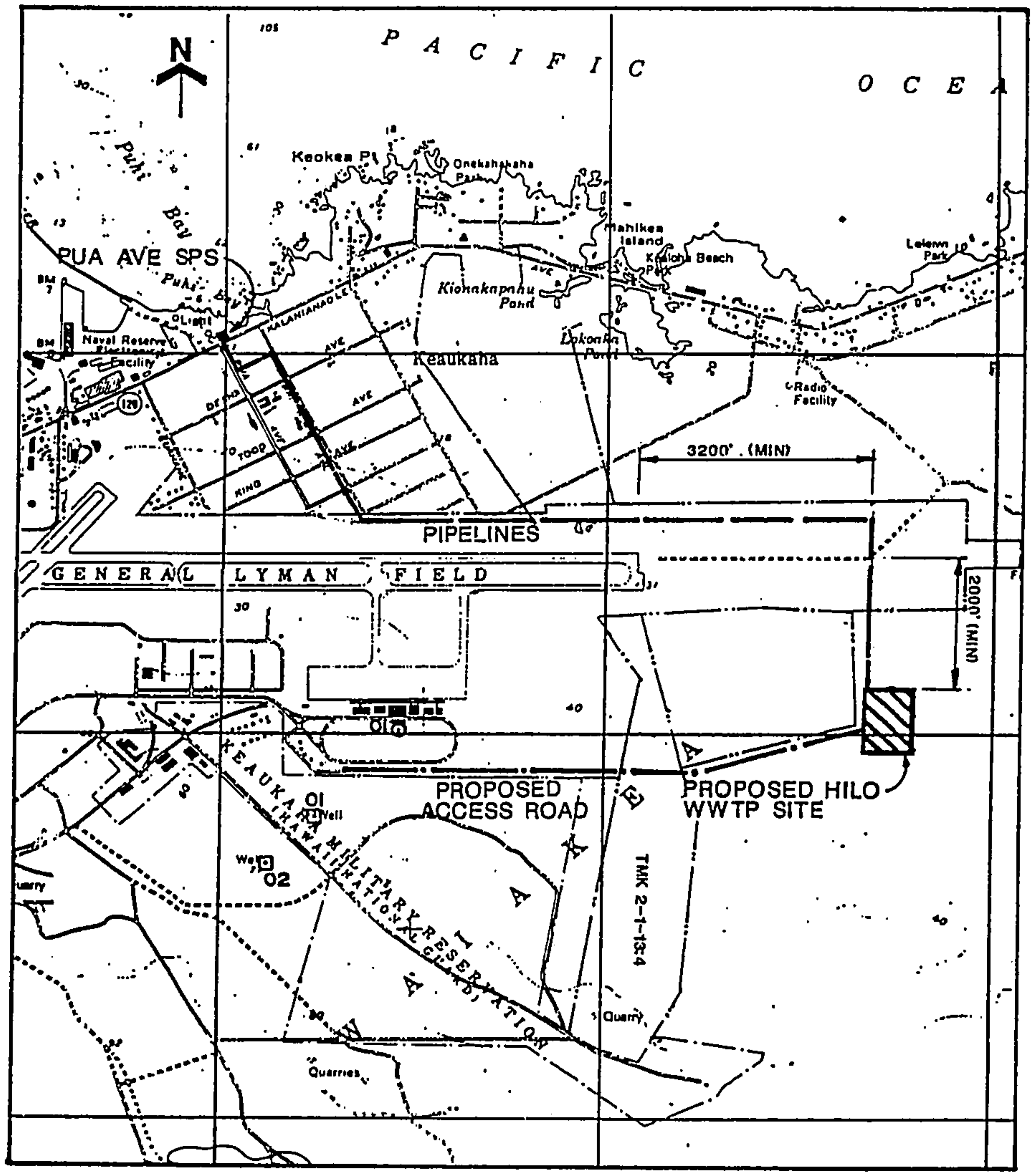
PUMP STATION

The pump station will boost the wastewater to the new treatment plant. The pump station will be located at the site of the existing treatment plant since the existing (and planned future) collection system currently discharges into a wet well at this location.

The site is located at a low point to accept gravity flow from the western Hilo tributary area and eastern coastal area, thereby minimizing repumping of this wastewater. The site is also conveniently situated for the minimization of the force main length to the new treatment plant.

Considerations in the design of the pump station include:

1. The pump station is located within a 100-year floodplain and in a tsunami impact area. As such, flood and tsunami protection will need to be incorporated into the design of the station.



HILO WASTEWATER TREATMENT PLANT SITE

SCALE: 1" = 2000'

FIGURE II-4

2. Because of the significant variation expected between the initial and design maximum sewage flows, variable speed pumps will be installed. Use of these pumps will help minimize detention times in the station which are desirable to reduce potential of odor-forming compounds.

3. An odor control system will be provided to control noxious odors from the sewage at the pump station and the sewage treatment plant.

4. Because the area in the vicinity of the pump station is subject to frequent power outages, emergency power is necessary for uninterrupted system operation.

5. Provision for dechlorination of treated effluent from gravity main from the new treatment plant will be included in the design. The existing chlorine contact chamber may be used for this purpose.

The remaining area at the existing wastewater treatment plant site not used to support either the pump station or dechlorination of the treated effluent will be landscaped and revert to park use.

FORCE MAIN

The new force main will be used to convey the wastewater from the pump station to the new treatment plant. The recommended alignment is along existing roads and sparsely occupied areas adjacent to the Hilo Airport runway to minimize impacts as well as the length of the pipeline to the plant sites.

Three routes are presently being pursued for the alignment of the force main/gravity discharge main alignment. The three alternatives are:

Alternative 1: Southeasterly direction along Pua Avenue, then northeast to Baker Avenue, midway between Kalanianaole and Desha Avenues. From this point, the pipeline alignment would continue up Baker Avenue to the Department of Transportation (DOT) Airports Division property line. See Figure II-5.

Alternative 2: Southeast along Pua Avenue, then northeast to Bishop Estate land, midway between Kalanianaole and Desha Avenue. From this point the pipeline alignment would continue through Bishop Estate land, paralleling Andrew Avenue, to the DOT Airports Division property line. See Figure II-6.

Alternative 3: Northeast along Kalanianaole Avenue, then in a southeasterly direction through Bishop Estate land, paralleling Andrew Avenue, to the DOT Airports Division property line. See Figure II-7.

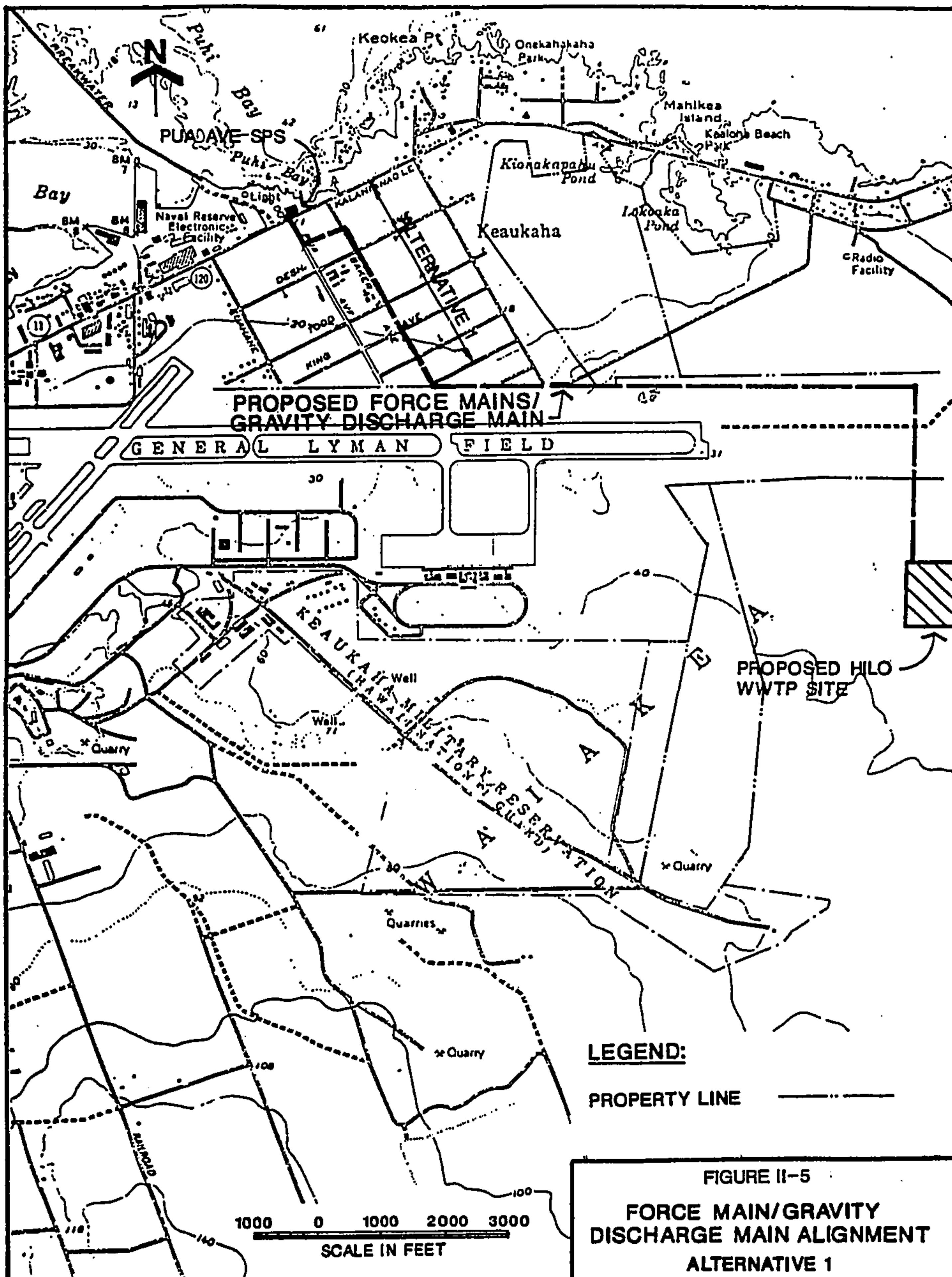


FIGURE II-5

FORCE MAIN/GRAVITY DISCHARGE MAIN ALIGNMENT

ALTERNATIVE 1

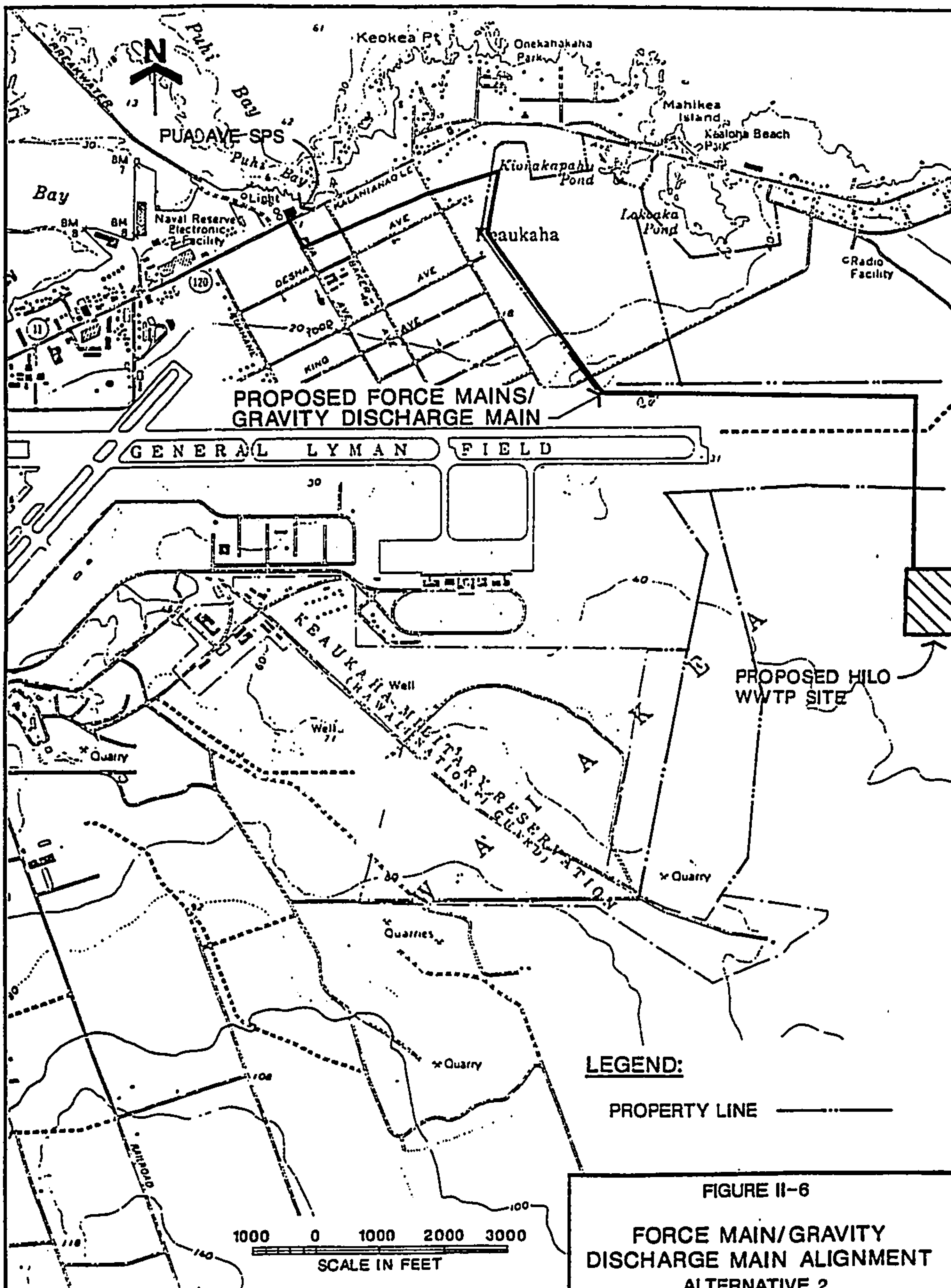


FIGURE II-6

FORCE MAIN/GRAVITY DISCHARGE MAIN ALIGNMENT ALTERNATIVE 2

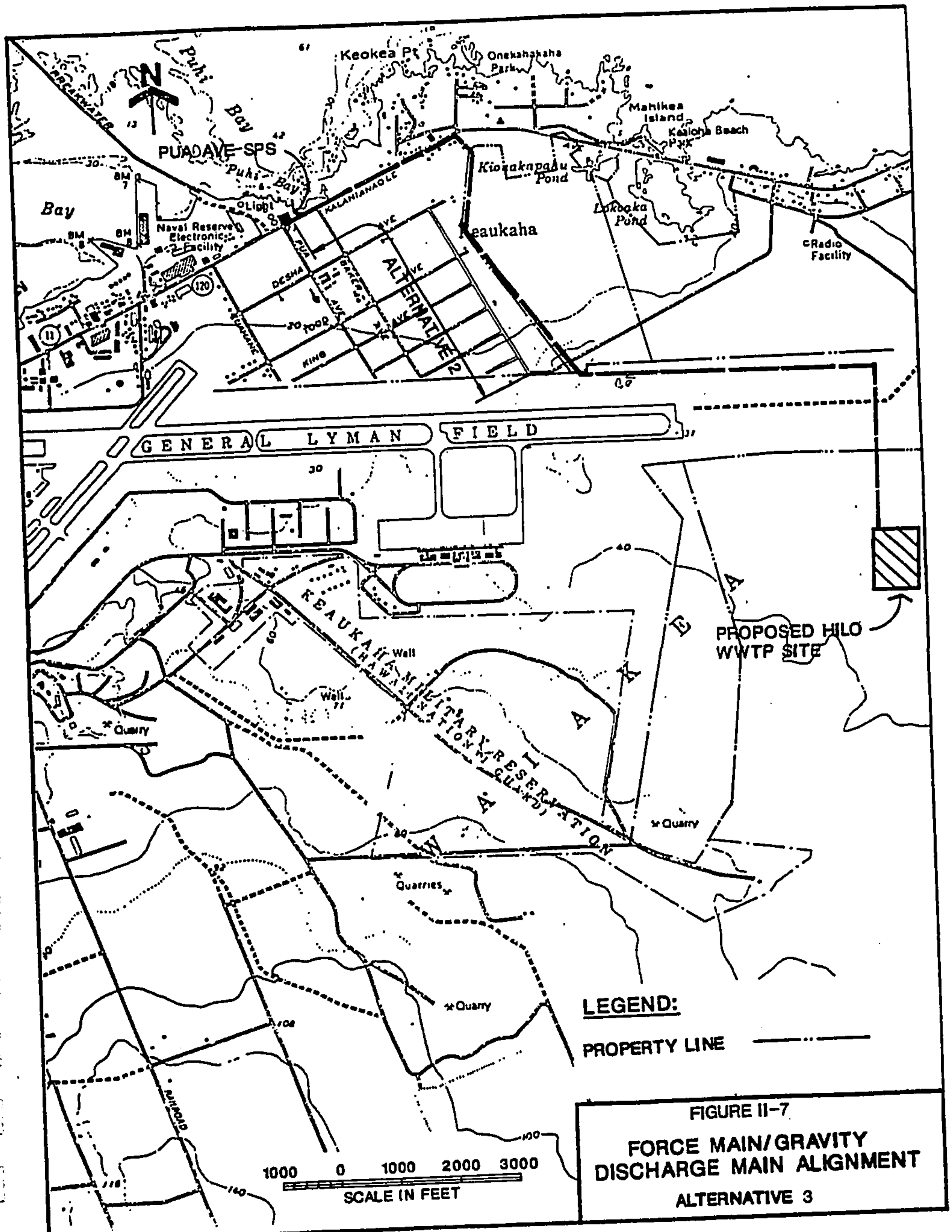


FIGURE II-7

FORCE MAIN/GRAVITY DISCHARGE MAIN ALIGNMENT

ALTERNATIVE 3

Alternative 1 is the preferred route for the following reasons:

- Minimal impact along Kalanianaole Avenue, the major ingress/egress roadway to the Keaukaha area.

- Construction cost savings due to the shorter alignment.

TREATMENT PLANT

The new wastewater treatment plant will be located on land which is presently under the jurisdiction of the Department of Land and Natural Resources (DLNR), State of Hawaii. Approximately 15 acres will be required by the county for plant use. This site is presently zoned for agricultural use and is situated in the northwest corner of the parcel.

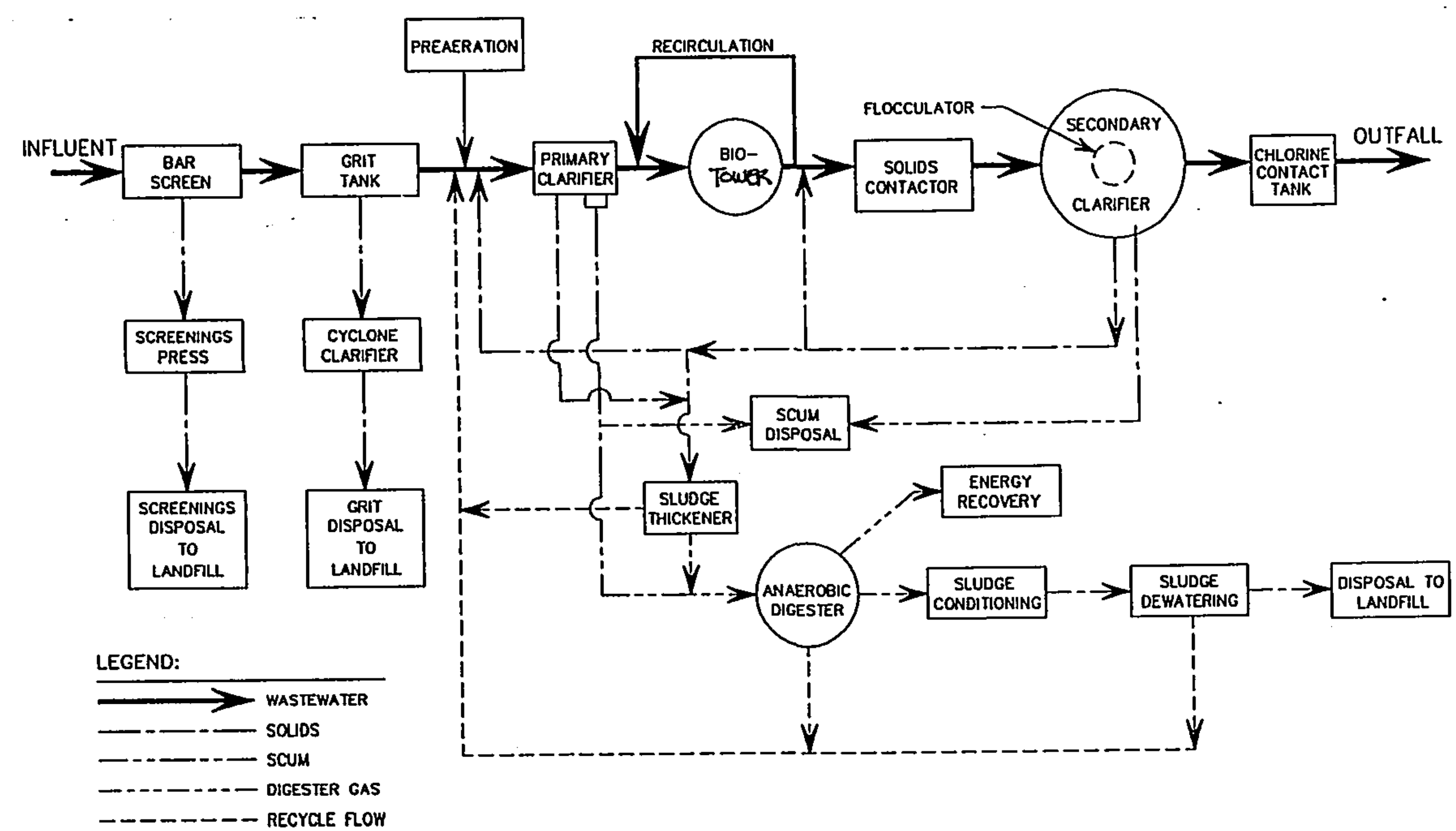
The new wastewater treatment plant would be of conventional design with processes that have successfully been demonstrated to achieve treatment goals. There are two process streams in the new treatment plant; liquid stream and solids stream (see Figure II-8). The process selected is known as the biotower/solids contactor or B/SC process.

Liquid Stream. The proposed treatment plant proper will contain bar screens and grit tanks to remove coarse solids, preaeration to suppress formation of odors, primary clarifiers to remove settleable solids and BOD_5, biotower to remove soluble BOD_5, secondary clarifiers to remove additional settleable solids and BOD_5, and a chlorine contact tank. These facilities are described below.

Bar screens. The first process element at the treatment plant will be a mechanically cleaned bar screen. The purpose of the screen is to remove any rags or other stringy material which would otherwise plug up and clog the plant's subsequent pumps and other mechanical equipment. The screen will be equipped with a rake which completely removes large rags and trash in the waste stream. This positive removal eliminates the potential problem of having fibrous material accumulate downstream where equipment clogging can occur.

Grit tanks. The grit device is necessary to remove grit and small stones prior to any of the plant processes; without such removal damage to equipment and clogging of pipelines can occur. The grit removal system will remove and accumulate heavy materials for offsite disposal.

Preaeration channel. The sewage in the Hilo area is characteristically septic with a tendency to form and release odorous compounds. As such, it is necessary to incorporate provisions for odor control into the Pua Avenue pump station as discussed previously. In order to maintain non-septic conditions, a preaeration tank will be provided. This process will introduce oxygen necessary to suppress formation of noxious compounds in subsequent wastewater treatment processes.



PROCESS SCHEMATIC DIAGRAM
HILO WASTEWATER PLANT

FIGURE II-8

Primary clarification. The primary clarifiers or settling tanks are the first major treatment units of the liquid treatment system. The sewage is typically held for a 1-1/2 to 2-1/2 hour period to remove those solids that will either settle or float. A consideration which will be addressed in the final design is the detention time which is important in order to reduce potential for reformation of septic conditions, given the warm ambient temperatures and propensity for septicity of the incoming sewage. The units are intended to decrease the pollutant load in the subsequent biological plant processes. Appurtenant sludge and scum handling equipment are also required for these units.

Biotowers. In the biotower, wastewater is applied to a biological community of active microorganisms. These organisms use raw sewage organics as food and in the process absorb and break down these pollutants. The biomass attached to a highly porous plastic media periodically sloughs-off. The highly porous plastic media maximized surface area contact between the active microorganisms and air and thereby maintain the oxygen level needed for proper aerobic (non-septic) conditions. A primary consideration is the maintenance of adequate air circulation for the continuous supply of biological metabolic oxygen. Typically, sewage leaving the biotower is recirculated to insure a continuous minimum hydraulic flow rate for "wetting" of the biological microorganisms.

Secondary clarifiers. Secondary clarifiers or settling tanks provide an environment in which the microorganisms from the biotower can be separated from the liquid stream. As with the primary clarifiers, the key design component is the overflow rate of sewage; typically secondary clarifiers have rates in a range of 400 to 1,200 gpd/sf.

Chlorination equipment. The final liquid stream process is disinfection of the treated sewage with chlorine. Subsequent removal of any residual chlorine with sulfur dioxide will be used if necessary. Disinfection with chlorine typically requires approximately 15 minutes of contact time to kill pathogenic microorganisms. This detention time can be easily achieved in the gravity discharge main from the treatment plant. Facilities for introduction and mixing of chlorine will be provided prior to discharge into the gravity main. Use of an onsite chlorine contact tank will also be evaluated in the design stage since an operational process control advantage exists for such a contact tank. As discussed previously, the chlorine contact chamber at the existing treatment plant may be used as a dechlorination facility.

Solids Stream. Major solid processes will consist of sludge thickeners, anaerobic digesters, and sludge dewatering systems. These processes have demonstrated track records of dependable, proven operation.

Sludge thickener. The sludge thickener concentrates the dilute sludge from the primary and secondary clarifiers to a thickened sludge which is fed to the sludge digesters. A dissolved air flotation thickener (DAFT) is advantageous for dilute, lighter sludges because of the physical tendency for solids to rise into the process.

The DAFT removes solids through flotation. A portion of recycled DAFT subnatant is saturated with air under pressurized conditions; it is then depressurized in the presence of incoming sludge. Upon depressurization, the rising gas bubbles form and attach to the sludge solids and form a blanket of thickened sludge. This blanket is skimmed and pumped to the digesters. The remaining clear liquid (subnatant) is returned to the liquid stream for treatment.

Anaerobic digesters. The digesters will be used to stabilize the thickened sludge to reduce pathogens, minimize the potential for putrefaction, and minimize odors. Digesters are designed to operate under a mixed mode with controlled temperatures to provide the environment necessary for biological destruction of organic solids. These organic solids are reduced to carbon dioxide and methane gases. Digesters are commonly sized based upon a loading rate of 0.07 to 0.4 lb of volatile suspended solids (VSS)/cu.ft./day. Two-step digestion is the typical process design of facilities this size. The primary tank is used for digestion. The secondary tank provides for quiescent detention of the digested sludge where remaining solids can settle out and be removed. The liquid is returned to the liquid stream for treatment. It is desirable for the primary and secondary digesters to be interchangeable with each other in order to provide for redundancy. Methane gas can be used to drive generators and thereby recover energy for use at the plant or elsewhere. Energy recovery systems will be evaluated during the design stage.

Sludge dewatering. The digested sludge must be dewatered in order to produce a solid material which can be easily handled and disposed of into a landfill. Dewatering will be accomplished by a mechanical device like a belt filter press which produces a sludge cake containing 20 percent or more solids. This cake can be easily transported in trucks for landfill disposal.

Other facilities. In addition to the liquid and solids treatment streams discussed above, a laboratory, maintenance shop, and operations area will be provided to support the facilities of this plant. Emergency generators will provide stand-by power to minimize the potential for sewage spills during any areawide power failure. A service road system will be provided both within the limits of the plant as well as for access to the plant. Access to the site will be from the roadway which fronts the Hilo Airport terminal building.

GRAVITY DISCHARGE MAIN

Treated effluent will discharge by gravity from the treatment plant to the ocean outfall for final disposal. The discharge main can also serve as a contact chamber for chlorine disinfection of the effluent. In the design, the use of a separate contact chamber will also be evaluated. The alignment recommended is parallel to the raw sewage force main to minimize construction implementation impacts and costs.

OUTFALL

A deep ocean outfall was selected as the preferred disposal method in the 1980 Facilities Plan. Land reclamation is a preferable mode of disposal. Until formal commitments for long term use of the wastewater can be obtained, the outfall will continue to be required for effluent disposal.

F. DESIGN CRITERIA

The design criteria used for sizing of facilities are summarized in Table II-1. The average design flow of 5.0 mgd is consistent with expected collection system capacity.

TABLE II-1
Design Criteria

Population	46,000
Average daily flow, mgd	5.0
Minimum hourly dry weather flow, mgd	1.8
Peak hourly wet weather flow, mgd	13.0
Wet weather inflow, mgd	2.45
Raw BOD_5, mg/L	161
Raw suspended solids, mg/L	147
Raw BOD_5, lb/day	6,714
Raw suspended solids, lb/day	6,130
Raw volatile solids, lb/day	5,752

Contributory flow to the plant will vary from average flow from hour-to-hour. The diurnal water use pattern shows increased water use (and hence wastewater flows) during the breakfast, lunch and dinner periods. Flow rate projections can be made from historical flow patterns in similar communities. The peak hourly flow was used to size the hydraulic capacities of the various processes.

Wastewater characteristics in Table II-1 were based on measurement at the existing collection system with adjustment for infiltration. These wastewater characteristics are consistent with those found at other wastewater plants in Hawaii that primarily receive domestic wastewater. The treated effluent quality is based on the need for secondary treatment.

G. CAPITAL COSTS

Criteria used for sizing units and preliminary unit sizes are shown in Table II-2.

The total construction cost of a project includes the capital construction costs and the non-construction costs. The non-construction costs include the Step 2 cost of preparing the plans and specifications of the selected plan and the additional expenses incurred as part of the Step 3 construction phase. Step 3 non-construction expenses include the cost of obtaining the necessary land and easement for the project, inspection costs, services of the Architect/Engineer, legal and administrative costs and interest costs during construction.

The costs eligible under the Construction Grants Program are funded by the federal, state and county governments. The federal share is 55 percent, the State of Hawaii share is 18 percent, and the County of Hawaii share is 27 percent.

The construction cost estimate for the treatment process is shown in Table II-3.

The construction of the collection sewers is implemented through the County Improvement District (I.D.). The costs of the I.D. project are shared by the individual landowners within the I.D. and the county. Estimates for the recommended collection system improvements are shown in Table II-4 and Figure II-9.

Project estimates, financing and expenditures showing the breakdown of the cost between the federal, state and county are shown in Table II-5.

TABLE II-2
Preliminary Unit Sizes for Cost Estimating

1. Pump station	
No. pumps	3
Type	Centrifugal
Capacity, each, gpm	4,500
2. Force main	
Diameter, in. (2 ea. in parallel)	24
Length, lf	14,200
3. Treatment plant	
3.1 Flowmeter	
Type - influent	Parshall flume
effluent	Magnetic meter
Peak capacity, mgd	16
3.2 Bar Screen	
Bar space width, in.	0.5
3.3 Grit chamber	
Number	1
Type	Aerated
Size (length x width x depth), ft	12 x 12 x 48
Peak capacity, mgd	13
Detention time, min	
Average	15
Peak	6
3.4 Degritting unit	
Number	2
Type	Classifier/Cyclones
Peak capacity, mgd	13
3.5 Primary clarifier	
Number	3
Type	Rectangular
Dimensions (length x width x depth), ft	120 x 24 x 12
Unit surface area, each, sq ft	2,890
Total surface area, sq ft	8,670
Sidewater depth, ft	12
Surface overflow rate, gpd/sq ft	
Average	580
Peak	1,500
Hydraulic detention time, hours	
Average	3.0
Peak	1.1
Horizontal velocity, fpm	
Average	0.5
Peak	1.2

TABLE II-2 (Continued)

	Sludge pumps	
	Type	Non clog centrifugal or progressive cavity
	Capacity, ea. gpm	0-60
	Capacity, total, gpm	0-120
3.6	Biotowers	
	No. of units	2
	Diameter, each, ft	60
	Media depth, ft	16
	Surface area, each, sq ft	2,826
	Total surface area, sq ft	5,652
	Hydraulic loading @ avg. flow, gpm/sq ft (without recirculation)	0.62
	BOD_5, loading, lb BOD_5,/1,000 cu ft/day	56
	Total volume, cu ft	90,432
	Recycle Ratio	2:1
3.7	Final clarifiers	
	No. of units	2
	Type	Circular, center feed with flocculator
	Diameter, ft	90
	Surface area, each, sq ft	6,350
	Total surface area, sq ft	12,700
	Sidewater depth, ft	15
	Volume, each, gal	712,500
	Detention time, avg flow, hr	6.8
	Avg surface overflow rate, gpd/sq ft	395
	Peak surface overflow rate, gpd/sq ft	1025
	Sludge pumps, waste activated	
	No. of units	2
	Type	Non-clog centrifugal
	Capacity, each, gpm	0-110
	Sludge pumps, return activated	
	No. of units	2
	Type	Non-clog centrifugal
	Capacity, each, gpm	400-1,800
3.8	Chlorination system--disinfection	
	Chlorine dosage, mg/L	15
	Chlorine demand, lb/day	
	Average	630
	Peak	1,650
	Chlorinators	
	Number (including 1 standby)	2
	Capacity, each, lb/day	2,000
	Contact tank	Contact tank or use of gravity main

TABLE II-2 (continued)

3.9	Dissolved air flotation thickener (option)	
	Number	1
	Diameter, ft	28
	Loading	
	Hydraulic, gpm/sq ft	0.29
	Solids, lb/sq ft/hr	1.95
3.10	Primary anaerobic digesters, completely mixed	
	Number	1
	Volume, cu ft	49,000
	Volatile solids load, each, lb/day	3,650
	Detention time @ 4% solids, days	20.1
	Operating temperature, deg F	95
	Cover type	Steel
3.11	Secondary anaerobic digesters	
	Same as, and interchangeable with, 3.10 - Primary anaerobic digesters	
3.12	Belt filter press, dewatering	
	Number	1
	Size, meters of belt width	1
	Loading	
	% solids	3
	Hydraulic, gpm/m	55
	Solids, lb/hr	710
4.0	Gravity discharge main	
	Diameter, in.	42
	Length, ft	14,200
5.0	Outfall	
	Diameter, in	48
	Length, ft	4480
	Diffuser ports	15

TABLE II-3
Cost of Plant

Direct Construction Costs		*Capital Cost ($1,000)*
SITE AND UTILITY SUPPORT		
Mobilization (3%)	$ 40	
Roadway to site	845	
Utility (water line)	263	
Utility (underground electricity)	210	
Subtotal:		$ 1,358
PUMPING STATION		
Mobilization & site work (15%)	$ 185	
Pump station	2,649	
Subtotal:		$ 2,834
FORCE MAIN		
Mobilization (3%)	$ 127	
Force main	4,234	
Subtotal:		$ 4,361
TREATMENT PLANT (PHASE I)		
Mobilization & site work (15%)	$ 559	
Bar screen	327	
Screenings press	65	
Grit tank	155	
Cyclone/classifier	90	
Odor control	1,370	
Primary clarifier	1,721	
Subtotal:		$ 4,287
TREATMENT PLANT (PHASE II)		
Mobilization & site work (15%)	$ 2,230	
Biotower	3,550	
Secondary clarifier & contactor	2,654	
Chlorination system	246	
Dissolved air flotation thickener	524	
Anaerobic digester	2,271	
Belt filter press (dewatering)	912	
Administration/maintenance building & laboratory	3,949	
Emergency generator & building	757	
Subtotal:		$17,093

TABLE II-3 (continued)

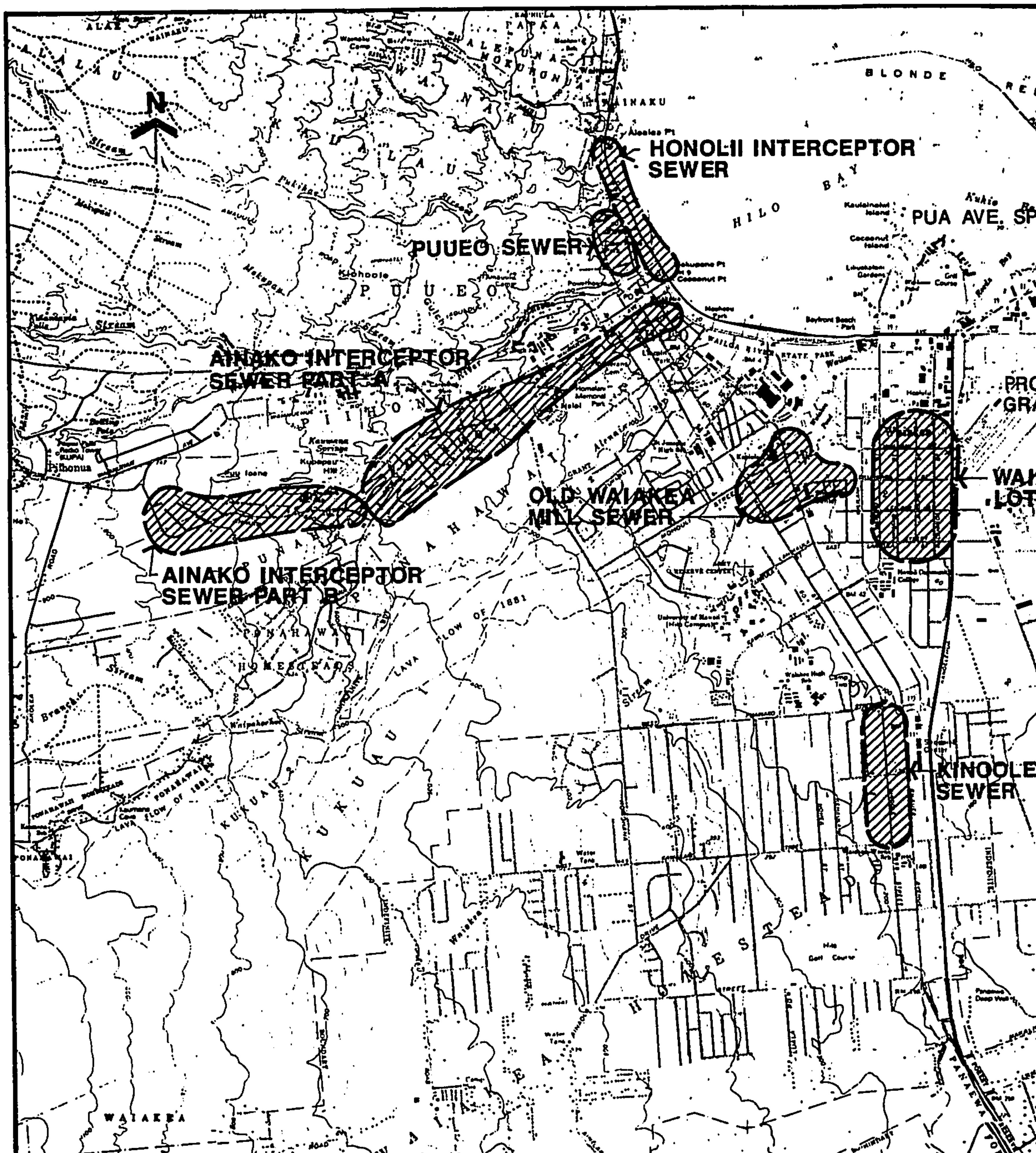
DIRECT CONSTRUCTION COSTS		*Capital Cost ($1,000)*		
GRAVITY MAIN				
Mobilization (3%)	$ 191			
Gravity Main	6,350			
Subtotal:		$ 6,541		
OUTFALL MODIFICATION		-0-		
Total:		$36,474		
15% Contingency:		$ 5,471		
Total Construction Cost:		$41,945	(1)	
NON-CONSTRUCTION COSTS				
STEP 2 PLANS AND SPECIFICATIONS				
Administrative		$ 419		
Architect/engineering design fees		3,565		
Total Non-Construction Cost		$ 3,984	(2)	
STEP 3 CONSTRUCTION				
Administrative/legal		$ 419		
Architect/engineering services		3,565		
Project inspection		4,194		
Miscellaneous and indirect cost		210		
Total Non-Construction Cost		$ 8,388	(3)	
SUBTOTAL (1) + (2) + (3)				$54,317
LAND ACQUISITION COST		161		
TOTAL CAPITAL COST		$54,478		
SAY		$54,000		

TABLE II-4
IMPLEMENTATION AND FUNDING PRIORITY LIST

Priority	Item	Avg. Q (MGD)	Quantity		Construction Cost (Mid 1988)	Implementation Dates (FY)	Additional Comments
1	Hilo WWTP Access Road & Power Line			LS	$1,561,700	1989	
2	Pua Sewage Pumping Station			LS	$3,260,250	1989	
3	Hilo WWTP Process , Incr. #1			LS	$4,930,050	1989	
4	Hilo Sewage System Rehabilitation			LS	$703,000	1989	
5	Hilo WWTP Process , Incr. #2 Anaerobic Digestors Operations Building			LS	$19,069,300	1989	
6	Hilo WWTP Force Main/Effluent Line Incr. #1			LS	$2,686,000	1989	
7	Hilo WWTP Force Main/Effluent Line Incr. #2			LS	$9,850,000	1989	
8	Demolish/Rehabilitation Existing Hilo WWTP			LS	$540,000	1989	
9	Old Waiakea Mill Sewer 1 SPS, 8" pipe, in place complete including manholes, paving, backfilling, etc.	0.768	7,700	LF	$1,130,000	1990	

TABLE II-4
IMPLEMENTATION AND FUNDING PRIORITY LIST

Priority	Item	Avg. Q (MGD)	Quantity	Construction Cost (Mid 1988)	Implementation Dates (FY)	Additional Comments
10	Waiakea Houselots Sewer 8" pipe, in place complete, including manholes, paving, backfilling, etc.	0.153	5,100 LF	$700,000	1990	
11	Ainako Interceptor Sewer, Part A 15" and 18" pipe, in place complete including manholes, paving, backfilling, etc.	0.669	9,750 LF	$3,300,000	1992	
12	Puueo Sewer 8" pipe, in place complete, including manholes, paving, backfilling, etc.	0.246	1,200 LF	$100,000	1992	
13	Kalanianaole Sewer 8" pipe, in place complete, including manholes, paving, backfilling, etc.	0.255	7,850 LF	$1,099,000	1993	
14	Ainako Interceptor Sewer, Part B 8" and 10" pipe, in place complete, including manholes, paving, backfilling, etc.	0.711	5,700 LF	$3,400,000	1994	
15	Hawaiian Homes Sewer 6", 8" and 10" pipe, in place complete, including manholes, paving, backfilling, etc.	1.302	31,250 LF	$7,000,000	1997	
16	Kinoole St. Sewer 8" pipe, in place complete, including manholes, paving, backfilling, etc.	1.490	9,100 LF	$730,000		
17	Honolii Interceptor Sewer 12" pipe, in place complete, including manholes, paving, backfilling, etc.	0.211	4,100 LF	$490,000		



N
HONOLII INTERCEPTOR SEWER
PUUEO SEWER
AINAKO INTERCEPTOR SEWER PART A
OLD WAIAKEA MILL SEWER
AINAKO INTERCEPTOR SEWER PART B
KINOOLE SEWER
PUA AVE. SP
HILO BAY
BLONDE

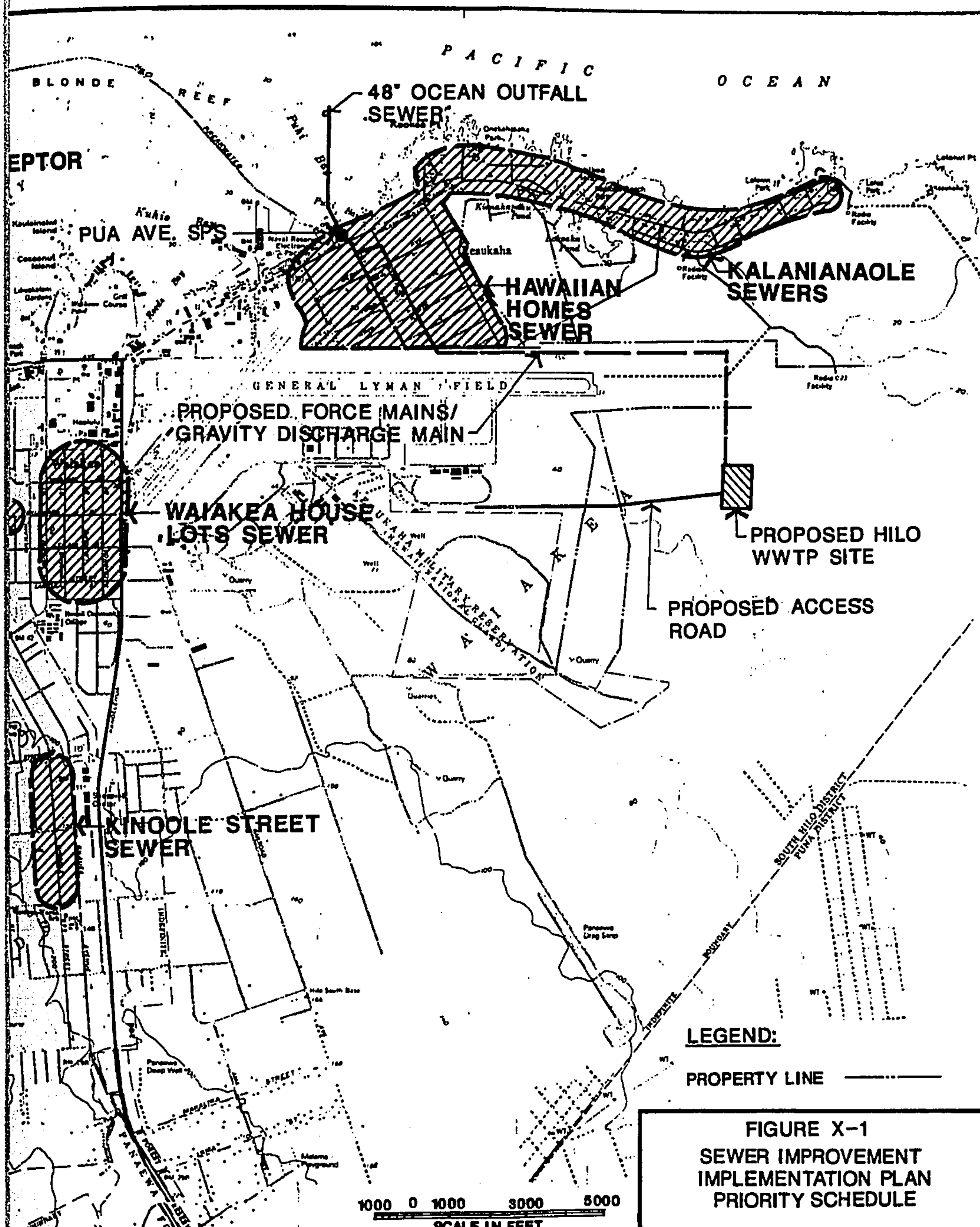


FIGURE X–1
SEWER IMPROVEMENT IMPLEMENTATION PLAN PRIORITY SCHEDULE

TABLE II-5

HILO WASTEWATER TREATMENT FACILITY
PROJECT ESTIMATES, FINANCING AND EXPENDITURES

PROJECT PHASES	ESTIMATED COST ($1000)	CURRENT & AVAILABLE FUNDING	JAN 89 OBLIGATIONS	JUNE 89 OBLIGATIONS	JUNE 90 OBLIGATIONS	FUTURE OBLIGATIONS
Project Management/Facility Plan/EIS	608	523	35			
Design	4180	2677	1503			
FY 89 = 1580						
FY 90 = 2600						
Administration/Land Acquisition	620	100	300	220		
Costruction (Incl. cost. Mgmt.)	46090			15400	30690	
FY 89 = 15400						
FY 90 = 30690						
Ocean Outfall Extension	Not Incl.					9000
Connection Program	Not Incl.					15000
TOTAL AMOUNTS	51498	3300	1888	15620	30690	Not Incl.
AVAILABLE FUNDS						
EPA Construction Grants	18000			9000	9000	
State Grants						
Advance =	0	3000 *		-3000		
Appropriation =	3000			3000		
DOH (Range)** =	11626			2950	8676	
County Funds						
Prior Ordinance =	300	300				
Bonds =	18572		1888	3670	13014	

*Legislative Act 390 SLH 1988, Section 6, Item K-31A
**Possible state funding share (DOH construction grants share not yet committed)

CHAPTER III

DESCRIPTION OF THE AFFECTED ENVIRONMENT

A. PROJECT AREA

The Hilo Wastewater Treatment Facility Site project area is situated in the Land of Waiakea, District of South Hilo, Island of Hawaii, TMK: 2-1-12:09 and 2-1-13:02, 04 and 143.

The project area is located southeast of General Lyman Field, approximately 3,200 feet east of the eastern end of the existing main runway, and approximately 2,000 feet south of the centerline of the main runway. The project area is comprised of a 590' x 1100' rectangular parcel and a sewerline corridor which extends seaward from the parcel. The parcel is approximately 15 acres with the piping corridor about 14,200 feet long.

B. TERRESTRIAL ENVIRONMENT

TOPOGRAPHY

The City of Hilo lies at the southeastern base of Mauna Loa at elevations ranging from sea level at Hilo Bay to 600 feet above sea level along the urban fringe. The slopes are generally very gentle, ranging from zero to five percent in the area where the proposed treatment plant will be located. The terrain in the project area, with the exception of an area of fairly level pahoehoe in the southwest portion of the parcel, is irregular and characterized by a series of pahoehoe ridges and low areas. Thin organic soils overlay a'a and pahoehoe lava flows. Small rocky outcrops or knolls and cracks and crevices are occasionally encountered at the site.

CLIMATE

Hilo is located in a belt of northeastern tradewinds generated from the semi-permanent Pacific high-pressure zone to the northeast. Orographic rainfall, the result of moisture-laden clouds that condense as it is forced to move upward along the mountain slopes by the prevailing winds, is the principal means of regional precipitation. At the project site and in the Hilo area, average annual rainfall is more than 150 inches per year.

Average temperature in Hilo ranges between 65 and 80 degrees. Cloudy skies often prevail; thus, the area receives only about 40 percent of the possible amount of sunshine.

Generally, tradewinds are more persistent in summer than in winter and are stronger in the afternoon than in the evening. Average wind speed is approximately seven miles per hour. A diurnal shift in wind direction often occurs as heating and cooling of the island give rise to onshore sea breezes during the day and offshore land breezes at night.

HYDROGEOLOGY

The surface rocks in the project area consist of the Ka'u volcanic series of Mauna Loa, an extremely permeable basalt that is too recent in origin to have formed a deep soil and saprolite top layer. The Ka'u series, which erupted from Mauna Loa following the main deposition of Pahala ash, is relatively thin in section, perhaps 25 feet thick in the Hilo region. Beneath the ash is the initial Kahuku series basalt, extraordinarily permeable formation.

Despite the discontinuous strata of ash, permeable surface and subsurface formations result in a lack of appreciable surface runoff and the occurrence of high infiltration and subsurface flow rates. Also contributing to the large infiltration rates are low slopes of the Ka'u volcanics over much of the region, varying from 0.005 to 5.0 percent. The water table exhibits a mild seaward gradient (one to four feet per mile), culminating in several fresh water springs along and off the coast.

WETLANDS

According to the wetlands survey conducted by the U.S. Army Corps of Engineers, wetlands in the Hilo area are limited to the Lokoaka and Kionakapahu Ponds, located in the Keaukaha area, fronting the Pacific Ocean. No wetlands will be affected by the proposed project.

VEGETATION

A survey of the vegetation of the project site was conducted in April 1988. The study is attached as Appendix A.

Mixed lowland forests occur along wet lower slopes from Hilo to Puna and on towards Kalapana. This forest type is a varied mosaic of plant associations rather than an integrated entity. It is usually composed of a mixture of native trees--'ohi'a, lama, hala--and a number of introduced tree species, many of them originally from forestry plantings but now naturalized.

The mixed lowland forest on the site consists of an open canopy 'ohi'a-hala association with a dense shrub layer of Malabar melastome; a more detailed description follows.

Mixed lowland forest. Both the pubescent (*Metrosideros collina* var. *incana*) and glabrous (var. *glaberrima*) varieties of 'ohi'a occur on the site, although the former is more abundant. The trees are 35 to 50 ft. tall and straight-trunked; trunk diameter varies from 1 to 2 ft. Canopy cover is 40% to 50%. Scattered among the 'ohi'a are small stands of hala or pandanus (*Pandanus odoratissimus*), 18 to 20 ft. tall. Scattered trees of guarumo (*Cercropia obtusifolia*) as well as saplings and seedlings are commonly observed on the site.

A dense, almost impenetrable, shrub layer of Malabar melastome (*Melastoma malabathricum*), 12 to 15 feet tall, occurs beneath the 'ohi'a trees. The melastome may become tree-like and form single-trunked specimens 18 feet tall with trunks 6 to 10 inches in diameter. In places, strawberry guava shrubs (*Psidium cattleianum*) may form dense thickets, almost excluding the melastome.

The ground cover is composed largely of the introduced sword fern (*Nephrolepis multiflora*) with a mixture of various species such as blechnum fern (*Blechnum occidentale*), basketgrass (*Oplismenus hirtellus*), vervain (*Stachytarpheta australis*), and woodfern (*Christella parasitica*).

Under the stands of hala, there are few shrubs and ground cover is sparse. The substrate is usually very rocky and fallen hala leaves (lauhala) may be abundant. Ti plants (*Cordyline terminalis*) are most frequently associated with the hala stands, although they are scattered throughout the site.

Dense mats of the native uluhe fern (*Dicranopteris linearis*) are found in open, sunny areas. Plants of thimbleberry (*Rubus rosaefolius*), broomsedge (*Andropogon virginicus*), Glenwoodgrass (*Sacciolepis indica*), bamboo orchid (*Arundina bambusaefolia*), wawae'iole (*Lycopodium cernuum*), ricegrass (*Paspalum scrobiculatum*), and hi'aloa (*Waltheria indica* var. *americana*) are found associated with these uluhe patches, especially along the edges of the uluhe mats.

Threatened and endangered plant species. No listed, proposed or candidate threatened and endangered plant species designated by the federal and/or state governments occur on the site, nor are any of the native species considered rare.

All those native species (i.e., endemic and indigenous) which occur on the proposed project site are found in similar environmental habitats throughout the Hilo and Puna Districts.

BIRDS AND MAMMALS

A study of the terrestrial vertebrate mammals inhabiting the site was conducted in March 1988. The study is attached as Appendix B.

There is no endemic ecosystem anywhere near the site which has been drastically disturbed for many years probably going back to the last century.

The following species of introduced birds have been recorded on the project site and on land surrounding the site: Cattle Egret (*Bubulcus ibis*), Rock dove or feral pigeon (*Columba livia*), Spotted or Lace-necked Dove (*Streptopelia chinensis*), Barred

Dove or Zebra Dove (*Geopelia striata*), Barn Owl (*Tyto alba pratincola*), Japanese White-eye (*Zosterops japonicus*), Common Indian Myna (*Acridotheres tristis*), Warbling Silverbill (*Lonchura malabarica cantans*), Nutmeg Mannikin or Ricebird (*Lonchura punctulata*), House Sparrow (*Passer domesticus*), Cardinal (*Cardinalis cardinalis*) and the House Finch (*Carpodacus mexicanus frontalis*).

Indigenous birds include the Black-crowned Night Heron (*Nycticorax hoactli*), which is uncommon on the Big Island. There is no habitat for this heron at the project site, but they do occur at the nearby ponds.

None of the seabirds nest or forage in the vicinity of the project site.

The most conspicuous of the migratory species is the lesser golden plover (*Pluvialis dominica fulva*), which occurs from sea level to elevations of nearly 10,000 feet on Maui and Hawaii during the winter season. There is no habitat for these winter visitors in the forest of the project site at present but the plover is a common bird in surrounding suitable habitat. The other migratory species (other shorebirds, ducks) are restricted to ponds, mud flats, and mountain streams. These were not seen during field studies and would not be expected in that habitat.

Endemic birds are birds that are unique to the Hawaiian Islands; they do not occur naturally in any other part of the world. Most of these endangered species are forest birds and there is no native forest ecosystem anywhere near the project site. There is no suitable habitat for any of the endangered Hawaiian waterbirds at the project site.

Two species of endemic birds forage over the general region of the project site. The endangered Hawaiian Hawk or 'Io (*Buteo solitarius*) is an adaptable species, feeding on spiders, insects, mammals (especially mice), and both endemic and introduced birds. This hawk has a large home range where it forages for food, and it has adapted to man's orchards and pastures. During the soil survey, two hawks were seen in the vicinity of the project area. The Hawaiian Owl or Pueo (*Asio flammeus sandwichensis*) is a subspecies of the North American short-eared owl. It is a permanent resident on all of the main islands. The birds occur from sea level to at least 8,000 ft. on Mauna Kea and Mauna Loa and are not considered an endangered species on Hawaii island. No Pueo were sighted during field studies but have been seen in this general district in the past.

The only mammal currently found in the Hilo area that is categorized as "endangered" is the Hawaiian bat.

ARCHAEOLOGICAL SITES

An archaeological reconnaissance study of the site was conducted in May 1988. No historical sites were found. The complete study is attached as Appendix C.

AIR QUALITY

The air quality in the Hilo area can be termed good. Records of the state Department of Health, Pollution Investigation and Enforcement Branch, indicate that particulate matter concentrations in the air average 34 micrograms per cubic meter ($\mu g/m^3$). Hawaii state regulations require concentrations of particulate matter shall not exceed 55 $\mu g/m^3$ of air. Concentrations of sulfur dioxide are less than 5 $\mu g/m^3$. Hawaii state regulations require concentrations of sulfur oxides shall not exceed 20 $\mu g/m^3$.

This quality of air in Hilo can be attributable to the absence of "heavy" industries in Hilo and the prevailing tradewinds.

NATURAL HAZARDS

The Hilo area is susceptible to various types of natural hazards. These include flood, tsunami inundation, volcanic activity, and earthquakes.

Flooding. Portions of the Hilo area are prone to flood damage by surface runoff from high intensity rainfall. Historical records indicate 31 major flooding incidents since 1880 in the Hilo area, with minor flooding occurring yearly. This high incidence of flooding can be attributed to a combination of high-intensity rainfall and undefined drainage ways.

The potential for flood damage has been considered in the developmental plans for the Hilo area and has limited the extent of urban development in flood-prone areas. To mitigate the potential for flooding in certain areas, drainage improvement programs have been initiated by the county.

Flood-prone areas are confined mainly to areas in the upper portions of Hilo where the land steepens to slopes of 6 to 12 percent and where the area is too geologically young for well-defined drainage areas to have developed. This situation, combined with the shallow soil condition, results in extensive sheet flow runoff.

Tsunamis. Tsunamis are impulse-generated water waves caused by seaquakes, volcanic eruptions, or explosions. The city of Hilo, with the orientation of crescent-shaped Hilo Bay towards portions of the Pacific seismic belt, is very susceptible to tsunamis from the eastern half-circle of the seismic belt that extends from the Aleutian Islands down to the western coast of South America. An existing breakwater, approximately 9,000 feet in length, encloses portions of Hilo Bay.

Forty-three destructive tsunamis have reached Hilo since 1819, seven of which inflicted much loss of life and property damage. The tsunamis of April 1946 and May 1960 are well documented regarding their inundation and severity of damage and form the basis of tsunami frequency studies.

Actions taken to lessen the impact of tsunamis include extension and enlargement of the breakwater (initially constructed in 1930), rezoning of vulnerable areas to open space, and adoption of stricter structural design codes.

Volcanic Activity. Lava flows are the most common volcanic hazards in Hawaii. Generally, there is very little direct danger to human life, but risk to property can be great. The greatest danger from volcanic activity to the Hilo area is from eruptions within the northeast rift zone of Mauna Loa, Since 1880, most lava flows from Mauna Loa have stopped prior to reaching the urban areas of Hilo.

Earthquakes. According to reports by the U.S. Geological Survey, earthquakes in the Hilo area can be expected in the future. Since the risk of major damage from earthquakes is considerable for all areas of the island, stringent earth-quake-resistant designs of structures have been implemented.

C. MARINE ENVIRONMENT

The material in this section is summarized from past reports on the coastal water environment of Hilo Bay. For additional detail, see Chapter II, B. Coastal Water Environment, of the 1980 Facility Plan EIS and the 1986 SEIS for the Proposed Hilo Bay Outfall Sewer Extension. The survey of benthic organisms and nekton summarized below was made by Dr. Steven Dollar in 1985.

The coastal water designation for Hilo Bay (Pepeekeo Point to Leleiwi Point) and Hilo Harbor (the area confined by the breakwater) in the State Department of Health, Chapter 54, Water Quality Standards (revised 1988) is Class A (see Appendix D). The uses to be protected in this class are recreational and aesthetic enjoyment.

WATER QUALITY

The entire water column in the outer bay is frequently very turbid with high concentrations of suspended particulate material, apparently of terrestrial origin. These high concentrations are potentially damaging to coral colonies that do not have the ability to rapidly remove settling particulates from their living surfaces. These water quality conditions have resulted in the development of an indigenous assemblage of coral suited to these naturally turbid conditions. High turbidity also results in restricted light levels at the reef surface which could slow the growth of corals adapted to the high light levels characteristic of clear water.

BENTHIC ORGANISMS

Bottom topography throughout Hilo Bay consists of a relatively flat reef platform intersected by shallow rubble-filled surge channels. The platform areas between the channels are characterized by very high levels of coral cover sometimes approaching 100 percent. Total cover estimates, which integrate cover from both the channels and platforms, range from 56 to 75 percent. Such values are considered extremely high for Hawaiian reefs, especially when the poor water quality (high turbidity) that is reportedly the normal condition for Hilo Bay is considered. Other areas of optimal coral cover encountered in Hawaii within the depth range of 60 to 80 feet, such as off the Kona coast, generally occur in areas of extremely clear water. Since the large majority of reef corals require light for growth, it is generally assumed that highly turbid water would serve as a negative influence for highly developed reef structures dominated by living cover. Clearly, such is not the case for Hilo Bay.

Field surveys show a dominance of genera and species that are normally rather minor components of reef assemblages, while the normally dominant forms are relatively scarce throughout most of the transect regions. In particular, two species of the genus *Montipora* (*M. verucosa* and *M. patula*) comprise very significant proportions of the coral cover. Both of these species occur predominantly in large overlapping plate-like growth forms that result in a three-dimensional aspect to the reef surface. Also occurring with relatively high frequency is the flat encrusting species *Leptastrea purpurea*. Generally, this species is encountered as small encrustations of several inches in diameter; however, at the Hilo Bay sites, very large expanses of the coral are commonly encountered.

Conspicuous by their absence, or very low occurrence levels, are several species of the genus *Porites* (*P. lobata* and *P. compressa*) and *Pocillopora meandrina*. These three species generally comprise the vast majority of coral cover on Hawaiian reefs.

The community assemblages described are not typical for the whole of Hilo Bay but just for the depth range of 60 to 80 feet. The *Montipora-Leptastrea* communities thrive to the point of complete community domination at depths below 70 feet. At progressively shallow depths, *Montipora* and *Leptastrea* become correspondingly less abundant, while both *Porites lobata* and *P. compressa* gradually increase. While total coral cover increases only slightly with increasing depth between 40 and 80 feet, the difference in cover between the two species groups is large. *Porites* dominates almost completely at the shallow depths and decreases to less than 5 percent of total cover at 80 feet, while the pattern for *Montipora-Leptastrea* is almost exactly reversed. At a depth of 60 feet, the two groups coexist in roughly equal proportions.

Two physical parameters appear to be largely responsible for the observed pattern within Hilo Bay: concussive force from wave stress that can break and abrade coral colonies and high particulate loads in the water column that can restrict light penetration and prevent growth by burial. The stability inherent to low wave stress, high particulate loads, and low light levels combine to create habitats suited to the plating or encrusting forms of *Montipora* and *Leptastrea*. The delicate plates observed to be the dominant growth form at the deep sites would be unable to sustain the physical force of storm waves without extensive breakage. However, this growth form is ideal to maximize utilization of the small quantity of light that reaches the reef surface since maximum surface area is available for incoming light utilization. In addition, the polyps (individual coral animals that comprise a coral colony) of the several species of *Montipora* are relatively large and the calices (cup-like skeletal structure secreted by the polyps) are raised so that settling sediment fills the inter-calyx space. All of these structural characteristics appear to be adaptations to optimal growth in a stable but turbid environment.

There is an almost complete lack of macrobenthic species other than corals. Only one individual each of the sea urchins *Tripnestes gratilla* and *Heterocentrotus mammillatus* were encountered during the field surveys. No observations of sea cucumbers, sea stars, or other motile macroinvertebrates were recorded. In addition, no macrothalloid benthic algae were observed.

NEKTON

Quantitative assessments of reef fish were conducted by divers in conjunction with the benthic survey. Care was taken to minimize disturbance and dispersal of fish populations. However, limited visibility due to high turbidity and the tendency for larger non-territorial fishes to aggregate and avoid divers contributed to a high variability of results.

Fishes noted on more than one occasion at intermediate depths (50 to 60 feet) were the herbivores *Scarus sordidus, Ctenochaetus strigosus, Acanthurus mata, A. triostegus, A. olivaceus, Zebrasoma flavescens, Naso lituratus,* and *Stegastes fasciolatus;* the butterfly fishes *Chaetodon unimaculatus, C. multicinctus, C. quadrimaculatus, C. trifasciatus,* and *Forcipiger flavissimus;* the angelfish *Centropyge potteri;* the goatfish *Parupaneus multifasciatus;* the wrasses *Thallosoma duperreyi, T. ballieui,* and *Gomphosus varius;* the snapper *Lutjanus kasmira;* the filefish *Pervagor spilosoma;* and the trigger-fish *Rhinecanthus rectangulus.*

At the deeper sites fewer fishes were noted. The predominant species were *Ctenochaetus strigosus, Chaetodon unimaculatus, Chaetodon multicinctus, Thallosoma duperreyi, Parupaneus multifasciatus,* and *Pervagor spilosoma.* At the top of a steep slope located at approximately 85 feet in depth, large groups of the planktivorous damselfish *Chromis agilis* were observed. Several specimens of the two introduced species of snapper *Lutjanus kasmira* and grouper *Cephalopholis argus* were seen in coral near the edge of the slope. A small school of the large parrotfish *Scarus perspicillatus* and a large kahala *Seriola dumerilii* were also observed near the slope.

In general, there was a distinct lack of all fish fauna that are generally regarded for commercial or recreational value as "food fish." In the total of approximately ten hours underwater, only six individuals of commercially valuable food fish and one small lobster were observed. The apparent lack of carangids (jacks,ulua), squirrelfish (menpachi, aweoweo), and large goatfish (kumu) is surprising, particularly considering the high coral cover and structural complexity of the reef. Generally, fish abundance and diversity are positively correlated with substratum complexity due to the increased shelter to small individuals created by dense three-dimensional coral structures.

The National Marine Fisheries Service (NMFS) has stated that endangered humpback whales inhabit Hilo Bay. A typical population in Hilo Bay at any time is five to six humpbacks. During the mating season (December to May), males "sing" at mid-depth or near the ocean floor. When calving, the humpbacks are near the surface and near shore. Whales begin to congregate off the Big Island during November. The bulk of the population then migrates along the archipelago and is near Kauai from April to May (NMFS & DLNR, 1984).

Green sea turtles are also an endangered species that may be found in the area. However, the NMFS reports that the turtles are distributed throughout the archipelago, with most of the population near the leeward isles (NMFS & DLNR, 1984).

SOURCES OF POLLUTION

Historically, the coastal waters extending from Pepeekeo Point to Leleiwi Point have served as a sink for natural and man-related pollutants from numerous point and non-point sources along the coast. Since the turn of the century, these pollutant sources have included wastewater from sugarcane processing operations, a canec plant, surface runoff from agricultural lands, raw sewage discharges, periodic shipboard waste disposal in Hilo Harbor, cesspool overflow and leachate, and the thermal discharges of Hilo Electric Company into Wailoa River.

Current point source discharges into Hilo Bay are:

- Hilo Electric Company's thermal discharge in Wailoa River (28 mgd).
- Pepeekeo sugar mill's agricultural process waste.
- Kulaimano WWTP discharge of chlorinated secondary effluent (125,000 gpd).
- Papaikou WWTP discharge of chlorinated secondary effluent (56,000 gpd).
- Hilo WWTP discharge of chlorinated primary effluent (4.0 mgd).

For Hilo Bay, the important non-point source of pollutant is groundwater discharges from cesspools entering the bay through large natural groundwater influxes south of the Wailuku River.

D. SOCIAL AND ECONOMIC CHARACTERISTICS

ECONOMY

The City of Hilo presently is Hawaii County's only major metropolitan area and serves as its center of government and trade--two categories that, along with the service industry, are the largest sources of island employment. Unlike the county as a whole, which is oriented more toward agriculture, Hilo is strongly oriented toward transportation, communication, trade, and utilities.

As the center for government, business and transportation, Hilo also became the major population center and thus, the major population support center on the island. Consequently, most of the secondary economic activities such as retail and wholesale trade, education, utilities, finance, insurance, real estate and professional and personal services also occur in Hilo.

It is anticipated that the Hilo area will continue to be the major urban center of Hawaii County despite a projected dispersion of some activities to other parts of the island. More specifically, the future economic emphasis in the Hilo area is directed toward the areas of governmental services, commercial activities, diversified industries (goods and services), and tourism.

Governmental Services. As in the past, federal, state and county governmental agencies will continue to be centralized in the Hilo area.

Commercial. The county's major commercial center is located in the South Hilo district. The city of Hilo contains a downtown business district, several major shopping center complexes, and neighborhood commercial facilities. Commercial activity in Hilo will continue to undergo change.

Industrial. With almost 70% of the county's industrially zoned lands, South Hilo is the major industrial center on the island. Industrial development in the area includes manufacturing and processing, wholesaling, and storage and transportation facilities. Future industrial gains are anticipated to be in the areas of transportation and utility facilities. Diversified manufacturing activities also are expected to make significant gains in the Hilo area.

However, in recent years, sugar cane processing operations in the East Hawaii region have declined and, in the case of Puna Sugar Company, terminated. Hamakua Sugar Company continues to consolidate its operations while C. Brewer & Company has replanted much of its land previously in sugar cane cultivation to less labor intensive macadamia nut orchards.

Tourism. Tourism activity in the Hilo area has declined as the visitor industry continues to expand in West Hawaii. In 1975, Hilo had a reported inventory of 2,167 transient accommodation units. By the end of 1984, the inventory declined to 1,313 units, and represented only 18 percent of the island total.

Since Hilo is the center for government, business and services on the island, Hilo hotels also serve business travelers. A segment of patronage, although not large at present, would be visitors to special events, including celebrations such as the Merrie Monarch Festival and athletic events. This patronage derives from both participants and spectators.

Other Economic Sectors. The University of Hawaii at Hilo, which offers a four-year undergraduate program, provides potential economic growth opportunities for Hilo. Within the University system, the Hilo branch is the second largest campus with an enrollment in 1986 of 3,700 students. It is noted for its cloud physics research, agricultural research, cooperative extension service, and support for geothermal research, volcanology and the Mauna Kea observatories for astronomy.

It is hoped by many that geothermal activities in the Puna District will lead to more energy self-sufficiency for the county as well as pave the way for other industries requiring large amounts of energy at relatively stable and predictable prices.

Income. The median family income for the county is $16,975. By comparison, the median family income for the state is $20,473. Poverty for a non-farming family of four is defined by federal guidelines as a yearly income lower than $13,400 (Hawaii Office of Economic Opportunity, May 1988).

LAND USE

State and county statutes and ordinances pertaining to land use control, to a large measure, influence and control the magnitude and direction of population growth and, indirectly, socio-economic activities. Population and related activities, in turn, exert a direct impact upon the emission of waste materials into the environment.

The existing distribution of state land use district classifications for the county is shown in Table III-1. Lands classified as urban are subject to county land use control. Agricultural and rural district land regulations are established by the state and administered by the county. Conservation lands are under the control of the Department of Land and Natural Resources.

Table III-2 summarizes the distribution of land uses based on the classifications used for real property tax assessments.

Table III-3 show the proposed land use district pattern acreage allocation for the South Hilo District indicated in the 1987 draft revisions to the General Plan.

TABLE III-1

State Land Use Districts in the County of Hawaii: July 1, 1987

District	*Acres*	*Percent of Area*
Urban	40,928	1.6
Agriculture	1,230,500	47.8
Conservation	1,301.353	50.6
Rural	619	–

From Table 200, *The State of Hawaii Data Book, 1987.*

TABLE III-2

Acreage of Land Use Classes: July 1, 1987

Use	*Area (Acres)*
Improved residential	12,209
Apartment	1,604
Commercial	1,256
Industrial	6,550
Agricultural	1,196,373
Conservation	1,286,449
Hotel and resort	520
Unimproved residential	15,245
Total acreage	2,520,205

From Table 199, *The State of Hawaii Data Book, 1987.* Based on land use classifications used for real property assessment purposes. Data exclude public streets and highways and other areas not in parcels of record.

TABLE III-3

Proposed Land Use Pattern Acreage, South Hilo District

Use	*Area (Acres)*
Residential	24,045
Commercial	2,405
Industrial	6,259
Resort	293
Total acreage	33,002

From *County of Hawaii Draft General Plan,* August 1987.

The Hawaiian Homes Commission was established to administer the provisions of the Hawaiian Homes Commission Act of 1920 which provides benefits to native Hawaiians. The Act sets aside certain lands statewide to be used by descendants of native Hawaiians. Large acreages of land (3,935 acres) in the eastern part of Hilo were so designated for homestead (residential) use, agriculture, and commerce, as dictated by county zoning. Presently, a portion of the Keaukaha area of Hawaiian Home lands has been developed for single-family residential use.

POPULATION

The draft of the Revised Hawaii County General Plan dated August, 1987 sets forth population estimates and projected levels of population to be used as a guide in land use planning. An econometric model was developed and utilized to project total employment and population. This model assumes moderate tourism growth, slight decline in sugar employment, continuing growth in diversified agriculture and modest expansion of new export industries. Table III-4 details the population projected for the Hilo area utilizing Series B, the projection adopted by the County of Hawaii Planning Department

TABLE III-4
Population Projection - Hilo
Series B

Year	*Hilo Projected Population*
1986	40,500[1/]
1990	43,000
1995	46,000
2000	48,000
2005	50,000
2010	52,000
2015	55,000
2020	57,000
2025	60,000

[1/]Hilo area population is based on a 90% proportion of the South Hilo district population: 45,000 (1987 Data Book) x 0.90 = 40,500

HOUSING

The draft of the revised Hawaii County General Plan dated August, 1987, enumerates three primary policy functions of housing. These are to provide: 1) physical shelter; 2) a setting, both within the structure and its neighborhood, for the day-to-day activities of the family members; and 3) the grouping of families within the larger neighborhood or community.

Within the city of Hilo, residential subdivisions have occurred primarily within the Waiakea Homesteads and Waiakea Uka areas. There are approximately 3,227 vacant parcels in these residential sections.

Nevertheless, available and accessible lands for residential use within the city limits and southeast of Wailuku River are very nearly reaching the limits presently allowed by the General Plan. Existing areas allowed for alternate urban expansion in the area between Kaumana and Waiakea will require infrastructure improvements.

Other housing problems continue to revolve around the provision of housing for low-income and elderly housing needs. According to the 1980 census data, approximately 43% of the households in the district of Hilo reported incomes of less than $15,000. These account for 5,440 households in the district.

Table III-5 is from the draft of the revised Hawaii County General Plan. It represents the profile of housing units in the city of Hilo.

RECREATION

The "County of Hawaii Recreation Plan" was prepared in 1974 to serve as a guide in the county's planning efforts for expansion, acquisition and development of the recreational program. This plan, however, needs to be revised and updated to reflect new and updated priorities.

The recreational program of the county is presently targeted toward diversification of activities. Active team sports for children and adults are continually being maintained. Recreational programs have been targeted for all ages with renewed emphasis on promoting activities for women and adolescents.

There is a high participation in swimming, jogging, and outdoor events among the residents of the Hilo area. However, natural features presently constrain shoreline recreation in the Hilo area because of the limited acreages of sandy beaches. There are approximately 60 acres of neighborhood recreational facilities currently available for public use.

EDUCATION

Public schools in Hilo are under the jurisdiction of the state Department of Education. The public school system in the South Hilo district is comprised of two high schools, three intermediate and eight elementary schools. The current school population of South Hilo is about 9,400 students.

TABLE III-5
Profile of Housing Units--South Hilo

DISTRICT: S. Hilo
PROFILE

	Population	Households
1980	42,278	13,251
1970	33,915	9,415
Growth	24.66%	40.74%

Existing Inventory - Housing Units

1985	UNITS: 15,188	SF: 11,505	DUPX: 444	APT: 2,681	OTHER: 558
1980	UNITS: 14,301	SF: 10,787	DUPX: 432	APT: 2,525	OTHER: 557
1970	UNITS: 9,585	SF: 7,826	DUPX: 354	APT: 907	OTHER: 498

Occupancy

1980	Fee	8,031	60.61%
	Rental	5,220	39.39%
1970	Fee	6,183	64.05%
	Rental	3,471	35.95%

Occupied/Vacant

1980	Occupied	13,251	95.13%
	Vacant	678	4.87%
1970	Occupied	9,415	97.52%
	Vacant	239	2.48%

Age of Structure

1985	0-5	949	7.94%	1970	0-5	2,180	22.58%
	6-15	3,183	26.62%		6-15	1,524	15.79%
	16-30	2,607	21.80%		16-30	2,686	27.82%
	30-	5,217	43.63%		30-	3,264	33.81%

Dwelling Units by Tax Map Sections

	Totals	*Sec 1*	*Sec 2*	*Sec 3*	*Sec 4*
1970	9,585	540	2,265	1,455	2,169
1980	14,301	926	2,751	1,810	4,151
1985	15,188	984	2,818	1,890	4,656
Diff 1970-85	5,603	444	553	435	2,487

	Sec 5	*Sec 6*	*Sec 7*	*Sec 8*	*Sec 9*
1970	992	880	678	483	123
1980	1,567	1,325	741	903	127
1985	1,669	1,341	758	941	131
Diff 1970-85	677	461	80	458	8

Parcel Inventory

	Totals	*Sec 1*	*Sec 2*	*Sec 3*	*Sec 4*
1969	14,323	1,354	3,231	1,558	3,323
1985	18,126	1,234	3,011	1,640	5,893
Vacant	4,961	456	553	286	1,932

	Sec 5	*Sec 6*	*Sec 7*	*Sec 8*	*Sec 9*
1969	2,267	819	1,032	565	174
1985	2,890	957	1,253	1,005	243
Vacant	1,127	195	226	150	36

Enrollment at Hilo High School is about 1,480 students. Students from two intermediate schools in the district transfer to this complex. The Waiakea High complex has an enrollment of approximately 1,900 students. The facility serves students from the Waiakea, Keaau and Mountain View intermediate schools.

Private school complexes in the district have a combined total of 780 student enrollment. St. Joseph High and Elementary complex (including the Hamakua Branch) accounts for 550 students, from kindergarten through twelfth grade level.

The University of Hawaii at Hilo (UHH), provides alternative higher educational opportunities within the University of Hawaii system through its variety of certificate, associate and baccalaureate degree programs. The UHH is the only public institution of higher education in the County of Hawaii and is the only institution in the University organization that incorporates a two-year community college, a four-year university, and a continuing education program.

The University of Hawaii at Hilo complex has an enrollment count of 3,700 students. The main campus encompasses an area of approximately 137 acres. Major projects include Beaumont Agriculture Research, Geothermal Power Research and Mauna Kea Observatory.

UTILITIES

Sewerage System. The Hilo sewerage system is described in Chapter II.

Water Supply. The Hilo Water System extends as far as Alae Point to the north, Panaewa Agricultural Park to the south, 6 miles Keaukaha to the east, and 6 miles Kaumana and Waiakea to the west. Water consumption in the Hilo area is approximately 5.3 million gallons per day.

Water for the Hilo area is supplied from both surface and ground water sources. The county's Department of Water Supply maintains and operates six water sources to serve the Hilo area. These are the Piihonua Surface Source, Lyman Spring, Olaa Flume, Waiakea-Uka Spring, Panaewa Well and Piihonua Well, with a combined normal capacity of 20 million gallons per day.

Electrical Power. The Hawaii Electric Light Company (HELCO), a public utility which is regulated by the state, furnishes electric power to the Hilo area. HELCO's power generation system presently has a total firm capacity of 127 MW. HELCO purchases a total of 26 MW of power from a privately-owned biomass generator (Hilo Coast Processing Company), and from one geothermal generator owned by Research Corporation of the University of Hawaii. The balance of 101 MW is produced by steam units, diesel units, a gas turbine, and hydroelectric units at six power plants owned by HELCO. These power plants are located at Keahole, North Kona; Waimea, South Kohala; and Waiau Puueo, Waiakea Peninsula, and Kanoelehua, South Hilo.

Solid Waste Disposal. The county's Solid Waste Management System provides for a series of regional landfills supplemented by 20 transfer stations located throughout the island. The county operates a sanitary landfill in the airport-industrial area serving the entire eastern section of the island from Honokaa to Pahala. Since municipal home collection is not currently provided, most residents haul their own refuse to the landfill. Commercial and resort establishments are normally serviced by private refuse collection firms.

Recent estimates from the county's Division of Solid Waste Management indicate that about 5.5 pounds per capita of domestic refuse is generated daily.

TRANSPORTATION

Roads. The County of Hawaii has 1,295 miles of public roads made up of 320 miles of State highways and 975 miles of County roads. The major highway system on the island is the Hawaii Belt Highway. The city of Hilo is a terminal point for the island-circling highway. Augmenting this primary highway system is the cross-island Saddle Road. The Belt highway circles the entire island of Hawaii and links Hilo with settlements along the Hamakua Coast (northern) and communities to the Puna area (east). This highway is used by tourists to visit such popular scenic areas as Akaka Falls (toward the north) and Hawaii Volcanoes National Park (toward the south).

Harbor Facility. There are two deep water harbors on the island, one at Hilo and another at Kawaihae. While improvements continue to be made, both harbor terminals lack adequate docking and support facilities. However, Hilo Harbor will continue to play a major role in the island's activity due to the established marketing and distribution centers in Hilo.

Airport. Air terminals which service inter-island transportation are located at Hilo, Waimea, Upolu and Keahole. The terminal at Hilo formerly accommodated overseas transportation and operated as the second gateway to the state. This air terminal, however, currently services only inter-island flights. The facility is underutilized while the statewide need for a second gateway, especially for cargo, still exists. The proximity of Hilo's airport and harbor offer a number of opportunities for centralized distribution.

CHAPTER IV

POTENTIAL ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

A. INTRODUCTION

The overall impact of the proposed improvements to the Hilo sewerage system will be beneficial to the human and natural environments. The system has been formulated to ultimately eliminate the undesirable practice of using cesspools and septic tanks for sewage disposal and to meet anticipated sewerage needs of the Hilo service area in accordance with federal and state requirements. The proposed system will impose less of an impact on the natural environment than the present method of employing many dispersed disposal facilities. Furthermore, the proposed system will avoid adverse impacts on the nearshore environment which has the highest susceptibility because of its limited capacity for dilution.

The new sewage treatment plant will provide secondary treatment to effluent discharged into Hilo Bay, thereby improving water quality. The old sewage treatment plant will be removed and replaced with a new pump station. This will not only eliminate a source of odors but will allow part of the land occupied by the existing plant to be used for recreational purposes.

Any action that requires construction for improvements involves tradeoffs. Unavoidable adverse impacts will include temporary, construction-related inconveniences, such as noise, traffic disruptions, dust, and unpleasant aesthetics, to the residents and visitors to the Hilo area. Actions will be taken to modify these impacts as much as possible. There will also be some unavoidable long-term impacts.

The following discussion identifies and evaluates both the short-term and long-term impacts that may occur over time as a direct results of the proposed construction of a new pump station, sewer mains, and secondary treatment plant, and the measures which will be taken to mitigate these effects.

B. SHORT-TERM IMPACTS

Construction of the treatment plant, pump station, and sewer mains will involve the excavation of trenches, installation of pipes, backfill operations, and other activities associated with construction. Accompanying these construction activities will be noise, dust, and traffic inconveniences as well as other undesirable aesthetic aspects. While mitigating measures will be employed, these temporary inconveniences will be unavoidable to some extent. These short-term impacts are as follows:

TRAFFIC DISRUPTION

Traffic disruption along roadways will, in some instances, probably restrict traffic to a single lane pattern, with vehicular speeds reduced accordingly. Construction vehicular traffic, generated by disposal of excavated material and other construction-related activities, will be scheduled during off-peak hours and regulated to minimize interruptions to normal traffic flow.

FUGITIVE DUST

Fugitive dust will be created during construction periods from activities such as clearing, excavating, and backfilling. These activities could cause minor disturbances to residents in proximity to the area. Such impacts will be temporary, with no continuous air quality impairment anticipated. Fugitive dust will be controlled as much as possible through watering and other measures as appropriate.

NOISE

Noise will be generated by various vehicular and construction equipment used in the construction activities. The anticipated noise level for construction equipment will be between 90 to 100 dBA measured at 50 feet. For comparative purposes, the noise level at the edge of a highway with dense traffic is 70 to 85 dBA, and the noise level of a jet plane at 1,000 feet is 100 to 105 dBA. Given the location of the site in proximity to the airport, construction noise levels will be nearly imperceptible. Noise levels from machinery and motors will be limited to conform with state and county regulations. Construction hours will be regulated also, to reduce impacts.

STORAGE AREAS

Storage areas for material, equipment, and supplies will be required. The contractor will be responsible for selecting a site that meets all applicable laws and regulations. Generally, storage areas present an unpleasant aesthetic appearance. Landscaping is not normally required because of their temporary nature.

FLORA AND FAUNA SPECIES

The site selected is in an area of low ecological value. There will be no impact on endangered flora and fauna species.

ARCHAEOLOGICAL AND HISTORIC SITES

There are no archaeological or other historic sites in the project area.

EROSION

Construction activities will have the inevitable result of exposing otherwise undisturbed soil to erosion by the weathering effects of the wind and rain. These effects will be minimized through the implementation of proper construction erosion techniques and are therefore considered short-term. The resultant impacts of erosion and sedimentation upon coastal water quality and marine organisms is not anticipated to be a significant problem compared to the 2,600 tons of sediment which is transported and discharged into Hilo Bay by the Wailuku and Wailoa Rivers each year.

ECONOMY

The proposed project will create short-term employment and income for residents of the area, but the extent of this short-term employment demand is not quantifiable. For the longer term, approximately 7-10 persons will be employed to operate the treatment facility and related facilities.

C. LONG-TERM IMPACTS

Long-term impacts of the proposed action will be primarily associated with the operation and maintenance of the proposed facility.

AESTHETICS

The sewage treatment plant and pump station facilities will consist of concrete buildings and tanks, surrounded by a chain-link fence. Landscaping will be incorporated in the design to provide some aesthetic appeal. The facility will not be readily visible because of its location.

NOISE

Noise emanating from the treatment plant and pump station site will be attributable to process equipment; however, noise levels are not expected to exceed normal background levels. All noise-generating equipment will be housed within structures with specially-installed noise abatement features. Air blowers will be equipped with intake and exhaust mufflers whenever required to reduce noise levels to conform to applicable codes and regulations.

ODORS AND AIR QUALITY

Objectionable odors have probably been the major detrimental effect of the existing Hilo treatment plant. The frequent occurrence of this odor problem is due to the septic nature of the incoming sewage and the long detention times of the sewage in the open primary treatment units.

The proposed plant design calls for enclosing the preliminary treatment units and scrubbing the exhaust gases prior to discharge. The exhaust system requires a permit from the Department of Health and must meet state air pollution control requirements. Provisions for adding oxidizing chemicals to the influent flow are included. Provisions to treat secondary waste flows prior to discharge in the main flow stream will also mitigate odor problems.

Aside from the temporary effects of construction activities and equipment, it is not anticipated that the proposed action will significantly affect air quality in the Hilo district. Incineration, which is often a principal source of air pollutants, is not included as a unit process of the proposed treatment scheme.

SOLIDS HANDLING

The proposed sludge treatment and disposal schedule calls for anaerobic digestion, followed by chemical conditioning and mechanical dewatering, with final disposal into a sanitary landfill. The grit removed from the incoming sewage will also be disposed of at the sanitary landfill.

The proposed disposal site is the existing municipal landfill located approximately 2 miles from the proposed site of the new treatment plant. The disposal site is on land currently zoned for general industrial use. The estimated life of the site is from 35 to 50 years, according to county personnel.

NATURAL HAZARDS

The proposed plant site is outside both the 100-year flood area and the estimated inundation limits of a 100-year tsunami. The proposed pump station, which is within the flood/tsunami area, will be designed for protection against flooding.

The Hilo area is also subject to earthquakes. All portions of the system will be designed and constructed to meet earthquake standards. Emergency power systems will be provided to ensure uninterrupted system operation.

Some concern has been expressed about the susceptibility of the outfall to damage from storm waves, earthquakes, and other disasters. Since its construction in 1964 and 1965, there have been three failures. In 1972 several sections of the outfall totaling 120 feet in length were found to be broken at a distance of 700 feet from the shoreline at a depth of 25 feet. Investigations determined that a 12-foot section of pipe, not used in construction of the outfall and left on the sea floor at the time of construction, had been driven by wave action to break the pipe. Damage then progressed as the loose sections moved back and forth breaking more sections loose. The outfall was repaired at a cost of $187,600.

In November, 1975, two strong earthquakes occurred in the Kapalama area of the Big Island. Inspections determined that two major breaks in the outfall had occurred. There was also severe undermining and tunneling throughout the surveyed area. These breaks took place at a distance of 3,500 feet from the shoreline at a depth of 40 to 45 feet. Major repairs were required at a cost of $576,000.

The most recent problems with the outfall pipe occurred in September, 1986, again at a depth of 15 feet, several hundred feet from the shoreline. In this instance, the problem was leakage rather than a break. Initial repairs were completed February 1, 1987 at a cost of $81,300. Additional repairs estimated to cost $573,674 are in progress.

In each of the three cases of failures in the outfall, none has resulted in measurable impacts to recreational beaches in the area.

There are no guarantees that additional breaks or leaks will not occur in the future. There is no way to ensure that there will not be adverse impacts if such breaks should occur. Use of injection wells would not solve the problem because the effluent would enter Hilo Bay continuously along the shoreline in concentrations several times higher than allowed by State water quality standards. The only alternative disposal methods that would ensure no impacts on water quality is complete removal of all effluent from the Hilo area. This has been demonstrated to be prohibitively expensive. (See Chapter V. *Alternatives to the Proposed Action* for a more detailed discussion of disposal alternatives.)

The only feasible method of mitigating impacts that may result because of damage to the outfall is through upgrading the treatment process to provide improved effluent quality.

FAUNA AND FLORA

The proposed plant site is in a previously disturbed area of low ecological value. There will be no impact on endangered fauna and flora species.

COASTAL WATERS

The present system, which has not been found to have had significant detrimental effects, discharges primary treated effluent within nearshore waters at a depth of 56 feet and at a distance of about 4,500 feet from shore. The proposed system calls for discharging an effluent that has undergone a higher degree of treatment (i.e., secondary treatment).

The Hilo sewage outfall dilution zone study conducted in conjunction with the 1980 facilities plan study and more recent studies conducted in 1985 indicated that the existing primary sewage discharge from the outfall has no measurable impact on water quality and marine life in the area when compared to control stations. Coral types and coverages appear to be nearly identical in the vicinity of the sewage discharge and at the "control" stations. Further, both benthic organisms and fishes were found to be as abundant and as diverse near the outfall than elsewhere. This is probably attributable to the biota utilizing the discharged colloidal materials as a food source. It has been suggested in the study that marine life in the area is largely a result of a combination of factors; turbidity, due to wave action and surface runoff, surge, and possibly fresh groundwater discharge. The scarcity of coral growth of the *Pocillopora meandrina* species and the preponderance of *Porites* or *Montipora* suggest that the area is subject to reduced light levels (attributable to turbidity due to wave action and surface runoff) and possibly reduced salinity levels attributable to the large groundwater discharge). If reduced salinity is a factor, the outfall discharge should not be significant, since the magnitude of sewage discharge is on the order of one-tenth that of the average combined groundwater and surface water discharge into Puhi Bay. (Overall, Hilo Bay--of which Puhi Bay is a portion--receives greater than 600 mgd over 50 percent of the time.)

The field investigations of the outfall revealed higher concentrations of heavy metals in the sediment in the immediate area of the outfall. It should be noted, however, that no large amounts of sediment were observed in the area, and samples taken were from small patches of sand. Further, metal concentrations in the samples were low when compared to samples measured by the Water Resources Research Center of the University of Hawaii from many other so-called "pristine" locations around the state.

With implementation of secondary treatment, plant effluent characteristics can be expected to improve significantly, with reductions in the standard pollutant parameters of suspended solids, BOD (oxygen-demanding materials), and enterococcus indicator bacteria. Anticipated effluent characteristics resulting from the secondary treatment process are anticipated to meet effluent limitations of the State water quality standards and National Pollutant Discharge Elimination System (NPDES) and further improve receiving water quality.

Facilities will be constructed to provide the capability for the secondary treated effluent to be disinfected with chlorine. Facilities for introduction and mixing of chlorine will be provided prior to discharge into the gravity main. Dechlorination facilities, if necessary, will introduce sulfur dioxide into the effluent prior to discharge into the outfall to eliminate toxic chlorine residuals. Concerns associated with adverse impacts of the effluent discharge on the microbiological quality of the receiving waters are addressed in the following section.

RECREATION

Recreational usage in the vicinity of the Hilo outfall extends approximately from Alealea Point on the west to Leleiwi Point on the east. Included in this area are the bay front, Coconut Island, Onekahakaha, James Kealoha, and Leleiwi Beach Parks. Shoreline activities are generally those associated with picnicking. Water contact activities at these parks include swimming, diving, surfing and nearshore fishing.

In general, most water contact activities occur within the nearshore waters, extending offshore to approximately 1,000 feet and to a depth of about 20 feet. No limitations on any water contact activity have ever been imposed by the State Department of Health. Also, neither the State Department of Health nor the Department of Land and Natural Resources has placed any limitations on the consumption of fish caught in the vicinity of the outfall diffuser. Data on concentrations of toxic pollutants in fish or shellfish tissue are not available, but the levels of these constituents in the effluent are expected to be low and therefore not be a problem with respect to fish catches.

Review of available data on water quality parameters of the receiving waters of the existing discharge shows that the quality of the receiving waters is not being significantly altered by the discharge and that all chemical water quality criteria, which may be of consequence relative to water contact activities, are being met after initial dilution of the discharge. Because these criteria, which are embodied in the State Department of Health Administrative Rules Chapters 54 and 55 (Hawaii Revised Statutes, Chapter 342), were established to protect the beneficial uses of the receiving waters, no adverse impacts on recreational activities should result from the chemical components of the discharge. Impacts on the microbiological quality of the receiving waters are expected to be minimal due to (1) the initial dilution obtained through the design of the outfall diffuser; (2) dispersion obtained through the ocean currents; (3) bacteria and virus die-off in the saline receiving waters; and (4) substantially reduced concentrations of enteric bacteria and viruses resulting from secondary treatment.

In the past, primary effluent from the existing Hilo WWTP has normally not been subjected to disinfection prior to being discharged through the outfall. The potential for health hazards as indicated by the microbiological quality of the receiving waters (measured in the past by fecal coliform counts), even under conditions where the diluted wastewaters are transported toward the various surfing and recreational sites in the vicinity of the discharge, has been minimal and recreational activities have not been affected. This conclusion is supported by available water quality monitoring data and compliance with water quality standards.

Recent revisions to the state water quality standards and recent findings by researchers on die-off (inactivation) of microbiological indicator organisms in the ocean environment, however, reinforces the need to at least have the capability to disinfect the secondary effluent. Current state water quality standards limit the level of enterococcus indicator bacteria to 35 cfu/100 ml. The previous applicable standard based on coliform bacteria as an indicator of fecal coliform has been superseded by the new standard. The use of coliform bacteria as an indicator organism has been criticized due to discrepancies in the survival time of coliform bacteria in the marine environment, and recovery of pathogenic human enteric viruses from the marine environment in the absence or negligible concentrations of coliform bacteria (Fujioka, 1981). Available information indicates the inactivation rate for enterococcus is approximately one-half that of fecal coliform in the marine environment. Recent studies have also shown that bacterial inactivation rates in Hawaiian waters can be reduced by a factor of about thirty in the absence of sunlight (Fujioka, 1981; Fujioka, et al, 1981).

Upgrading the level of treatment from primary to secondary will undoubtedly reduce enteric bacteriological concentrations in the discharged effluent substantially. Based on data presented in *Municipal Wastewater Disinfection* (EPA, 1986), total coliform and virus reductions may increase from less than 10 percent removal to more than 90 percent removal as a result of the upgrade in treatment. The new enterococcus standard and the taking of early morning samples of receiving water (to account for reduced inactivation rates during darkness), however, may still justify more frequent use of disinfection facilities than currently provided. In general, the disinfection requirements could vary widely, depending on many variable factors such as effluent quality, level of lateral dispersion, intensity of onshore currents, etc. Water quality monitoring data will ultimately dictate the operating requirements of the disinfection facilities.

The projected level of disinfection required under the worst case conditions (99% removal of enterococcus) can be readily met by the planned chlorination/dechlorination facilities which will be designed for a wide margin of safety (99.9% reduction of enterococcus) and have the necessary capacity to meet special operating conditions such as plant upsets and emergency bypassing of units.

Although there are no standards for viruses, the chlorination facilities will be capable of providing for partial disinfection of viruses. Due to the relatively low concentration of viruses in secondary effluent, initial dilution of the effluent from the outfall alone should reduce the viral concentrations to less than one plaque forming unit per liter. Since the receiving waters are not utilized as a potable water source, public health risks associated with enteric viruses can be considered negligible.

ECONOMIC IMPACTS

Total capital costs for the new facilities are estimated to be $54,000,000. An annual expenditure of approximately $870,000 (based on a flow of 5.0 mgd) is anticipated for plant operations, including labor cost. It is estimated that 10 full-time staff members will be required, augmented by support specialists and supervisory personnel. This compares to the current O&M cost of $770,000 and employment of 8 staff.

FINANCIAL IMPACTS

Financing for operation, maintenance, and replacement (OM&R) costs is presently obtained from the county's sewer user charge to those using the sewerage system. The current user charge is $10 per dwelling unit per month for residential users and 85 percent of the water bill per month for non-residential users discharging domestic strength wastewater. Deficits are covered by the county's general tax funds. To qualify for a 55 percent federal construction grant under Public Law 92-500, however, the county is currently revising the existing user charge ordinance to cover OM&R costs of the expanded sewerage and sewage treatment plant system.

The new user charge rates have not yet been determined, but the total cost for operation and maintenance of the secondary treatment plant is estimated at approximately $870,000 per year when flows reach 5.0 mgd.

Financial responsibility for hook-up costs for each individual sewer connection has not yet been established.

Although many have expressed objections to this direct method of assessment, the current requirements leave no other alternative. Funds are needed to operate and maintain the plant and related facilities, and Public Law 92-500 requires user charges as a condition for obtaining federal construction grants.

In summary, the major long-term impact is the establishment of an effective wastewater management system that will have beneficial effects on both groundwater and nearshore waters due to the eventual elimination of cesspool seepage and effective treatment of effluent in a modern treatment plant. Risks to public health and welfare attendant with malfunctioning cesspools would be minimized.

D. SECONDARY IMPACTS OF THE PROPOSED ACTION

The degree to which this project will ultimately affect the growth rate and character of the area is not quantifiable. Development has proceeded even without municipal facilities in certain areas of the State of Hawaii. Single-family residences have utilized cesspools, while multi-unit structures (hotels, commercial developments, apartments) have utilized private treatment facilities.

The direction and character of development of the area are controlled by land use plans, which in turn, are reviewed periodically for evaluation of past growth and future trends. Present planning policies indicate that the area will continue to develop primarily in a residential fashion to support labor needs in the commercial, tourist, governmental and diversified industries fields. It is expected that public services will need to be correspondingly expanded to accommodate the projected growth, and the proposed project is essential to the orderly development of the area.

Many factors contribute to the degree to which development will actually occur in the service area. Any significant residential development will depend primarily upon a market for sale of houses. Where a market is likely to occur will, in turn, depend upon where there is available land. Commercial and industrial development will similarly occur only where a potential for profitmaking exists, and that depends upon the availability of materials at a reasonable price, transportation, and labor. Should any of these ingredients not materialize, the potential for development is decreased, regardless of whether sewage service is available or not. Adequate sewer and water service serve only to create a climate in which residential and commercial development will be able to proceed in a planned orderly fashion and do not serve to provide a stimulus for uncontrolled development.

Most of the major interceptors are already installed to convey flows from existing residences, hotels, apartments and commercial developments to the existing municipal sewage treatment plant. Where extensive development has occurred in the service area, sewage service is intended to be provided to eliminate the use of private facilities. Undeveloped areas in the upper reaches, beyond the service area, will not be served in the immediate future and will continue to utilize individual sewage disposal systems (cesspools). Ultimately, these areas will be served as they develop in a manner guided by future sewerage planning studies.

E. PROBABLE ADVERSE IMPACTS THAT CANNOT BE AVOIDED

Adverse impacts will be most pronounced during construction. Dust, noise, and traffic disruption will be the most noticeable irritants. Despite mitigation measures such as watering to control dust, regulating hours of construction to minimize noise impact, and scheduling construction traffic during off-peak hours, there will be some unavoidable adverse impacts. Traffic would be affected primarily by the trucks and heavy equipment entering and leaving the plant and pump station sites and along the streets where the mains will be placed. Traffic guides and scheduling of construction to avoid the early morning and evening traffic flows will be necessary, especially near commercial and residential developments.

Besides the construction-related impact, there is always a potential odor problem associated with the operation of sewage treatment plants. Future facilities will have special provisions for odor control; the grit chamber and screening facilities will be covered to prevent emanating odor compounds from escaping into the atmosphere. However, despite these efforts, there is always a possibility of odor problems. The best method of addressing the problem is through location of the facilities away from residential areas.

Backup power generation facilities designed to automatically operate during instances of power outages should assure that odor problems do not materialize and that operations will not be significantly interrupted.

Special provisions also are being made to process the digester supernatant, which is another source of odor. Another source of odor attributable to digester operation is leaking gas lines, but strict maintenance procedures will mitigate this problem.

F. RELATIONSHIP BETWEEN LONG-TERM AND SHORT-TERM USES OF MAN'S ENVIRONMENT

The practice of implementing individual sewerage systems is a short-term expedient, but proliferation of these systems can lead to problems in the long term. Part of the problem is that these systems rely entirely on land disposal facilities within the populated areas. Malfunctions in the treatment process would have an immediate impact on the populace in the form of health and nuisance problems or nearshore water quality impairment.

By contrast, the centralized sewerage system possesses the factors of economy of scale, reliability of performance and control, and effectiveness absent in the present individual system. With an ocean outfall already in use malfunctioning treatment processes would have a negligible effect on the disposal system and hence on the environment. To take advantage of these factors, the county must construct suitable facilities now and include provisions for handling future flows. This means that larger expenditures must be made, but, in the long run, the total cost to society in terms of tangible and intangible values would be less.

High expenditures required at one time often lead to problems of insufficient funds as other competing demands for "municipal services are being satisfied. The result is a delay in construction that, in turn, leaves no alternative but to implement or maintain a small, individual system to satisfy immediate needs. The end result is the same as before without the regional system.

The issue of long-term productivity, therefore, reduces itself to financing, recognizing that those agencies influencing the appropriation of funds must weigh factors on a broader scale of satisfying the many requests and demands for municipal funds.

G. IRREVERSIBLE AND IRRETRIEVABLE RESOURCES COMMITTED BY THE PROPOSED ACTION

There are several irreversible commitments of resources, the most prominent being land and capital investment in facilities for collection, transmission, treatment, and disposal of sewage. Additional land area committed to the proposed project will be required for the treatment plant site.

Capital investment in facilities for treatment plants is generally staged over short-term periods to match as closely as practicable the needs arising during those periods. Because of the large investment required, a commitment to certain facilities is almost irreversible.

Commitment of manpower and energy to sustain operations, procurement of supplies, and replacement of defective equipment are required over the long term. From the public's viewpoint, the commitment to the proposed action means a commitment to support these costs through user charges as dictated by Public Law 92-500.

In addition to the capital investments, wastewater effluent which will be disposed of by an ocean outfall system will be an irretrievable resource.

H. SUMMARY OF UNRESOLVED ISSUES

The only unresolved issues are the alignment of the new force main that will convey wastewater from the pump station to the new treatment plant and the gravity discharge main to convey the treated effluent to the outfall and responsibility for hook-up charges. The three alternative routes are described in Chapter II. The alignment will be decided upon completion of negotiations between the county and Hawaiian Home Lands. Various methods of financial assistance for hook-up charges are presently being investigated by the County of Hawaii.

CHAPTER V

ALTERNATIVES TO THE PROPOSED ACTION

Several alternatives and subalternatives for sewage treatment and disposal were evaluated for the updated Hilo Wastewater Management Plan. The major constraints in selecting alternatives are statutory and regulatory. These include the federal law which requires all municipal point discharges to receive a minimum of secondary treatment prior to discharge; compliance with state receiving water quality standards; federal regulations defining secondary treatment; and the state administrative rules for water pollution control.

The major alternative choices relating to upgrading facilities to meet secondary treatment standards and their advantages and drawbacks are described in this chapter. The alternatives are as follows:

A. Upgrade the existing sewage treatment plant at Puhi Bay or build a new plant at a different location.

B. Alternative sites for location of a new plant.

C. Route of sewer mains between new plant and pump station.

D. Level of treatment to be provided.

E. Effluent disinfection methods .

F. Effluent disposal methods.

G. Solids disposal methods.

H. No project.

A. UPGRADING THE EXISTING SEWAGE TREATMENT PLANT AT PUHI BAY VS. BUILDING A NEW PLANT AT A DIFFERENT LOCATION

The alternative to the proposed action of building a new plant is to update the existing facility to provide secondary treatment. The major problem with this alternative, as noted in Chapter II, is that the existing plant is within the tsunami inundation zone. This alternative would require the construction of a berm, which would be costly and unfavorable from an aesthetic standpoint. Even with tsunami protection, reliability would not be as certain as a site located inland. In addition, there is a lack of sufficient space at the existing site for an expanded secondary facility. Another disadvantage is that untreated sewage would be discharged into

Hilo Bay during the period of construction. With a new site, the existing facility can be utilized until such time that the proposed system is functional. Finally, by relocating the plant, the existing treatment plant site can be converted to additional coastline park use.

B. ALTERNATIVE LOCATIONS FOR A NEW PLANT

Three alternative sites for the new secondary treatment plant were considered: the site near the landfill, designated in the 1980 facilities plan; Wainaku Mill; and the selected site at the east end of runway at Hilo airport.

The site selected in the 1980 Facilities Plan is located south of the airport near the present county landfill and proposed Hawaiian Home Land development site, This site offers advantages for sludge disposal, but would involve major construction impacts in terms of pump station and force main routing. Impacts on the current landowner, the State of Hawaii, would be minimal.

The old Wainaku Mill site could involve conflicts with its proposed designation as a historic site. A major drawback is that a new outfall would be required due to its remote location and distance from the existing outfall. Impacts on current landowners would be substantial due to the fact that all available lands in this area are privately owned.

The selected site is located at the east end of the airport on state-owned land. Features which makes this a desirable site is its relatively remote location, capability of expansion; compatibility of use with the adjacent Hilo Airport; and its location outside the tsunami zone. In addition, it is the least costly of the three sites, with minimal amounts of construction impacts.

C. ALTERNATIVE ROUTES FOR SEWER MAINS

Three routes are presently being pursued for the alignment of the force main/gravity discharge. The two alignments preferred by the County are along existing roads and sparsely occupied areas adjacent to the Hilo Airport runway.

One route, shown in Figure II-5, runs in a southeasterly direction up Pua Avenue, then in a northeast direction to Baker Avenue, midway between Kalanianaole and Desha Avenues. From this point, the pipelines proceed up Baker Avenue to the Department of Transportation (DOT) Airports Division property line.

The second route runs southeast along Pua Avenue, then northeast to Bishop Estate land, midway between Kalanianaole and Desha Avenue. From this point the pipeline would continue through Bishop Estate land, paralleling Andrew Avenue, to the DOT Airports Division property line (See Figure II-6).

These routes are preferred by the county because they will have minimal impact along Kalanianaole Avenue which is the major ingress/egress roadway to the Keaukaha area and because of construction cost savings due to the shorter alignment.

The alternative route, shown in Figure II-7, runs northeast along Kalanianaole Avenue, then in a southeasterly direction up Bishop Estate land, paralleling Andrew Avenue, to the DOT Airports Division property line.

Route selection is still unresolved.

D. LEVEL AND METHODS OF TREATMENT TO BE PROVIDED

Secondary treatment of sewage is required by federal law unless a waiver allowing primary treatment is granted by EPA. The only acceptable alternative is tertiary treatment. Tertiary treatment involves not only secondary treatment but also simple inorganic ions and complex synthetic organic compounds normally unaffected by secondary treatment. Concomitant with this high degree of treatment is the need for extensive, highly complex mechanical and electrical equipment and a high operational cost. Based on the high cost factor related to tertiary treatment, this alternative was discounted. Further, the incremental degree of tertiary treatment over that of secondary is not cost beneficial, especially when applied to effluent disposal into an open ocean regime.

SECONDARY TREATMENT ALTERNATIVES

There are a number of methods available to achieve secondary treatment levels. Four methods were evaluated during facilities planning. These methods are: biotower/solids contactor (B/SC), rotating biological contactor (RBC), activated sludge (AS), and sequential batch reactor (SBR).

The alternatives were chosen as potential secondary treatment processes and operations which could meet the discharge requirement.

Each of the alternatives considered has the following processes in common: screens, grit chamber, primary sedimentation tanks, secondary clarifiers, and disinfection. Sludge is discussed separately. These processes are described briefly below. An in-depth discussion of each process is contained in the 1988 Facilities Plan.

Biotower with Solids Contactor (B/SC). The biotower is an attached growth system in which effluent from the primary treatment system is applied over a fixed bed plastic media. Effluent can be recirculated to allow flexibility in the loading rate. This system and its predecessor, the rock media trickling filter, is one of the most widely used secondary treatment processes, capable of treating high strength organic wastes to meet the secondary treatment requirements most of the time. This is the recommended alternative.

Rotating Biological Contactor (RBC). The RBC process is an aerobic, fixed-film biological treatment process consisting of a series of drum-shaped, large-diameter corrugated plastic media shaft-mounted horizontally. The media is partially submerged in the wastewater in a contoured tank and provides an attachment for biological growth.

Although recommended in the 1980 Facilities Plan as the selected process, the RBC system has not met its full performance expectations. Problems experienced by this process include lower loading rates per shaft than initially established by the industry, uneven biological growth on shaft, and problems with the shaft drive mechanisms.

Activated Sludge with Fine-Bubble Diffusers (AS). The AS process removes organic material in sewage by a dispersed air-biological process. It consists of an aerated basin and secondary clarifier. Activated sludge is among the most widely used secondary treatment processes for municipal and industrial wastewater

Sequencing Batch Reactor (SBR). The SBR is a fill-and-draw process which is similar to activated sludge operated in a batch mode.

Criteria used in the evaluation of the alternatives include costs, both capital and annual O&M; the extent of operator attention and control required; precedents, i.e., extent of use in other communities and operating experiences; and degree of odors, nuisance insects, and other environmental impacts.

Costs have been adjusted to reflect prices and wages in Hilo, Hawaii for mid-1988. Capital costs include a factor for design, construction management, administration, and contingencies. Annual O&M costs include labor, materials, and energy and are converted to total present worth using an interest rate of 8% and an average lifespan of 20 years.

Costs are only for secondary treatment processes. Processes common to all alternatives, such as screens, grit chamber, primary sedimentation tanks, and disinfection, are not included. The costs are reconnaissance level only, accurate for decision-making but should not be considered precise estimates of actual construction or O&M. Capital, O&M, and total present worth costs for each alternative are summarized in Table V-1. Non-cost factors are shown in Table V-2 through V-4.

The B/SC process is recommended because of its low cost, ability to consistently meet the secondary treatment standards, and minimal operation and maintenance requirements. The B/SC system is also able to best take shock loads, including sharp changes in saline concentrations.

TABLE V-1, Comparison of Alternatives
Present Worth Analysis

	Capital	O&M, $/YR Labor & Materials	O&M, $/YR Energy	O&M, $/YR Total	Present Worth 8% 20 yrs
SECONDARY TREATMENT					
OPTION 1					
Biotower	4,076,000	24,600	107,800	132,400	5,376,000
Solids contactor	336,000	13,300	31,500	44,800	776,000
Secondary clarifier	2,835,000	81,400	3,200	84,600	3,666,000
Total	7,247,000	119,300	142,500	261,800	9,818,000
OPTION 2					
Rotating Biological Contactor	8,607,000	84,500	157,500	242,000	10,983,000
Solids contactor	336,000	13,300	31,500	44,800	776,000
Secondary clarifier	2,835,000	81,400	3,200	84,600	3,666,000
Total	11,442,000	165,900	160,700	326,600	14,649,000
OPTION 3					
Activated sludge	4,492,000	73,700	73,500	147,200	5,937,000
Secondary clarifier	2,835,000	81,400	3,200	84,600	3,666,000
Filter	3,155,000	178,100	35,000	213,100	5,247,000
Total	10,482,000	333,200	111,700	444,900	14,850,000
OPTION 4					
Sequencing batch reactor	4,005,000	111,700	169,200	280,900	6,763,000
Filter	3,155,000	178,100	35,000	213,100	5,247,000
Total	7,160,000	289,800	204,200	494,000	12,010,000
SLUDGE THICKENING					
OPTION 1 Dissolved air flotation	599,000	26,000	29,000	55,000	1,139,000
OPTION 2 Centrifuge w/polymer addition	515,000	118,700	79,000	197,700	2,456,000
OPTION 3					
Belt filter press w/polymer addition	689,000	17,600	2,000	19,600	881,000
3-day storage tank	212,700	0	0	0	213,000
Total	901,700	17,600	2,000	19,600	1,094,000
SLUDGE DEWATERING					
OPTION 1 Vacuum filter	816,200	101,500	4,200	105,700	1,854,000
OPTION 2 Centrifuge	663,200	27,300	21,000	48,300	1,137,000
OPTION 3 Belt filter press	688,700	17,600	2,000	19,600	881,000
SLUDGE DIGESTION					
OPTION 1					
Anaerobic (incl. energy recovery)	2,467,400	(-)	(-)	83,100	2,467,000 (a)
Credit for energy	(-)	(-)	(-)	-85,400	(-)
Total	2,467,400			-2,300	2,467,000
OPTION 2					
Aerobic	900,000	9,500	221,000	230,500	3,163,000
Additional sludge disposal				24,700	243,000
Total	900,000			255,200	3,406,000

TABLE V-1, Comparison of Alternatives
Present Worth Analysis

	Capital	O&M, $/YR Labor & Materials	Energy	Total	Present Worth 8% 20 yrs
DISINFECTION					
OPTION 1					
Disinfection only (b)	33,581	17,820	320	18,140	212,000
Dechlorination	150,500	37,200	1,400	38,600	529,000
Total	184,081	55,020	1,720	56,740	741,000
OPTION 2 Ozonation	2,149,300	9,700	169,000	178,700	3,904,000
OPTION 3 Ultraviolet Radiation	826,600	(-)	(-)	42,800	1,247,000

(a) Total labor, material and energy O&M cost per year is offset by credit for energy recovery. Therefore, present worth of sludge digestion option 1 is equal to the capital cost only.
(b) Costs of chlorinator and appurtenances for disinfection only. Additional chlorination facilities required for odor control and process control (see text).

TABLE V-2

Summary of Non-Cost Factors
Secondary Treatment

Factors	Bio-tower/Solids Contactor	Rotating Biological Contactor	Activated Sludge	Sequencing Batch Reactor
Flexibility	• Can meet 30/30 or 85% removal consistentally with SC. • Able to take shock loads.	• Usually can meet 30/30. Can meet 85% removal with SC.	• Can meet 30/30. • Highly flexible. • May require filtration to meet 85% removal.	• May require filtration to meet 30/30 or 85% removal. • Great flexibility in operation.
Operator Attention	• Very little.	• Very little.	• Extensive	• Very little after start-up.
Precedents	• Numerous; SC relatively new.	• Introduced in late 1960's.	• Numerous.	• Few.
Environmental Impact	• Potential odor at point of discharge to media.	• Potential odor at RBC.	• Potential odor at aerator.	• High odor potential when aerator cycle begins.
Others		• Shafts can be high maintenance items.	• Prone to upsets.	• May require lengthy start-up. • Prone to upsets.

TABLE V-3

Summary of Non-Cost Factors
Sludge Thickening

Factors	DAF	Centrifuge	Belt Filter
Thickened Sludge, % solids.	. Up to 12 %.	. 7%	. 8%
Precedents	. Numerous.	. Numerous for dewatering; limited for thickening.	. Numerous for dewatering; limited for thickening.
Environmental Impacts	. Potential for odor . Noise from air compressors.	. Noise.	. Potential for odor
Others	. May require pilot work.	. Needs chemicals.	. Needs chemicals.

TABLE V-4

Summary of Non-Cost Factors
Sludge Dewatering

Factors	Vacuum Filters	Centrifuge	Belt Filter Press
Cake Solids, %	. 15-20 %	. 15-40 %	. 25-41 %
Operator Attention	. Extensive.	. Little.	. Little.
Precedents	. Numerous, but use Declining	. Numerous.	. Relatively new, but no serious problems reported.
Environmental Impacts	. Potential for odor	. Noise and vibrations.	
Others		. Facilities for major maintenance/repairs may not be locally available.	

SOLIDS HANDLING METHODS

Solids generated from the treatment processes require separate treatment processes: thickening, digestion, and dewatering, before being disposed. Alternative processes are described and evaluated in the following sections. The criteria for evaluation are the same as for secondary treatment processes above.

Sludge Thickening. Alternatives methods considered for thickening sludge are dissolved air flotation (DAFT); centrifuge; gravity thickener (GT); and belt filter thickener (BFT).

Dissolved Air Flotation. The DAFT system removes suspended solids by using flotation (rising) to decrease their apparent density. Recycled subnatant is pressurized and saturated with air and then mixed with influent sludge in the flotation tank. The rising gas bubbles attach themselves to particles and form a floating sludge blanket which is skimmed off and sent to digestion. The subnatant is returned to the plant. The DAFT system is highly successful in thickening low density sludge solids, such as waste activated sludge. It is the recommended alternative.

Centrifuge. A centrifuge uses centrifugal force to increase the removal rate of the sludge solids. Sludge is pumped into a rotating bowl, and clear supernatant continuously overflows through effluent weirs. A rotating conveyor pushes the thickened sludge out either end, depending on which way the conveyor rotates. The construction costs for the centrifuge are more than for the DAFT. Also, the O&M and total annual costs are higher, primarily because of greater power requirements.

Gravity Thickener. The GT uses the difference in specific gravity between the solids and water for separation. The sludge is fed into the influent end of a circular tank and allowed to settle. Scraper blades along the bottom of the tank rotate and move the settled solids to the center of the tank where they are removed. The supernatant overflows to an effluent trough. The scraper blades also dislodge any gas bubbles trapped in the settled solids and prevent bridging.

The GT is considered a non-viable alternative at Hilo because of the nature of the sludge being treated. The sludge at Hilo has been highly variable in concentration with a tendency to float. Such characteristics counteract the settling necessary for good gravity thickening operation. In order for gravity thickening to work, a prohibitively large amount of chemicals would then be needed.

Belt Filter Press Thickening. The BFP uses gravity thickening and filtration followed by pressure dewatering to squeeze water out of sludge that is sandwiched between two belts. Usually it is necessary to coagulate the sludge to avoid penetration of the filter belt by sludge; polymer is often used.

Comparisons of the cost and non-cost factors are shown in Tables V-2 and V-4. The DAFT process is recommended because of low capital and O&M cost, ability to thicken sludge to 8%-12%, and because operation requirements are lower than the other processes. The DAFT does not require constant adjustment with fluctuating influent concentration, and the local warm weather conditions are conducive to improvement of the processes efficiency.

Sludge Digestion Methods. Digestion is a process that stabilizes sludge and reduces its volatile solids content. The sludge is less odorous and putrescible and has fewer pathogenic organisms. Both anaerobic and aerobic digestion were evaluated in the 1980 Facilities Plan. Although the present worth costs were about the same, anaerobic digestion was selected, since aerobic digestion had much lower O&M costs and anaerobic digesters were used at the existing plant. Energy costs for aerobic digestion were predicted to inflate higher than other costs, further favoring the anaerobic alternative. Anaerobically digested sludge is also easier to dewater than aerobically digested sludge. Furthermore, anaerobic processes generate gas that can be recovered to heat the digester or produce electricity.

Incineration was also considered but rejected because of high capital and O&M costs, nearly double those of anaerobic digestion.

These factors have not changed since the completion of the *1980 Facilities Plan* and anaerobic digestion remains the appropriate choice.

Sludge Dewatering Methods. Sludge dewatering methods include vacuum filtration, centrifuge, and belt filter press (BFP).

Vacuum Filtration. Vacuum filtration dewaters the sludge by sucking the moisture out of the sludge. A cylindrical drum rotates into a vat of sludge and a vacuum is applied. The drum rotates out of the vat while still applying the vacuum. At the top of the drum air is applied to the drum to help remove the cake. Scrapers may also be used to remove the cake.

Centrifuge. A centrifuge uses centrifugal force to increase the sedimentation rate of the sludge solids. Its operation is similar to that of the centrifugal thickener. Just as with thickening, a solid bowl type is used. Sludge is pumped into a rotating bowl, and clear supernatant continuously overflows effluent weirs at the other end. A rotating conveyor pushes the thickened sludge cake out one end of the bowl.

Belt Filter Press. The BFP operates the same as the BFP thickener, but includes a pressure section to squeeze the water out of the sludge which is sandwiched between two belts. The sludge is fed onto an endless bottom filter belt after which a top belt is pressed on top, using rollers. The belt rolls in a S-shaped direction to induce shear forces. The filtrate is returned to the plant influent.

Construction and O&M costs for the sludge dewatering alternatives are shown in Table V-1 and non-cost factors in Table V-4. Belt filter presses are recommended because of their low construction and O&M costs, their ability to produce an acceptable cake solids concentration, and their ability to handle hard-to-dewater sludges.

E. EFFLUENT DISINFECTION ALTERNATIVES

Wastewater disinfection is the process of destroying pathogenic microorganisms in the wastewater by physical or chemical means. In the past, chlorine has been by far the most widely used disinfectant for wastewater. Other processes such as ultraviolet radiation, gamma radiation and sonics, and other chemical agents such as ozone, chlorine dioxide, hypochlorite bromine, and bromine chloride have also been used with varying degrees of success. The three disinfection processes which are deemed most applicable to the Hilo facility -- chlorination, ozonation, and ultraviolet radiation -- are evaluated in the following discussion.

Chlorination. The wide use of chlorination in the disinfection of wastewater results from its effectiveness, well-developed technology, wide availability of equipment, and relatively low capital and operating costs.

Disinfection with chlorine is a chemical process in which microorganisms are destroyed as a result of chemical reaction between cells and hypochlorous acid or other chlorine compounds. Chlorination is also typically used for other purposes in wastewater treatment. At the Hilo facilities, it will be used for odor control.

Since chlorine has been found to be toxic to corals and other aquatic biota, dechlorination of the effluent must be provided before discharge through the outfall. Sulfur dioxide is most commonly used as the dechlorination agent to remove chlorine residuals because of its proven cost-effectiveness.

Ozonation. Ozonation is a disinfection process that uses ozone as a germicide. Like chlorine, disinfection with ozone is a chemical process. Since ozone quickly reverts to oxygen, no toxic residuals remain in the effluent. Other advantages of ozone include superior efficiency compared to chlorine in viral and elimination of transportation and handling hazards due to onsite production of the disinfectant. Major disadvantages of ozone include very high capital costs and the requirement for intensive maintenance and skilled labor.

Ultraviolet radiation. Ultraviolet (UV) radiation is a physical process which uses UV radiation to inactivate microorganisms. Although the exact process of UV radiation is not known, it is believed that the DNA and/or RNA of cells is damaged, inactivating the microorganisms. Advantages of the UV process include capital and O&M costs comparable to chlorination/dechlorination, no use or production of toxic compounds, effectiveness in inactivating viruses, and relatively simple O&M requirements. Disadvantages include the need for constant maintenance to prevent fouling of components and reduced disinfection efficiency with high effluent suspended solids.

The relative costs of chlorination, ozonation, and ultraviolet radiation based on a 1976 EPA study on disinfection of wastewater are shown in Table V-5.

TABLE V-5
Comparative Costs of Disinfection

Plant size (mgd)	*1*	*10*	*100*
Capital Cost (thousands $)			
Chlorine/SO_2	70	220	930
Ozone	190	1,070	6,880
Ultraviolet	70	360	1,780
Disinfection Cost ($ per thousand gallons)			
Chlorine/SO_2	.0437	.0175	.0089
Ozone	.0731	.0402	.0284
Ultraviolet	.0419	.0270	.0227

The chlorination/dechlorination alternative was selected as the recommended scheme for the following reasons

1. Relatively low capital and O&M costs.
2. Availability of proven technology and equipment.
3. Need for chlorination facilities for odor control.
4. High operational flexibility with respect to dosage control (applicable during plants upsets or emergency operating conditions).
5. Capability for high disinfection efficiency (particularly applicable if effluent is used in future for irrigation).

F. EFFLUENT DISPOSAL METHODS

Disposal of effluent was a critical consideration in the overall wastewater management plan in the 1980 Facilities Plan. Effluent disposal alternatives considered in 1980 included:

1. Ocean Outfall Disposal (existing method of disposal),

2. Injection Wells, and

3. Reclamation and Wastewater Reuse.

In the selection of a disposal alternative, consideration was given not only to financial factors but also to the impact on the environment. Salient features of several effluent disposal methods were described to point out peculiarities of the service area that had significant bearing on the systems design. Maintaining the existing ocean outfall disposal system is recommended in the 1980 Facilities Plan for the following reasons:

1. Reliability (repairs currently underway on the existing outfall will further increase reliability of the system),

2. Effectiveness,

3. Lower operation and maintenance costs,

4. Cost comparison of alternative disposal methods in the 1980 Facilities Plan indicated outfall to be the least expensive.

A reevaluation of the effluent disposal alternatives was performed to reevaluate the selected method of effluent disposal in this Facilities Plan Amendment. The same three alternatives considered in the 1980 Facilities Plan were again deemed the most viable alternatives by the Citizens Advisory Group. These alternatives were evaluated for feasibility, cost-effectiveness and environmental impacts.

Two studies were conducted to assist in the evaluation process. These include:

1. *Suitability of Hilo STP Site for Injection Wells,* by John F. Mink and Frank L. Peterson, February 29, 1988. (See Appendix E)

2. *Evaluation of Injection Wells for Disposal of Wastewater Effluent at Hilo Wastewater Treatment Plant, Hilo, Hawaii,* by Harding Lawson Associates, August 30, 1988. (See Appendix F)

OCEAN OUTFALL

This is the present method of effluent disposal from the existing wastewater treatment plant. Water quality impacts of the present discharge are not discernible in water quality sampling results (see Chapter V, 1980 Facilities Plan), and the impact of the discharge at the existing outfall is not measurably detrimental to the surrounding biological communities. No illnesses or beach closures have been attributed to the outfall (personal communication, H. Matsuura, Dept. of Health, August 16, 1988).

The 1980 Facilities Plan assumed that the existing outfall would have to be extended to approximately 70- to 90-foot depth of water, which would involve an extension of about 2,000 feet. This, however, was contingent upon EPA approval of the Section 301(h) primary discharge permit. Since receiving water quality data shows no significant impacts with the existing primary discharges and the proposed level of treatment will be upgraded to secondary, extension of the outfall may not be necessary. An ongoing monitoring effort is presently underway to further assess the existing water conditions in the Hilo Bay area.

Based on the proposed wastewater treatment facility location at the southeast end of Hilo Airport and maintaining the present method of effluent disposal through the existing outfall, an estimated capital cost of approximately $7.5 million with an estimated annual O&M of $24,500 is anticipated (see Table V-6). This equates to an annual present worth cost of approximately $791,000. This cost includes approximately 14,200 linear feet of gravity main which will return the effluent from the plant site to the ocean outfall.

INJECTION WELLS

Two previously cited studies were conducted to assess the suitability of injection well disposal of wastewater effluent from the proposed wastewater treatment plant. Recommendations and findings from these two reports were used to establish a preliminary injection well disposal system from which a system cost could be developed and compared with the present method of effluent disposal.

Criteria which were considered in the siting of this injection well disposal system include:

1. All wells should be sited seaward of the Underground Injection Control (UIC) line -- DOH Administrative Rules (Chapter 23).

2. Adjacent well spacing required to assure no interference between plumes is approximately 2,200 feet -- Harding Lawson study.

3. Recommended number of wells required to accommodate the wastewater design flow of 3,470 gpm (5 mgd) is five wells (4 wells + 1 well standby) -- Harding Lawson study.

4. A minimum 10,000 feet separation must be maintained between any body of water which might attract birds, i.e., the effluent storage pond, and any jet runway airport. The concern is that sewage treatment facilities can attract birds that pose potential bird strike hazards to aircraft -- Federal Aviation Administration (FAA) regulation.

TABLE V-6

ESTIMATED COST FOR MAINTAINING
THE EXISTING OUTFALL DISPOSAL SYSTEM

CAPITAL COSTS

Item	Description	Quantity	Unit	Unit Price	Total
1	Gravity Main (Cost Savings)	14,200	LF	$ 530	$6,541,000
				Subtotal Cost:	$6,541,000
				15% Contingencies:	981,150
				Estimated Construction Cost (1):	7,522,200
				Annual Capital Cost:	766,500

[($7,522,200 x 0.1019), i = 8%, n = 20]

O&M COST

Item	Description	Annual Cost
1	Outfall	$ 11,400
2	Efluent line	13,100
	Annual O&M Cost:	$ 24,500
	Total Annual Cost:	$ 791,000

(1) Does not include land cost or design, legal, administrative and overhead costs.

Anticipated system costs are listed in Table V-7. These costs are based on the development of an effluent storage pond site located to the southeast of the proposed plant site and adjacent to the South Hilo/Puna District line. This would maintain an approximate 10,000-foot separation with the existing or any anticipated extension of Hilo's General Lyman Field. Associated costs which are required for this disposal alternative include a pump station and force main to transport the effluent from the plant site to the storage pond site, infrastructure piping between injection wells and an access roadway to the site. No provisions for replacement wells have been added to this cost due to the exceedingly high injection capacity and low clogging potential (Mink & Peterson, 1988). Also not included are any land acquisition costs.

It is estimated that this disposal system would cost approximately $9.5 million with an estimated annual O&M of $90,000. This equates to an annual present worth cost of approximately $1.05 million.

LAND TREATMENT

Land treatment is defined as the controlled application of wastewater onto the land surface to achieve a designed degree of treatment through natural physical, chemical, and biological processes within the plant-soil-water matrix.

The three most common land treatment processes include overland flow, slow rate, and rapid infiltration. Since the soil horizons are relatively thin and irregular, a slow rate sprinkler application system to existing vegetation is assumed to be the most practicable. Slow rate land treatment is the application of wastewater to a vegetated land surface with the applied wastewater being treated as it flows through the plant-soil matrix. This method of land treatment would maximize any nutrient uptake by existing plant vegetation.

The land area required for disposing of 5.0 mgd average flow at an application rate of 3 inches/week (EPA: *Innovative and Alternative Technology Manual*, MCD-53, February 1980) is approximately 430 acres.

Anticipated system costs are listed in Table V-8. These costs are based on the development of an effluent storage pond site similar to the one developed for the injection well alternative. Sited in the same general vicinity of the South Hilo/Puna District line, this location will maintain the required separation from Hilo's General Lyman Field. Similar associated costs required for this system include a pump station and force main, infrastructure piping, and an access roadway to the site. Land acquisition cost is not included.

It is estimated that this disposal system would cost approximately $13.8 million with an estimated annual O&M of $100,000. This equates to an annual present worth cost of approximately $1.41 million.

TABLE V-7

ESTIMATED COST OF A 5.0-mgd
(AVERAGE FLOW) INJECTION WELL DISPOSAL SYSTEM

CAPITAL COSTS

Item	Description	Quantity	Unit	Unit Price	Total
1	Access Roadway	6,000	LF	$130/LP	$ 780,000
2	Pump Station	LS	--	--	1,500,000
3	Force Main (from plant site to storage pond)	6,000	LF	$500/LF	3,000,000
4	Storage Pond	LS	--	--	700,000
5	Well Piping System (gravity)	5,000	LF	$300/LF	1,500,000
6	Wells	5	EA	$150,000 ea.	750,000
				Subtotal Cost:	$8,230,000
				15% Contingencies:	1,234,500
				Estimated Construction Cost (1):	9,464,500
				Annual Capital Cost:	964,400

($9,464,500 x 0.1019), i = 8%, n = 20

O&M COST

Item	Description	Annual Cost
1	Pond O&M and Cleaning	$ 40,000
2	Wells and Pumps (including well back finishing)	50,000
	Annual O&M Cost:	$ 90,000
	Total Annual Cost:	$1,054.400

(1) Does not include land cost or design, legal, administrative and overhead costs.

TABLE V-8

ESTIMATED COST OF A 5.0-MGD
(AVERAGE FLOW) LAND TREATMENT DISPOSAL SYSTEM

CAPITAL COSTS

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL
1	Access Roadway	7,000	LF	$130/LF	$ 910,000
2	Pump Station	LS	--	--	$1,500,000
3	Force Main (from Plant Site to Storage Pond)	7,000	LF	$500/LF	3,500,000
4	Storage Pond	LS	--	--	700,000
5	Land Application Piping System	18,000	LF	$300/LF	5,400,000
				Subtotal Cost:	12,010,000
				15% Contingencies:	1,801,500
				Estimated Construction Cost (1) :	13,811,500
				Annual Capital Cost:	1,407,400

($13,811,500 x 0.1019), i = 8%, n = 20

O&M COST

ITEM	DESCRIPTION	ANNUAL COST
1	Pond O&M and Cleaning	$ 40,000
2	Land maintenance	60,000
	Annual O&M Cost:	100,000
	Total Annual Cost:	$1,507,400

(1) Does not include land cost or design, legal, administrative and overhead costs.

EFFLUENT DISPOSAL RECOMMENDATION

An evaluation of these three effluent disposal alternatives identified several key points which were used in the overall selection process. These points are:

1. Ocean outfall

   - The existing outfall is a proven method of effluent disposal with no illnesses or beach closures attributed to the outfall.

   - This alternative has an annual present worth cost of approximately $791,000.

2. Injection well

   - Because of the very high transmissivities and groundwater flow rates in the region, the wastewater plume will be restricted over a relatively narrow distance (about 1,000 feet at the coast) and mixing effects will be minor; thus essentially a continuous slug of undiluted wastewater can be expected to discharge into the ponds and along the coast (Mink & Peterson).

   - A mathematical model of contaminant transport assuming various scenarios resulted in nitrogen concentration at Kionakupahu and Lokoaka Ponds between 1.5 - 6.8 mg/l (Harding Lawson).

   - The state water quality standard, Title 11, Chapter 54, for acceptable total nitrogen levels (geometric mean) for inland water areas, i.e. anchialine pools, is 0.25 mg/l (Dept. of Health).

   - The direction of groundwater flow is assumed to be towards the ponds because there is evidence of large concentrated groundwater discharge at the pond (Harding Lawson).

   - Increased nutrients would probably cause more environmental impact to the ponds than to coastal water (Harding Lawson).

   - This alternative has an annual present worth cost of approximately $1.05 million.

3. Land treatment

   - Land application presents an environmental hazard because of the potential for direct exposure of the public to effluent. An area for land application could be cordoned off, but would not be practical because of the required size, including buffer area. High winds could generate some fugitive aerosols even with the use of slow rate sprinklers.

- This alternative has an annual present worth cost of approximately $1.51 million.

Injection wells would have the most severe environmental impact of the three preceding alternatives. Land application impacts are dependent upon the specific site of application, rate of application, soil type, and vegetation cover. Since no potential acceptors have been identified, however, hydrologic model studies would not be very practical at this time. Land application is expected to have a less severe impact than injection wells. Land application would probably have impacts no better and probably worse than an ocean outfall discharge because it would impact the sensitive nearshore environment, which has very low capacity for dilution.

An alternate method of effluent disposal was considered by the State of Hawaii, Department of Agriculture, in a study entitled *Feasibility of Hilo Land Reclamation Using Reclaimed Soil From Pepeekeo Mill*. This study conducted by W.A. Hirai & Associates, Inc., in March 1982 looked at the feasibility of combining the effluent from the Hilo sewage treatment plant with the soil slurry from Pepeekeo Mill and disposing of the effluent by deposition along witht he soil at the Panaewa land reclamation site. This alternative was discounted for the following reasons:

1. High cost factor - Total capital costs for the project, including the soil slurry preparation and conveyance system, land reclamation system and effluent co-disposal option, were estimated to be approximately $24.1 million (1982 dollars).

2. Impact - Co-disposal of effluent with soil slurry would impact the sensitive nearshore environment due to the nutrients within the effluent as well as the slurry material.

G. SOLIDS DISPOSAL METHODS

There are two alternatives available for disposal of sludge, incineration or landfill. Incineration was considered in the 1980 Facilities Plan and rejected because of high capital and O&M costs. The 1988 Plan continues to recommend disposal by landfill.

H. NO PROJECT ALTERNATIVE

If there is no project, the existing plant will continue in operation. The county will not be able to meet EPA and state requirements and will violate the court order imposed upon it, thus subjecting the county to additional enforcement action and heavy fines. Grant monies will not be received and spent. Existing odor problems with the old sewage treatment plant can be expected to continue.

CHAPTER VI

RELATIONSHIP TO LAND USE PLANS, POLICIES AND CONTROLS

A. STATE

HAWAII STATE PLAN

The proposed action to build a new secondary treatment plant, pump station and sewer main is consistent with the Hawaii State Plan's objectives and policies to improve water quality and provide sewerage facilities to support physical and economic activities. These objectives and policies are contained in the *Hawaii State Plan Revised* adopted by the Hawaii State Legislature in May, 1986.

The Hawaii State Plan objectives for the physical environment include "the maintenance and pursuit of improved quality in Hawaii's land, air, and water resources." Policies to achieve these objectives include "promote effective measures to achieve desired quality in Hawaii's surface, ground, and coastal waters."

The Hawaii State Plan also includes objectives and policies for solid and liquid waste disposal systems. The two objectives are:

1. Maintenance of basic public health and sanitation standards relating to treatment and disposal of solid and liquid wastes.

2. Provision of adequate sewerage facilities for physical and economic activities that alleviate problems in housing, employment, mobility, and other areas.

To achieve these objectives, it is the policy of the state to:

1. Encourage the adequate development of sewerage facilities that complement planned growth.

2. Promote reuse and recycling to reduce solid and liquid wastes and employ a conservation ethic.

3. Promote research to develop more efficient and economical treatment and disposal of solid and liquid wastes.

HAWAII COASTAL ZONE MANAGEMENT PROGRAM

The Hawaii Coastal Zone Management Program has established objectives and policies to protect, preserve, and where possible, restore or enhance the natural and man-made resources within the coastal zone, which includes the entire island of

Hawaii except for the Forest Reserve areas. The program reviews federal programs, licenses, and permits, and state programs receiving federal funding for consistency with the state program. Consistency review of proposed actions is coordinated by the Office of State Planning. The proposed project furthers the objective of coastal zone management to improve water quality.

OTHER STATE PLANS AND PROGRAMS

The proposed action is consistent with the *Water Quality Management Plan for the County of Hawaii* (1980), a joint effort of the Hawaii State Department of Health and the County of Hawaii. This plan sets forth the measures needed to achieve water quality goals. These include expanding sewerage systems and upgrading sewage treatment methods, as appropriate for receiving waters.

The proposed project is entirely with lands designated as Urban by the State Land Use Commission. Urban lands are under the exclusive jurisdiction of the counties.

B. COUNTY

The *Hawaii County General Plan*, adopted in 1971, provides policy guidance for land development and other activities for the County of Hawaii. The plan is presently in the process of being revised and updated. Policies and courses of action described below are from the 1987 Draft Plan.

The County General Plan contains several policies supporting protection and enhancement of water quality, including upgrading sewage treatment systems and construction of new systems. The plan states that "disposal of raw sewage directly into waterways and the ocean shall be discontinued as soon as possible." Specific courses of action are prescribed for each of the districts in the county. For South Hilo, these include:

1. Expand the existing sewer collection system to include interceptors and pump stations.

2. Construct a new treatment plant to eventually provide either advanced primary or secondary treatment of incoming sewage flows.

The site of the proposed sewage treatment plant is in an area zoned for industrial use. The plant, pump station, and other appurtenant structures will be designed and built to conform to all county building codes and standards.

C. PERMITS AND APPROVALS

A list of applicable reviews, permits and approvals is shown in Table VI-1. Clearance from the Federal Aviation Administration has already been received. The other permits and approvals will be obtained after designs are completed.

TABLE VI-1

APPLICABLE REVIEWS, PERMITS, AND/OR APPROVALS

AGENCY AND PERMIT	LEGISLATION OR REGULATION	CONCERN
Federal Aviation Agency		
Clearance for construction	40 Code of Federal Regulations 77	Airport safety
Department of Health (DOH)		
National Pollution Discharge Elimination System (NPDES) Discharge Permit	Clean Water Act (33 USC 1251 et seq.) Hawaii Revised Statutes, Chapter 342 DOH Adminstrative Rules, Title 11, Chapter 55	Water quality, public health
Zone of Mixing	Hawaii Revised Statutes, Chapter 342 DOH Adminstrative Rules, Title 11, Chapter 54	Water quality, public health
Authority to Construct or Modify a Facility: Permit to Operate	Clean Air Act (42 USC 1857h-7 et seq.) Hawaii Revised Statutes, Chapter 34 DOH Adminstrative Rules, Title 11, Chapters 59 and 60	Odor control performance (air quality, public health)
Hawaii County Planning Dept.		
Special Management Area Permit	Hawaii Revised Statutes, Chapter 205A	Environmental impacts of construction in coastal zone
Hawaii County Dept. of Public Works		
Grading, Grubbing & Stockpiling	County of Hawaii Ordinance No. 168	Environmental impacts of earth moving activities

CHAPTER VII

AGENCIES, ORGANIZATIONS AND INDIVIDUALS CONSULTED DURING PREPARATION OF THE DSEIS

A. COMMENTS AND RESPONSES

The Supplemental Environmental Impact Statement Notice of Preparation (NOP) for the proposed Hilo Wastewater Treatment and Conveyance Facility was published in the *OEQC Bulletin* on June 23, 1988. The thirty-day review period announced in the *OEQC Bulletin* ended on July 25, 1988. All comments received were acknowledged. A total of 16 letters were received; 10 expressed "no comment" and therefore did not require a response. The following agencies, organizations, and individuals received copies of the Environmental Assessment and NOP. Those identified with an asterisk (*) responded; respondents with substantial comments are identified by double asterisks (**) and their comments are included in this section of the draft SEIS.

FEDERAL

Army Corps of Engineers
Department of Agriculture
    Soil and Conservation Service
Department of the Interior
* Fish and Wildlife Service
    Geological Survey
Environmental Protection Agency

STATE

* Department of Agriculture
* Department of Accounting and General Services
* Department of Business and Economic Development
* Department of Defense
    Department of Hawaiian Home Lands
** Department of Health
* Department of Human Services
        Hilo District Health Office, DOH
** Department of Land and Natural Resources
* State Historic Preservation Office, DLNR
** Department of Transportation
    Office of Environmental Quality Control

University of Hawaii
- Environmental Center
- Water Resources Research Center

Senator Robert N. Herkes
Senator Richard Matsuura
Senator Malama Solomon
Senator Mamoru Yamasaki
Representative Andrew Levin
* Representative Wayne Metcalf
Representative Dwight Takamine
Representative Virginia Isbel

COUNTY OF HAWAII

Office of the Mayor
County Council
Department of Planning
Department of Parks and Recreation
Department of Research and Development
** Department of Water

ORGANIZATIONS AND INDIVIDUALS

American Lung Association
Conservation Council of Hawaii, Hawaii Island Chapter
Hawaii Audubon Society
Hawaii Island Chamber of Commerce
* Hawaiian Electric Company
Hilo Chamber of Commerce
Keaukaha Panaewa Community Association
Kokua Hilo Bay
** Leleiwi Community Association
* Office of Hawaiian Affairs
Panaewa Community Association
Native Hawaiian Association
** Sierra Club, Hawaii Chapter, Moku Loa Group

B. PREPARERS OF DSEIS

A list of the persons involved in the preparation of this draft supplemental environmental impact statement, the firms with which they are associated, and their areas of expertise and qualifications is presented in Table VII-1. Consultants received invaluable assistance from the Citizens Advisory Group who participated in the preparation of the update of the Facilities Plan. Members of the CAG are:

Robert Cooper, Hawaii Island Chamber of Commerce
Keoloa Kalauli, Keaukaha Panaewa Community Association
Bonnie Twitchel, KIAA
Steve Holmes, Kokua Hilo Bay
Linda Dela Cruz, Native Hawaiian Association
Lillian Kaeha, Panaewa Community Association
John Mannia, Native Hawaiian Association

Ex Officio Members:

Hugh Ono, Department of Public Works
Harold Sugiyama, Department of Public Works
Ronald Ibarra, Office of the Mayor
Fred Gianini, Deputy Corporation Counsel
Keith Kato, Planning Department
Merle K. Lai, County Council
Ronald Kokubun, County Council
Dennis Tulang, Department of Health
Donald Pakele, Department of Hawaiian Home Lands
Glenn Taguchi, Department of Land & Natural Resources
Frank Kamahele, Department of Transportation
Francis Sanpei, M&E Pacific, Inc.
Ed Harada, M&E Pacific, Inc.
Jim Lutz, Barrett Consulting Group
Scott Kvandal, Barrett Consulting Group
Donald Okahara, Okahara & Associates

TABLE VII-1

LIST OF EIS PREPARERS

NAME	FIRM	TITLE	EXPERTISE
Lambert Yamashita, PE	M&E Pacific	Project Manager	engineering
Winona P. Char M.S. Botanical Sciences	Char & Associates	Botanical Consultant	botany
Andrew J. Berger. Ph.D. Zoology	NA	Zoological Consultant	terrestrial vertebrates
Margaret L. K. Rosendahl, SOPA B.A..	Paul H. Rosendahl, Ph.D, Inc.	Supervisory Archaeologist	archaeology
John F. Mink	Mink & Yuen, Inc.	hydrological & geological consultant	geology/ hydrology
Frank L. Peterson	University of Hawaii	Associate Professor	geology
Jacqueline A. Parnell, AICP MCP	KRP Information Services	Environmental Planner	technical writing

United States Department of the Interior

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

IN REPLY REFER TO:
ES
Room 6307

JUL 7 1988

Mr. Hugh Y. Ono
Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96721

Re: Environmental Assessment and Notice of Preparation for Supplemental Environmental Impact Statement, Hilo Wastewater Treatment and Conveyance Facility, Hilo, Hawaii

Dear Mr. Ono:

We have reviewed the June 23, 1988 Environmental Assessment for the referenced project and offer the following comments for your consideration.

We understand the proposed sewage transmission main alignment from the proposed sewage treatment plant to the existing outfall at Puhi Bay will avoid Lokoaka and Kionakapahu fishponds. It appears that these wetland habitats for endangered Hawaiian waterbirds will not be adversely affected by the construction for this project. In view of this, we have no additional comments to offer at this time.

We appreciate the opportunity to comment.

Sincerely,

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

cc: ✓M & E Pacific, Inc.

JOHN WAIHEE
GOVERNOR

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

SUZANNE D. PETERSON
CHAIRPERSON, BOARD OF AGRICULTURE

ROBERT Y. TSUYEMURA
ACTING DEPUTY
TO THE CHAIRPERSON

Mailing Address:
P. O. Box 22159
Honolulu, Hawaii 96822-0159

July 25, 1988

COPY

Mr. Hugh Y. Ono, Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Subject: Environmental Impact Assessment and Preparation Notice (EIA & PN)
Hilo Wastewater Treatment and Conveyance Facilities
TMK: 2-1-13: Por. of 12, 13, 20 and 22
South Hilo, Hawaii
Area: Approx. 15 acres

The Department of Agriculture has reviewed the subject EIA & PN and has no comments to offer.

Thank you for the opportunity to comment.

Sincerely,

Suzanne D. Peterson

SUZANNE D. PETERSON
Chairperson, Board of Agriculture

cc: M & E Pacific, Inc.

F5

(P)1662.8

JUN 20 1988

Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Gentlemen:

Subject: Environmental Assessment and Notice of Preparation of a Supplemental Environmental Impact Statement for the Hilo Wastewater Treatment and Conveyance Facilities

We have reviewed the subject document and have no comments to offer.

Very truly yours,

T. Tominaga

TEUANE TOMINAGA
State Public Works Engineer

LO:jk
cc: M&E Pacific, Inc.

DEPARTMENT OF BUSINESS AND ECONOMIC DEVELOPMENT
KAMAMALU BUILDING, 250 SOUTH KING ST., HONOLULU, HAWAII
MAILING ADDRESS: P.O. BOX 2359, HONOLULU, HAWAII 96804 TELEX: 7430250 HIDPED

JOHN WAIHEE, GOVERNOR
ROGER A. ULVELING, DIRECTOR
BARBARA KIM STANTON, DEPUTY DIRECTOR
LESLIE S. MATSUBARA, DEPUTY DIRECTOR

Ref. No. P-8529

July 8, 1988

The Honorable Hugh Y. Ono, P.E.
Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Subject: Environmental Assessment and Notice of Preparation of a Supplemental Environmental Impact Statement for the Hilo Wastewater Treatment and Conveyance Facilities, South Hilo, Hawaii

We have reviewed the subject document and do not have any comments to offer at this time. Thank you for the opportunity to review this proposal.

Sincerely,

ORIGINAL SIGNED BY
ROGER A. ULVELING

Roger A. Ulveling

cc: ✓M&E Pacific, Inc.

RECEIVED JUL 8 '88

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE ADJUTANT GENERAL
3949 DIAMOND HEAD ROAD, HONOLULU, HAWAII 96816-4495

Engineering Office

06 JUL 1988

Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Sir:

Environmental Assessment and Notice of Preparation of a Supplemental Environmental Impact Statement for the Hilo Wastewater Treatment and Conveyance Facilities, Hilo District, South Hilo, Hawaii

Thank you for providing us the opportunity to review the subject project.

We have no comments to offer at this time regarding this project.

Sincerely,

SIGNED

Jerry M. Matsuda
Major, Hawaii Air
National Guard
Contr & Engr Officer

Enclosure

cc: M&E Pacific, Inc.

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
Department of Human Services
HAWAII HOUSING AUTHORITY
P. O. BOX 17907
HONOLULU, HAWAII 96817

Joseph K. Conant
Acting Executive Director

IN REPLY REFER TO:

88:PLNG/1088 JT

July 8, 1988

Mr. Hugh Y. Ono
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Re: Environmental Assessment and Notice of Preparation of a Supplemental Environmental Impact Statement for the Hilo Wastewater Treatment and Conveyance Facilities

We have reviewed the subject document and have no comments to offer.

Thank you for the opportunity to comment.

Sincerely,

JOSEPH K. CONANT
Acting Executive Director

cc: M&E Pacific

JOHN WAIHEE
GOVERNOR OF HAWAII

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

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

In reply, please refer to:
EPHSO

August 2, 1988

MEMORANDUM

To: Mr. Hugh Y. Ono, Chief Engineer
Department of Public Works, County of Hawaii

From: Deputy Director for Environmental Health

Subject: Environmental Assessment (EA) and Notice of Preparation of a Supplemental Environmental Impact Statement (SEIS) for the Hilo Wastewater Treatment and Conveyance Facilities, Hilo District, South Hilo, Hawaii

Thank you for allowing us to review and comment on the subject EA and SEIS. We provide the following comments:

Environmental Permits Branch

The odor controls will require an air permit.

Also, NPDES and Zone of Mixing Permits will be required.

Wastewater Treatment Works Construction Grants Branch

Comments and review will occur with the Facilities Plan.

BRUCE S. ANDERSON, Ph.D.

cc: DHO, Hawaii

DEPARTMENT OF PUBLIC WORKS
COUNTY OF HAWAII • 25 AUPUNI STREET • HILO, HAWAII 96720 • TELEPHONE (808) 961-8321

September 20, 1988

MR. BRUCE S. ANDERSON, Ph.D.
DEPARTMENT OF HEALTH
STATE OF HAWAII
P.O. BOX 3378
HONOLULU, HAWAII 96801

SUBJECT: HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES
NOTICE OF PREPARATION OF SUPPLEMENTAL EIS

Thank you for your letter of August 2, 1988 concerning the subject Notice of Preparation. Your comments are appreciated. Responses to your comments are provided below in the order they appear in your letter.

1. Environmental Permits Branch:

Air, NPDES and Zone of Mixing Permits will be processed with the Environmental Permits Branch.

2. Wastewater Treatment Works Construction Grants Branch:

All comments and reviews on the Facilities Plan Amendment will be processed with the Wastewater Treatment Works Construction Grants Branch.

We appreciate the comment expressed by your agency.

HUGH Y. ONO, P.E.
Chief Engineer

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

FILE: 88-592
DOC.: 3886E

AUG 1 1988

The Honorable Hugh Y. Ono, Chief Engineer
County of Hawaii
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

SUBJECT: Environmental Assessment and Notice of Preparation of a Supplemental Environmental Impact Statement for the Hilo Wastewater Treatment and Conveyance Facilities, South Hilo, Hawaii
TMK: 2-1-12: 9 and 2-1-13: 1, 4 & 143

Dear Mr. Ono:

Thank you for giving our Department the opportunity to comment on this matter. We have reviewed the materials you submitted and have the following comments.

We note no reference to outdoor recreation. The potential adverse impact on outdoor recreation areas and outdoor recreation activities, if any, should be addressed in the DEIS.

Thank you again for your cooperation in this matter. Please feel free to call me or Jay Lembeck of our Office of Conservation and Environmental Affairs, at 548-7837, if you have any questions.

Very truly yours,

WILLIAM W. PATY, Chairperson
Board of Land and Natural Resources

DEPARTMENT OF PUBLIC WORKS
COUNTY OF HAWAII • 25 AUPUNI STREET • HILO, HAWAII 96720 • TELEPHONE (808) 961-8321

September 20, 1988

MR. WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
STATE OF HAWAII
P. O. BOX 621
HONOLULU, HAWAII 96809

SUBJECT: HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES
NOTICE OF PREPARATION OF SUPPLEMENTAL EIS

Thank you for your letter of August 1, 1988 concerning the subject Notice of Preparation. Your comments are appreciated.

In response to your comments concerning the potential adverse impact on outdoor recreation areas and activities, the proposed wastewater treatment plant site, access roadway and pipeline alignment areas are presently not available to the general public for recreational use. It is the County of Hawaii's intent to transform the existing Hilo wastewater treatment facility site, except for a pump station facility and some supporting structures, to park use upon the completion of and start up of the new facility. The SEIS will discuss outdoor recreation.

We appreciate the comments expressed by your agency.

HUGH Y. ONO, P.E.
Chief Engineer

RECEIVED JUL 1 8 1988

1626 FS

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

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

Mr. Hugh Ono, Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

SUBJECT: EA & Supplemental EIS Preparation Notice — Hilo Wastewater Treatment & Conveyance Facilities Waiakea, South Hilo, Hawaii

Thank you for the opportunity to comment.

Page III-6 of the document correctly summarizes the historic preservation review process conclusions. We have reviewed the archaeological survey report by PHRI. No historic sites were found. Therefore, the project will have "no effect" on significant historic sites.

Very truly yours,

WILLIAM W. PATY
Chairperson and State
Historic Preservation Officer

cc: M & E Pacific Inc.

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION

IN REPLY REFER TO
STP 8.3023

July 28, 1988

Mr. Hugh Y. Ono, Director
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Environmental Assessment and Notice of Preparation of a Supplemental Environmental Impact Statement for the Hilo Wastewater Treatment and Conveyance Facilities

By letter of June 22, 1988 (attached), our Airports Division expressed their concerns to you. Their comments are still valid and represent our position on your proposal to develop wastewater treatment facilities for Hilo.

Thank you for this opportunity to provide comments.

Very truly yours,

Edward Y. Hirata
Director of Transportation

Attachment

JUN 22 1988

AIR-E
88.2013

Mr. Hugh H. Ono, P.E.
Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Subject: Hilo Wastewater Treatment Plant Facility
Easement Request

In reply to your June 6, 1988 letter regarding the subject matter, the Airports Division has no objections to the basic concept and siting of the facilities. However, in view of the master plan and noise compatibility study now underway, a number of concerns remain unresolved. They are as follows:

1. The noise compatibility study preliminarily indicated that an earth berm constructed along the north boundary could be affected by that location of the pipeline. Location of the pipeline within the Hawaiian Homes subdivision or in the area between the runway safety area and the proposed berm are alternates that may be acceptable.

2. The pipeline crossing within the approach to Runway 26 should be located not only outside of the extended runway safety area but at a distance where the highest anticipated equipment to construct, repair, maintain, or replace the pipeline will not penetrate the approach surface.

3. We have assumed that FAA has been consulted on the location of the plant itself since it is located east of the FAA ASR facility.

Should you have any questions on this matter, please contact us.

Very truly yours,

Owen Miyamoto

OWEN MIYAMOTO
Airports Administrator

DEPARTMENT OF PUBLIC WORKS

COUNTY OF HAWAII • 25 AUPUNI STREET • HILO, HAWAII 96720 • TELEPHONE (808) 961-8321

HUGH Y. ONO
Chief Engineer

BRUCE C. MCCLURE
Deputy Chief Engineer

September 20, 1988

MR. EDWARD Y. HIRATA, DIRECTOR
DEPARTMENT OF TRANSPORTATION
STATE OF HAWAII
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

SUBJECT: HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES
NOTICE OF PREPARATION OF SUPPLEMENTAL EIS

Thank you for your letter of July 28, 1988 concerning the subject Notice of Preparation. Your comments are appreciated. Responses to your comments as referenced in your letter of June 22, 1988, are provided below in the order they appear in your letter.

1. Earth berm coordination:

As presented in our July 15, 1988, meeting with DOT, Airports Division and FAA, the preferred siting of the transmission pipelines is in the area between the runway safety area and the proposed berm. The coordination between these two proposed efforts will be closely monitored both during the planning and design stages.

2. Pipeline crossing within the approach to Runway 26:

The pipeline crossing within the approach to Runway 26 will be located outside of the proposed extended runway safety area and at a distance where the highest anticipated equipment to construct, repair, maintain, or replace the pipeline will not penetrate the approach plane. Again, coordination between these two proposed efforts will be closely monitored both during the planning and design stages.

3. FAA coordination of plant site location:

FAA's Notice of Proposed Construction (Form 7460-1) has been processed by the Western-Pacific Regional Office, Air Traffic Division AWP-530 and issued on August 23, 1988. Also, coordination meeting such as the one held on July 15th at the DOT, Airports Division, will be scheduled on an as needed basis to resolve any problems.

We appreciate the comments expressed by your agency.

HUGH Y. ONO, P.E.
Chief Engineer

HOUSE OF REPRESENTATIVES
THE FOURTEENTH LEGISLATURE

STATE OF HAWAII
STATE CAPITOL
HONOLULU, HAWAII 96813

July 1, 1988

Hugh Y. Ono
Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

I acknowledge receipt of and thank you for the EIS for the Hilo Wastewater treatment and conveyance facilities. I have no comments on the project at this time, however please be assured that I will forward any concerns that might arise at a later time.

With warm personal regards.

Sincerely,

WAYNE METCALF
Chairman
House Committee on Judiciary

COPY

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
25 AUPUNI STREET • HILO, HAWAII 96720

July 15, 1988

TO: Department of Public Works

FROM: H. William Sewake, Manager

SUBJECT: ENVIRONMENTAL ASSESSMENT
HILO WASTE WATER TREATMENT AND CONVEYANCE FACILITIES

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

Water demand figures should be included in the report.

H. William Sewake

H. William Sewake
Manager

CS

cc - M&E Pacific, Inc.

... Water brings progress...

DEPARTMENT OF PUBLIC WORKS

COUNTY OF HAWAII • 25 AUPUNI STREET • HILO, HAWAII 96720 • TELEPHONE (808) 961-8321

HUGH Y. ONO
Chief Engineer

BRUCE C. McCLURE
Deputy Chief Engineer

September 20, 1988

MR. H. WILLIAM SEWAKE, MANAGER
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII
25 AUPUNI STREET
HILO, HAWAII 96720

SUBJECT: HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES
NOTICE OF PREPARATION OF SUPPLEMENTAL EIS

Thank you for your letter of July 15, 1988 concerning the subject Notice of Preparation. Your comments are appreciated.

In response to your comment concerning water demand for the proposed wastewater treatment plant, the anticipated water demand for this facility is based on the following uses:

Daily Demand:		
Sanitary use	40 gpm	
Equipment operation requirements	5 gpm	
Treatment process	70 gpm	
	115 gpm	(8 hour work day)
Fire Protection and Emergency Demand:		
Fire protection	750 gpm	(1 hour duration)
Emergency showers and eye washes	20 gpm	
	770 gpm	

(Note:. These water demand figures are preliminary in nature and are subject to change. The Department of Water Supply will be kept apprised of any changes in these water demand figures.)

We appreciate the comment expressed by your agency.

HUGH Y. ONO, P.E.
Chief Engineer

Hawaii Electric Light Company, Inc. • PO Box 1027 • Hilo, HI 96721-102

July 20, 1988

Department of Public Works
County of Hawaii
25 Aupuni St.
Hilo, HI 96720

Gentlemen:

Subject: Environmental Assessment
Hilo Wastewater Treatment & Conveyance Facilities

We have reviewed the subject environmental assessment and have no comments to offer at this time. Thank you for allowing us the opportunity to review the document.

Very truly yours,

Clyde H. Nagata, Manager
Engineering Department

CHN:ia

cc: H&E Pacific, Inc.

An HEI Company

July 21, 1983

Hugh Ono, Chief Engineer
Department of Public Works
County of Hawaii
Hilo, Hawaii 96720

Re: Hilo Wastewater Treatment and Conveyance Facilities Supplemental Environmental Impact Statement

We, the residents of the Keaukaha District, represented by the Leleiwi Community Association live within one mile along the shoreline area of the present Hilo sewage treatment facility and sewage outfall pipe. There are 150 homes and 300 condominium units with over 2000 people residing in the Leleiwi-Keokea Loop Road area. This is also one of the most popular areas of the Hilo District, hundreds of people visit this shoreline daily for recreation and sustenance from the ocean. We believe, therefore, that it is imperative to protect and preserve this land and ocean area from contamination of any kind, not just for ourselves, but also for future generations.

Therefore, we request the following questions be answered in the EIS:

1. Why was the ocean outfall method for disposal of the effluent chosen over other methods?
2. Will the aging pumping stations be upgraded or replaced?
3. Would the pumping station be moved from Puhi Bay to an inland site? If not, why?
4. Are nutrients removed in secondary treated sewage? What would be their effect on the ocean waters?
5. What is the guarantee that the pump would not break down or other breakdowns occur that would cause spills of untreated sewage entering the ocean?
6. What is the guarantee that a repaired outfall pipe in the ocean would not leak and/or be damaged by wave action or tsunamis as it has in the past?
7. How will rainstorm runoff be handled? Does it go into the ocean untreated? How will the method of ocean outfall avoid spills from storm overload?
8. What is the risk analysis of public health from accidental spills of raw sewage?
9. Describe other alternatives to ocean outfall for the effluent. What other cities are using what other methods and why?

10. Describe land application methods of disposing effluent. Describe other cities processes of land application and uses. What are the costs or profits to these citie
11. Give evidence why ocean outfall is more economically feasible than other methods. Give an economic analysis comparing methods. Discuss the pros and cons of the differ methods.
12. How will residents afford the high cost of hook-up to the system? Describe how and when residents will be required to hook-up. Describe what government assistance will be available. Are there ways residents will be able to amortize the cost.
13. Concerning the present sewage treatment plant, what are you going to do about the present stench? Does the present outfall pipe leak? How is it going to be repaired & when? Will these problems continue until the new plant is built or will there be a way to alleviate the problems?
14. When will the Ice Pond near Harringtons be cleaned up and open again to the public? Why was it closed?
15. What is the past history of the outfall pipe? Has it not leaked and been in disrepa for most of the time it has been used?

The primary reason we oppose ocean outfall for future use is because of its poor pas record since the day it was installed.

We know many other cities have found alternatives for disposing of the sewage effluen other than by means of their waterways. Although we realize not all situations are similar, we believe it is imperative to find another method for the Hilo system.

We would appreciate these questions answered fully and in addition request a public hearing be held for a sharing of information by and for the public.

Sincerely,

Jan Moon

Jan Moon, Director/Secretary
Leleiwi Community Association
121 Lokoaka Street
Hilo, Hawaii 96720

DEPARTMENT OF PUBLIC WORKS
COUNTY OF HAWAII · 25 AUPUNI STREET · HILO, HAWAII 96720 · TELEPHONE (808) 961-8321

September 20, 1988

LELEIWI COMMUNITY ASSOCIATION
121 LOKOAKA STREET
HILO, HAWAII 96720

ATTENTION: JAN MOON, DIRECTOR/SECRETARY

SUBJECT: HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES
NOTICE OF PREPARATION OF SUPPLEMENTAL EIS

Thank you for your letter of July 21, 1988 concerning the subject Notice of Preparation. Your comments and suggestions are appreciated. All of the questions you raised will be addressed in the SEIS. A brief response to each of your comments is provided below in the order presented in your letter.

1. Ocean outfall disposal

Continuing to use the existing ocean outfall for disposal of effluent was selected due to the concern of contaminating coastal and inland waters and because it is the most cost-effective method of disposal at this time. Other disposal options, including underground injection and land application were considered and are discussed in the SEIS. Ultimately, recycling and reuse of wastewater is the preferred method of disposal. However, no potential recipients willing to offer firm commitments for utilizing the projected 3.2 MGD effluent discharge have been identified. The use of the ocean outfall for effluent disposal will be continued until such time that the recyling and reuse option becomes feasible and economically viable.

2. & 3. Pump station

A new pump station will be built at the site of the existing sewage treatment plant. The new pump station will be provided with emergency power generation capability in order to minimize any potential failure resulting from power outages. The criteria utilized in selecting the pump station site is generally a function of topography. The new pump station site needs to be located at the existing sewage treatment plant site as it is the low point of the existing sewer system to which accepts gravity flow from both west and east tributary areas.

4. Nutrient removal

A relatively small percentage of nutrients are removed in secondary treatment. Given the small volume of the effluent discharge being mixed with the large volume of ocean water, there will be little discernible effect of nutrients on ocean waters.

5. Pump station breakdown

Precautionary measures against accidental spills are being incorporated into the design of the pump station, including standby power generation, duplication of pumps, and an alarm warning system. There are no guarantees that pumps or other mechanical equipment will not breakdown, however, mechanical equipment subject to failure is being duplicated. Emergency power backup systems to be utilized in case of emergencies will be described in the SEIS.

6. Outfall failure

There is no guarantee that the outfall pipe will withstand the effects of a devastating tsunami. Repairs to the outfall are currently under way.

7. Stormwater runoff

Stormwater runoff in Hilo is not collected in the sewer system, but through a separate storm water collection system and discharged untreated into the ocean at various locations. Therefore, rainstorms will have no appreciable impact on the wastewater systems ability to treat and dispose of the wastewater.

8. Accidental spills

If properly maintained, emergency power backup systems for the sewage pump stations and the new treatment plant should continue to allow normal operations without spills of raw sewage. Raw sewage from cesspools, on the other hand, will continue to adversely impact the environment. The purpose of the proposed Hilo Wastewater Treatment Plan and the proposed action is to <u>decrease</u> the amount of untreated or minimally treated sewage in the environment.

9. - 11. Disposal alternatives

Alternative disposal measures and the various rationales for each, including costs and benefits, will be discussed in the SEIS.

12. Financing hookups

Various alternative measures for financing sewerage system hookups is presently being pursued by the County of Hawaii. As these alternatives develop, public notification of the alternatives will be made.

13.a. Odors

The existing treatment plant will cease operation and a new pump station will be constructed on the same site. As noted in the previous response to your comments 2 and 3, pump station siting is a function of topography. Odor control facilities will be included with the new pump station. Interim odor mitigation measures such as the addition of chemical oxidants and masking agents are being attempted until the existing treatment plant ceases operation. Minimizing potential odor impacts was the primary reason for providing such a large uninhabited buffer zone around the proposed new treatment plant site. Provisions for odor control facilities will also be incorporated into the design of the new treatment plant.

13.b. Outfall

The outfall has suffered some minor storm damage. Repairs are already underway.

14. Ice Pond

The Ice Pond had been closed by the state Department of Health because of high bacteria levels attributable to cesspool seepage. Connecting some residences mauka (inland) of the pond to the sewer system has brought marked decreases in bacterial levels. The Department of Health continues to keep the Ice Pond closed as a precautionary measure, however, because high coliform levels still occasionally occur (personal communication with H. Matsuura, August 16, 1988). Until all residents in the area are connected to the sewer system, existing conditions will most probably continue.

15. History of the outfall pipe

The outfall pipe has operated properly throughout its history, excepting when damaged as a result of major storm events. Repairs have been made as quickly as possible following the detection of any such damage. In no instances has any past damage to the outfall posed any threat to the public. No illnesses or posted beach closures have ever been attributed to the outfall discharge (personal communication with H. Matsuura, August 16, 1988). The known recorded history of the outfall from construction to the present will be included in the EIS.

We appreciate the comments expressed by the Leleiwi Community Association. We are pleased that the community has such a strong willingness to support a clean environment and the necessary means to do so.

HUGH Y. ONO, P.E.
Chief Engineer

LY

RECEIVED SEP 27 1988

STATE OF HAWAII
OFFICE OF HAWAIIAN AFFAIRS

COPY

September 23, 1988

Hugh Y. Ono, Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Subject: Supplemental EIS Preparation Notice: Hilo Wastewater Treatment Plant and Conveyance Facilities, Hilo, Hawai'i.

Thank you for the opportunity to comment. Please send our office a copy of the Draft EIS when it becomes available.

Sincerely,

Kamaki A. Kanahele III

Kamaki A. Kanahele, III
Administrator

cc: M & E Pacific, Inc.

RECEIVED JUL 25 1988

SIERRA CLUB, HAWAI'I CHAPTER
P.O. BOX 11070, HONOLULU, HAWAI'I 96828
(808) 946-8494
MĀLAMA I KA HONUA - CHERISH THE EARTH

21 July 1988

M&E Pacific, Inc.
1001 Bishop St.; Pauahi Tower
Suite 500
Honolulu, HI 96813

Dear Sir or Madam:

The Sierra Club Clean Coastal Waters Task Force would like to respond to the notice of preparation for the supplemental EIS for the Hilo Wastewater Facility.

We protest the depiction of this document as a supplemental EIS because no public hearings were held regarding the 1980 Facilities Management Plan. While public hearings may not be required under Hawaii Revised Statutes, it most certainly is under the Code of Federal Regulations Title 40, Chapter 5, part 1506.6 rules governing public participation. This project is both heavily federally financed and federally regulated, therefore, it falls under the National Environmental Policy Act and all of it's conditions.

We, also, reject the earlier "supplemental" EIS for the outfall extension for the same reasons. Public hearings were requested and denied.

It is only fair that the public have should have the right to examine and challenge all of the documents involved in this very large publically financed project which has such large environmental and public health ramifications.

We reject the comments in the notice of preparation on the ocean outfall that conditions favoring an outfall as the disposal method haven't changed. Since 1980, major repairs have had to have been done on the outfall to repair damage. Public health has been repeatedly threatened by the failure of this disposal method. An EIS should include a thorough risk assessment of alternatives to the outfall compared with the future risk of failure if the outfall is perpetuated.

A great deal has been learned in the field of microbiology since the 1980 Facilities Plan. Sierra Club has enclosed several documents which show the fallacy of using fecal coliform as an indicator organism to determine the impacts of an ocean outfall on public health and marine organisms. The EIS should address concerns over the long-term surviveablity of pathogens, viral and bacterial and the impacts to public health if the outfall is perpetuated. The EIS should discuss fully the type of disinfection to be used. The Sierra Club is concerned that chlorination has serious environmental impacts if dechlorination doesn't follow. A discussion of ozonation and ultraviolet disinfection should be included.

A full treatment of land-based treatment options and water recycling should be included in the EIS. The plant site has been moved since the 1980 Facilities Plan enhancing the land-based disposal option. The EIS should include a dye testing and computer models of the hydrology in the plant site area given a number of different land-based disposal scenarios. The EIS should include an economic analysis of various land-based treatment options compared to the costs of building a return line from the relocated plant to the existing outfall and likely need for constant repairs to said outfall, replacement of that outfall during the projected life of the plant due to tsunami impacts and winter storm stress, and the costs of monitoring the outfall during it's lifetime for pollutants. Possible options should include piping the secondarily treated effluent to nearby agricultural areas, golf course irrigation, use as boiler make-up water for the nearby HELCO powerplant, or irrigation of the lush tropical vegetation in the lands surrounding the plant site or other adjacent lands. Hydrological models should be developed for each of these disposal options. The models should take into consideration the total acreage to be irrigated, nutrient uptake by various plants to be irrigated, pan evaporation rates, soil uptake of nutrients, the rate of flow of basal groundwater through the subject areas based on test wells rather than assumed models, and dilution ratios based on tested values using dye tests or similar techniques rather than assumed models.

An economic analysis should be made of improvements to treatment to enhance water reuse if land-based options are employed and improved treatment is found to be necessary before disposal.

An economic analysis of the ocean recreation industry in the Hilo area should be made and a discussion of the overall impacts continuing with ocean disposal would have on future growth in that industry. Impacts to tourism if beaches are posted closed due to ocean outfall failures should also be discussed. Puhi Bay has great potential for year-round water access for water recreational users if the use of an outfall pipe is discontinued. Many scuba divers and kayakers would benefit from close, easy access afforded at Puhi Bay.

An economic analysis should be included in the EIS to evaluate the impacts of water conservation measures such as greywater recycling, low-volume toilets, and low-volume showerheads.

A section in the EIS should be devoted to financing options to pay for sewage hookups for homeowners to mitigate financial impacts to the community and enhance public acceptance.

The EIS should include a discussion of backup generating capacity at the new plant.

The EIS should include an update of the feasibility of the co-disposal option discussed in the 1984 report by W.A. Hirai and Associates wherein mud from the Hilo Coast Processing Plant could be piped to the Panaewa area for land reclamation and co-mingling with the treated sewage effluent. The sugar industry is under tremendous pressure from the Environmental Protection Agency to not dump cane wash mud into the ocean. This would help the ailing sugar industry and provide soil for cover in the landfill operations in Hilo.

A tsunami impact risk analysis should be done for the outfall pipeline and the various pumping stations in the sewage system.

The EIS should include a discussion of improvements planned to the various pumping stations to handle increased loads and insure that failures don't occur like the one which dumped a million and a half gallons of raw sewage into Hilo Bay.

The Sierra Club Clean Coastal Waters Task Force in Hawaii looks forward to receiving the draft EIS and responding to it. We hope that efforts are made by the County of Hawaii and M&E Pacific to meet the requirements of federal as well as state environmental laws relating to this project to avoid litigation that would delay the project and threaten the loss of millions of dollars of Construction Grant money. Allowing public participation through hearings and a review of all of the documents would avoid needless delay. Meeting the other NEPA requirements for this EIS would ensure that public health is protected, the marine environment is protected, and the investment in taxpayers dollars is protected.

Sincerely,

Stephen A. Holmes

Stephen A. Holmes
Acting Regional Vice President

DEPARTMENT OF PUBLIC WORKS
COUNTY OF HAWAII · 25 AUPUNI STREET · HILO, HAWAII 96720 · TELEPHONE (808) 961-8321

HUGH Y. ONO
Chief Engineer

BRUCE C. McCLURE
Deputy Chief Engineer

September 20, 1988

MR. STEPHEN A. HOLMES
ACTING REGIONAL VICE PRESIDENT
SIERRA CLUB, HAWAII CHAPTER
P.O. BOX 11070
HONOLULU, HAWAII 96828

SUBJECT: HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES
NOTICE OF PREPARATION OF SUPPLEMENTAL EIS

Thank you for your letter of July 21, 1988 concerning the subject Notice of Preparation. Your comments and suggestions are appreciated. Responses to your comments are provided below in the order they appear in your letter.

1. Public hearings and citizen participation

The environmental impact statement (EIS) prepared in 1980 for the Hilo Wastewater Management Plan and the supplemental environmental impact statement (SEIS) addressing the outfall extension alternative prepared in 1987 are separate documents from the Hilo Wastewater Management Plan, with a separate preparation and approval process. The EIS and SEIS were prepared in accordance with the state EIS law and administrative rules which provide for public participation through a consultation and review process rather than through public hearings. None of these documents -- the original EIS, the 1987 SEIS and the SEIS now being prepared -- are NEPA documents. NEPA requirements are met by the U.S. Environmental Protection Agency (EPA) in accordance with its own regulations.

With regard to public participation, documents relating to both the state and federal actions have been, and continue to be, available for examination and public participation. The County of Hawaii has made a special effort to solicite community interest during the planning preparation of the SEIS and the Hilo Wastewater Management Plan Amendment. At the inception of the planning process, a Citizens Advisory Group was formed and has met with the County of Hawaii and their consultants on a frequent basis. Through the news media, the general public has been informed and updated as to the progress of the project. In accordance with EPA regulations promulgated for facilities planning documents, a public hearing will be held on November 1, 1988.

2. Ocean outfall

The section of the EIS Administrative rules on supplemental statements (Subchapter 10, Section 11-200-26) states that an EIS continues to be valid as long as there is no substantial change in the proposed action. Section 11-200-27 states that:

> Proposing agencies or applicants shall prepare for public review supplemental statements whenever the proposed action for which a statement was accepted has been modified to the extent that new or different environmental impacts are anticipated. A supplemental statement is warranted whenever the scope of an action has substantially increased, when the intensity of environmental impacts will be increased, when the mitigating measures originally planned are not to be implemented, or where new circumstances or evidence have brought to light different or likely increased environmental impacts not previously dealt with.

The SEIS is being prepared because of a change in the action, that is, the design and location of the proposed treatment plant, pump station, sewer mains, and liquids handling system. No changes in the design and location of the disposal system is contemplated. "Different or likely increased environmental impacts" will be less significant because of the County of Hawaii's commitment to provide secondary treatment to the effluent before discharge into the ocean environment.

There have been repairs to breaks in the outfall since 1980. However, we have found no evidence or data indicating that "public health has been repeatedly threatened" as a result of the outfalls condition. Records of the Hilo District, Department of Health Office do not support any correlation between public health and the outfall discharges (personal communication with H. Matsuura, August 16, 1988). Future potential risk to public health will be further diminished by the improved levels of wastewater treatment.

3. Indicator organisms

We concur that fecal coliform is a poor bacterial indicator organism. This is why EPA regulations and the newly revised state water quality standards (Chapter 11-54, Department of Health (DOH) Administrative Rules) have substituted enterococci for fecal coliform as the indicator organism for marine waters. The EIS will discuss bacterial and viral survivability.

4. Disinfection

The SEIS will discuss disinfection alternatives and their associated impacts.

5. Land-based treatment options and water recycling

Recycling and reuse of treated wastewaters is the preferred disposal method. At the present time, the primary constraint of water reuse is finding a viable use for the treated effluent within a reasonable distance of the facility. Certainly, opportunities for implementation of this method are available in the drier parts of the island. However, there is little demand for irrigation water in the vicinity of the Hilo plant. As you note, the vegetation surrounding the plant site is lush and tropical. Opportunities for water reuse in an area with an average rainfall of 150 inches are very limited.

Land disposal (without any present reuse) adjacent to the treatment plant site would add approximately $5-8 million to the cost of the project, while resulting in potentially more acute adverse environmental impacts. Land disposal sites further in distance from the treatment plant would be even more costly. Since the available amount of federal construction grant funds are fixed and limited, any additional costs would have to be borne by county tax payers. HELCO is opposed to the use of treated sewage effluent because of the additional maintenance cost and down time that would be necessary if sewage was used in lieu of clean water (personal communication with C. Nagata, August 23, 1988). Economic analyses of disposal options, including land disposal, will be discussed in the EIS.

Hydrologic models of the land disposal options will be included in the EIS. Further refinements, including the collection and use of new field data will be performed if warranted by the feasibility of the respective options.

6. Puhi Bay and impacts on tourism

The practice of disposing treated wastewater via ocean outfall has never precluded the use of Puhi Bay for recreational purposes. To our knowledge, there have been no posted beach closures attributable to the operation of the outfall (personal communication with H. Matsuura, August 16, 1988).

7. Water conservation measures

Reduction of water usage by water-saving devices is more relevant to future water development plans of the Department of Water Supply which may have an impact on future quantity of waste flows. Upgrading of treatment systems, however, must be done regardless of the quantity of flows presently in or anticipated for the system.

8. Financing options

Various alternative options for financing severage system hookups is presently being pursued by the County of Hawaii. As these alternatives develop, public notification of the alternatives will be made.

9. Backup generating capacity

A backup power generation capacity is planned for the new pump station and treatment plant. The proposed facilities will be discussed in the SEIS.

10. Co-disposal options

The SEIS will discuss the co-disposal option proposed in the 1984 W.A. Hirai & Associates report.

11. Tsunami impacts

The damage to the outfall, pump station, and other structures within the tsunami inundation zone that would likely be caused by a tsunami will be discussed in the SEIS.

12. Increased loads

The capacities of all parts of the proposed severage treatment system and their capabilities of handling increased loads will be addressed in the SEIS.

We appreciate the concerns expressed by the Sierra Club Clean Coastal Waters Task Force and welcome your continued support in achieving our common goal of improvements in the quality of Hilo's marine environment.

HUGH Y. ONO, P.E.
Chief Engineer

cc: BCG
MEPAC (Honolulu)

CHAPTER VIII

COMMENTS ON AND RESPONSES TO THE DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

The following agencies and organizations reveiwed the Draft Supplemental Environmental Impact Statement and provided a written response. Respondents who made substantive comments concerning the proposed action received written responses to their concerns; they are identified by an asterisk (*). All of the letters received, together with the responses to all substantive questions, are included in this section of the Final Supplemental Environmental Impact Statement.

FEDERAL

* Department of the Army
Department of the Navy
Department of Agriculture
  Soil and Conservation Service
Department of the Interior
  Geological Survey
* Environmental Protection Agency

STATE

Department of Agriculture
Department of Accounting and General Services
Energy Division, Department of Business and Economic Development
* Department of Hawaiian Home Lands
* Department of Health
* Department of Land and Natural Resource
* Environmental Center, University of Hawaii
Hawaii Housing Authority
* Office of State Planning
Housing Finance and Development Corporation

ORGANIZATIONS AND INDIVIDUALS

* Hawaii Island Chamber of Commerce
* Office of Hawaiian Affairs

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

November 16, 1988

REPLY TO ATTENTION OF:

Planning Branch

Mr. Hugh Y. Ono, P.E.
Chief Engineer
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Thank you for the opportunity to review the Draft Supplemental Environmental Impact Statement for Hilo Wastewater Treatment Facilities, Hilo District, South Hilo, Hawaii. The following comments are offered:

a. The proposed project does not involve work in waters of the United States or adjacent wetlands. A Department of the Army permit is not required.

b. The discussion of flood hazards on page IV-4 is accurate.

Sincerely,

Kisuk Cheung for
Chief, Engineering Division

Copy furnished:

✓Mr. Labert Yamashita
M & E Pacific, Inc.
Engineers and Architects
1001 Bishop Street
Honolulu, Hawaii 96813

DEPARTMENT OF PUBLIC WORKS
COUNTY OF HAWAII • 25 AUPUNI STREET • HILO, HAWAII 96720 • TELEPHONE (808) 961-8321

BERNARD K. AKANA
Mayor

HUGH Y. ONO
Chief Engineer

BRUCE C. McCLURE
Deputy Chief Engineer

February 7, 1989

MR. KISUK CHEUNG, CHIEF, ENGINEERING DIVISION
U.S. ARMY ENGINEER DISTRICT, HONOLULU
DEPARTMENT OF THE ARMY
BUILDING 230
FT. SHAFTER, HAWAII 96858-5440

SUBJECT: HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES
DRAFT SUPPLEMENTAL EIS

Thank you for your letter dated November 16, 1988 concerning the subject Draft Supplemental Environmental Impact Statement. Your comments concerning the Department of the Army permit and the flood hazards are consistent with the Supplemental EIS.

We appreciate the comments expressed by your agency.

HUGH Y. ONO, P.E.
Chief Engineer

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO:

5090 (72B)
Ser 032/2599
13 Oct 1988

Hugh Y. Ono, P.E.
Chief Engineer
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

The Draft Supplemental Environmental Impact Statement for the Hilo Wastewater Management Plan System has been reviewed and we have no comments to offer. Since we have no further use for the EIS, it is being returned to the Office of Environmental Quality Control.

Thank you for the opportunity to review the draft.

Sincerely,

W. K. LIU
Assistant Base Civil Engineer
By direction of
the Commander

Copy to:
Lambert Yamashita
M & E Pacific, Inc.
Engineers and Architects
1001 Bishop Street
Honolulu, HI 96813

Office of Environmental Quality Control (w/encl)

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. BOX 50004
HONOLULU, HAWAII
96850

November 15, 1988

Mr. Hugh Y. Ono, P.E.
Chief Engineer
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

Dear Hugh:

Subject: Draft Supplemental Environmental Impact Statement (DSEIS) – Hilo Wastewater Management Plan System, Hilo, Hawaii

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

Sincerely,

RICHARD N. DUNCAN
State Conservationist

cc:
Lambert Yamashita, M & E Pacific, Inc., Engineers and Architects, 1001 Bishop Street, Honolulu, HI 96813

RECEIVED NOV 1 1 1988

United States Department of the Interior

GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
677 Ala Moana Blvd.
Suite 415
Honolulu, Hawaii 96813

November 14, 1988

Mr. Hugh Y. Ono, P.E.
Chief Engineer
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Subject: Hilo Wastewater Management Plan System

The staff of the Hawaii District Office of the U.S. Geological Survey, Water Resources Division, has reviewed the subject report, but has no comments to make at this time.

Thank you for allowing us to review the subject report.

Sincerely,

William Meyer
District Chief

cc: Lambert Yamashita, M&E Pacific, Inc., Honolulu, Hawaii

November 22, 1988

Mr. Hugh Y. Ono, P.E.
Chief Engineer
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Enclosed please find EPA Region 9 comments on the October 1988 Draft Supplemental Environmental Impact Statement for the Hilo Wastewater Treatment and Conveyance Facilities. Should you have any questions do not hesitate to call me or Jose T. Caratini of my staff at (415)974-8303.

Sincerely,

L. Keith Silva, Chief
AZ/HI/NV Liaison and
Audit Resolution Section

Enclosure

cc: Lambert Yamashita, M & E Pacific Inc.
Dennis Tulang, Chief, WTW Construction Grants Branch

EPA Region 9 Comments
on the
October 1988 Draft Supplemental Environmental Impact Statement
for the
Hilo Wastewater Treatment and Conveyance Facilities.

COMPLETE WASTE TREATMENT SYSTEM: 40 CFR 35.2005(b)(12)
PHASE AND SEGMENTED TREATMENT WORKS: 40 CFR 35.2108

A complete waste treatment system includes: (1) the transport of wastewater from individual homes to the treatment facility; (2) the treatment of wastewater to remove pollutants; and (3) the disposal or reuse of the treated wastewater. The proposed Hilo Wastewater Treatment Facility (WWTF) separates the treatment system, the interceptors and sewer lines into segmented projects. Therefore, each grant for the Hilo WWTF will include a schedule for completion of the remaining segments of the project described in the facilities plan.

UNRESOLVED ISSUES: (Page IV-12)

Alignment: A delay in the construction of the force main and gravity line may delay the initiation of operation of the WWTF. The alignment of the new wastewater treatment inflow force main and the effluent gravity line must be determined prior to grant award.

Responsibility for Hook-up Charges: A hook-up delay may delay the initiation of operation of the WWTF. The responsible agent for the hook-up charge should be determined prior to grant award.

INFILTRATION/INFLOW: 40 CFR 35.2120

The existing Hilo WWTF receives 1.3 MGD of infiltration. The County should follow the provisions in 40 CFR 35.2120 when designing the new Hilo WWTF. The maximum allowable flow per capita per day during high groundwater is 120 gallons.

RESERVE CAPACITY: 40 CFR 35.2123

A detailed breakdown of population and flows is needed so EPA can determine the eligible capacity and the sewer systems to be included in the grant construction schedule. The 13.0 MGD design peak flow should be documented. Table II-4 should include the present and future populations of the proposed sewer collection systems. We also have the following two questions on Table II-4:

1. What year flows are included in the Table II-4?

2. Does Table II-4 includes the existing 2.59 MGD flows?

DEPARTMENT OF PUBLIC WORKS
COUNTY OF HAWAII • 25 AUPUNI STREET • HILO, HAWAII 96720 • TELEPHONE (808) 961-8321

BERNARD K. AKANA
Mayor

HUGH Y. ONO
Chief Engineer

BRUCE C. McCLURE
Deputy Chief Engineer

February 7, 1989

MR. L. KEITH SILVA, CHIEF
LIAISON AND AUDIT RESOLUTION SECTION
REGION 9
U.S. ENVIRONMENTAL PROTECTION AGENCY
215 FREMONT STREET
SAN FRANCISCO, CA. 94105

SUBJECT: HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES
DRAFT SUPPLEMENTAL EIS, HILO HAWAII

Thank you for your letter dated November 22, 1988 concerning the subject Draft Supplemental Environmental Impact Statement. Your comments are appreciated. Response to your comments are provided below.

Unresolved Issue: Alignment

The routing of the force main and gravity lines is still an unresolved issue, however, close coordination between the County and Department of Hawaiian Home Land (DHHL) will resolve this issue prior to grant award.

Unresolved Issue: Responsibility for Hook-up Charges

The County is presently investigating various alternatives for assistance for hook-up.

Infiltration/Inflow

The County, in its effort to initiate a sewer rehabilitation program to reduce excessive infiltration, has contracted a private consulting firm to conduct an in-depth assessment of the Hilo area collection system. This rehabilitation program will consist of additional data collection such as flow monitoring and TV inspection as well as the development of a recommended program for grouting, replacement, improvements and repairs to the system.

Reserve Capacity

A detailed breakdown of population and flows, present and future, to determine the eligible capacity and the sewer systems to be included in the grant construction schedule was provided in Chapters VI and VII of the Hilo District Facilities Plan Amendment. (See attached excerpt of these chapters.)

MR. L. KEITH SILVA, CHIEF
U.S. Environmental Protection Agency
February 7, 1989
Page Two

Response to questions:

1. Table II-4 is the general implementation and funding priority list for all of Hilo's wastewater improvement works. The sizing of the proposed wastewater treatment facility, however, is based on the existing needs as of the October 1, 1990 cut-off date for reserve capacity.

2. Yes, Table II-4 does account for the existing flows.

We appreciate the comments expressed by your agency.

HUGH Y. ONO, P.E.
Chief Engineer

JOHN WAIHEE
GOVERNOR

YUKIO KITAGAWA
CHAIRPERSON, BOARD OF AGRICULTURE

SUZANNE D. PETERSON
DEPUTY TO THE CHAIRPERSON

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

November 11, 1988

Mr. Hugh Y. Ono, Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Subject: Draft Supplemental Environmental Impact Statement
Hilo Wastewater Treatment And Conveyance Facilities
TMK: 2-1-12: 09
2-1-13: 02, 04, & 143
South Hilo, Hawaii
Approximately 15 acres

The Department of Agriculture has reviewed the subject document and has no comments to offer.

Thank you for the opportunity to comment.

Sincerely,

Suzanne D. Peterson

YUKIO KITAGAWA
Chairperson, Board of Agriculture

cc: OEQC
Mr. Lambert Yamashita,
M&E Pacific, Inc.

(P)1913.8

OCT 14 1988

Mr. Hugh Y. Ono
Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Subject: Hilo Wastewater Management Plan System
Draft Environmental Impact Statement

We have reviewed the subject document and have no comments to offer.

Very truly yours,

T. Tominaga

TEUANE TOMINAGA
State Public Works Engineer

/jnt
cc: Mr. Lambert Yamashita, M&E Pacific

DEPARTMENT OF BUSINESS AND ECONOMIC DEVELOPMENT

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813

October 28, 1988

Hugh Y. Ono, P.E.
Chief Engineer
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Subject: Draft Environmental Impact Statement for the Hilo Wastewater Management Plan System

Thank you for the opportunity to review the Draft EIS. We have no comments to offer at this time.

Sincerely,

MAURICE H. KAYA
Energy Program Administrator

MHK/hk

cc: Lambert Yamashita

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

ILIMA A. PIIANAIA
CHAIRMAN
HAWAIIAN HOMES COMMISSION

STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS
P. O. BOX 1879
HONOLULU, HAWAII 96805

November 18, 1988

Mr. Hugh Ono
Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Thank you for sending us a copy of the Draft Supplemental Environmental Impact Statement for Hilo Wastewater Treatment and Conveyance Facilities dated October 1988.

The Department of Hawaiian Home Lands (DHHL) supports the county's efforts to relocate Hilo's wastewater treatment plant. For years, the present plant has been the source of numerous complaints from our lessees in Keaukaha. The relocation of the plant will alleviate this problem.

The one area of concern about the project is the routing of the force main and gravity discharge main. The draft indicates three alternatives. At its meeting on July 26, 1988, the Hawaiian Homes Commission (HHC) adopted a motion which supported this project but did not agree to the routing of the project mains through the Keaukaha residential area. While alternative three for routing the mains fully complies with the HHC's resolution, alternatives one and two do not. Alternative two might be acceptable to the HHC, however, because it could assist in providing access to newly awarded lots. Based on the HHC's action, alternative one is not acceptable at this time. Further discussions are needed on this issue. The minutes of the meeting are attached for your review.

If you need any additional information or we can be of further assistance, please do not hesitate to contact me.

Sincerely,

Ilima A. Piianaia

Ilima A. Piianaia, Chairman
Hawaiian Homes Commission

IAP:HS:eh

Attachment

cc: Lambert Yamashita, M & E Pacific, Inc.

MINUTES OF July 26, 1988, Meeting held in Hilo, Hawaii

ITEM D-1

SUBJECT: Authorization for the Chairman to Communicate with Hawaii County Its Support for Current Planning Efforts Being Undertaken to Relocate the Hilo Wastewater Treatment Plant

COMMISSIONERS	MOTION	SECOND	AYES	NAYS	ABSTAIN
Piianaia			X		
Apana			X		
Brandt			X		
Kawaiani					
Keomaka		X	X		
Park			X		
Robertson	X		X		
Smith					
TOTAL			6		

Action Approved X
Denied

Deferred
Tabled

DISCUSSION

Mr. Hugh Ono of the Hilo Department of Water was present to answer any questions that the Commission or public may have had.

Lengthy discussion was had on the clarification of information that was provided within the agenda. Mr. Ono additionally detailed the court-ordered deadlines that the County faces; failure to meet the deadlines will result in a $1,000/day penalty. The County plans to begin work on the plant by this time next year; the design must therefore be complete by March or April, construction must begin by August 1990, the project is to be completed by September 1992, and a six-month period will be allowed for the plant to be operating at the secondary, minimum level of treatment, with the final test in March 1993.

The community voiced its many concerns against the plant at the previous evening's Community Meeting with the Commission; there was a question, therefore, as to the extent of the community's input on the project. Mr. Ono reported that status meetings were held with the community; additionally, there were several members from the community, as well as a representative from the Department of Hawaiian Home Lands, on the twelve-member Citizens' Advisory Committee. The County's request is to run the lines through Hawaiian home lands; a resultant benefit will be construction and improvements of roads in the area. Upon completion of the project, plans are to remove the present plant and grass the area, possibly allowing for a park since there are restrooms existent on the site; additionally, there will be a new pumping station.

Commissioner Robertson asked of the possibility of a one-line versus a two-line system. Mr. Ono replied that a two-line system is necessary because there is no area large enough to accommodate the use of the effluent resultant from a one-line system; the outfall would accommodate an area as large as five to seven golf courses. In response to the Chair, Mr. Ono reported that routing the lines further east, towards the Puu Maili direction, would cost an additional $400,000 to $700,000; routing the lines

MINUTES OF July 26, 1988, Meeting held in Hilo, Hawaii

ITEM D-1 (continued)

up Andrews would cost an additional $400,000 and the County has not looked into routing lines further than Andrews. Federal funds contribution in the project will amount to $18 million. The trenching will be approximately 10 feet wide and 10 to 15 feet deep. There are no plans for higher level treatment, nor for injection or surface dispersal because of the unique geological condition of the Hilo area, the ecological impact on marine life, and cost factors involved.

The Commission requested that the County meet with the Keaukaha community, as soon as possible, prior to the facility's plan being completed, to inform them of the total project. Mr. Ono assured the Commission that it is the County's intent to maintain contact and communication with the homestead community, as well as with the community at large. The Chair also noted that the Commission would like the County to work with the Commission/Department as they review plans on the routing of the lines because it may provide the opportunity to open up additional homesteading areas.

The primary concern of those in attendance at the meeting was that there is a possibility of damage to the sewer line due to volcanic and tsunami activities, which may result in a severe pollution problem. Several members of the audience requested to voice their concerns: Keola Kalauli, President of the Keaukaha-Panaewa Community Association; Sandy Buckles, resident of Keaukaha; Linda Dela Cruz, President of the Aboriginal Native Hawaiian Association and resident of Panaewa; Kalu Gumapac; Eleanor Ahuna, resident of Keaukaha and former Hawaiian Homes Commissioner; Malie Akimseu, and Skippy Ioane. The attendees reiterated the concerns raised by the commissioners and were adamant about locating the lines in a currently unpopulated area.

An additional community concern involved the question of costs related to hook-up to the system. The Chair noted that at some point, residents of all homestead communities will be required to hook up to sewer systems. The Waimanalo community was faced with the same concerns and options available were to take advantage of loans made available to them, or to become involved in a self-help program.

MOTION/ACTION

To agree in principal to the relocation of the Hilo Wastewater Treatment facility and provide the County of Hawaii preliminary consent to route the pressurized sewer mains across Hawaiian home lands outside of the existing Keaukaha residential area. This preliminary consent is contingent upon the selection of the final sewer main alignment and agreement as to compensation for the use of DHHL lands.

Motion carried unanimously.

DEPARTMENT OF PUBLIC WORKS

COUNTY OF HAWAII · 25 AUPUNI STREET · HILO, HAWAII 96720 · TELEPHONE (808) 961-8321

BERNARD K. AKANA, Mayor

HUGH Y. ONO, Chief Engineer

BRUCE C. McCLURE, Deputy Chief Engineer

February 7, 1989

MS. ILIMA A. PIIANAIA, CHAIRMAN
HAWAIIAN HOMES COMMISSION
DEPARTMENT OF HAWAIIAN HOME LANDS
STATE OF HAWAII
P. O. BOX 1879
HONOLULU, HAWAII 96805

SUBJECT: HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES DRAFT SUPPLEMENTAL EIS

Thank you for your letter dated November 18, 1988 concerning the subject Draft Supplemental Environmental Impact Statement. Your comment is appreciated.

As identified in your letter, the routing of the force main and gravity line is still an unresolved issue. An evaluation of the alternatives is being conducted by our consultants to evaluate the impacts on both the County and Department of Hawaiian Home Land (DHHL). I am confident that a cost-effective alternative can be selected that will meet with the approval of both parties.

We appreciate the concerns expressed by your agency and welcome your continued cooperation in achieving a common goal of improvements in the quality of Hilo's environment.

Hugh Y. Ono

HUGH Y. ONO, P.E.
Chief Engineer

COPY

November 22, 1988

MEMORANDUM

To: Mr. Hugh Y. Ono, P.E.
Chief Engineer
Department of Public Works
County of Hawaii

From: Deputy Director for Environmental Health

Subject: COMMENTS ON THE DRAFT SUPPLEMENTAL EIS FOR HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES

Thank you for the opportunity to review and comment on the proposed project. We offer the following comments:

Drinking Water

Although the proposed site is situated below the Underground Injection Control (UIC) line and injection wells are permitted for the disposal of sewage effluent, the Department of Health concurs with the EIS on favoring the ocean outfall method of effluent disposal.

The Department feels that the alternate proposal for effluent disposal by way of injection wells will have an adverse impact on a section of coastline. The continuous discharge of a projected 5 to 13 MGD of effluent into injection wells will essentially create an underground river of water that must eventually discharge somewhere along the coast.

Water Pollution

The Draft Supplemental EIS should address the recently adopted revisions to Chapter 11-54, Water Quality Standards, which include enterococcus limitations for recreational marine waters and specific criteria for Class A open coastal waters.

BRUCE S. ANDERSON, Ph.D.

cc: Lambert Yamashita, M & E Pacific, Inc.

BERNARD K. AKANA
Mayor

HUGH Y. ONO
Chief Engineer

BRUCE C. McCLURE
Deputy Chief Engineer

DEPARTMENT OF PUBLIC WORKS
COUNTY OF HAWAII · 25 AUPUNI STREET · HILO, HAWAII 96720 · TELEPHONE (808) 961-8321

February 7, 1989

MR. BRUCE S. ANDERSON, Ph.D.
DEPUTY DIRECTOR FOR ENVIRONMENTAL HEALTH
DEPARTMENT OF HEALTH
STATE OF HAWAII
P.O. BOX 3378
HONOLULU, HAWAII 96801

SUBJECT: HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES DRAFT SUPPLEMENTAL EIS

Thank you for your letter dated November 22, 1988 concerning the subject Draft Supplemental Environmental Impact Statement. The response to your comments are provided below.

Drinking Water

We acknowledge your comment about the method of effluent disposal. We are pleased that the Department of Health concurs with the continued use of the ocean outfall method of effluent disposal.

Water Pollution

The adopted revisions to Chapter 11-54, Water Quality Standards for enterococcus limitations for recreational marine waters and specific criteria for Class A open coastal waters will be addressed in the Final Supplemental EIS.

We appreciate the comments expressed by your agency.

HUGH Y. ONO, P.E.
Chief Engineer

COPY

November 22, 1988

MEMORANDUM

To: Mr. Hugh Y. Ono, P.E.
Chief Engineer
Department of Public Works
County of Hawaii

From: Deputy Director for Environmental Health

Subject: COMMENTS ON THE DRAFT SUPPLEMENTAL EIS FOR HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES

Thank you for the opportunity to review and comment on the proposed project. We offer the following comments:

Drinking Water

Although the proposed site is situated below the Underground Injection Control (UIC) line and injection wells are permitted for the disposal of sewage effluent, the Department of Health concurs with the EIS on favoring the ocean outfall method of effluent disposal.

The Department feels that the alternate proposal for effluent disposal by way of injection wells will have an adverse impact on a section of coastline. The continuous discharge of a projected 5 to 13 MGD of effluent into injection wells will essentially create an underground river of water that must eventually discharge somewhere along the coast.

Water Pollution

The Draft Supplemental EIS should address the recently adopted revisions to Chapter 11-54, Water Quality Standards, which include enterococcus limitations for recreational marine waters and specific criteria for Class A open coastal waters.

BRUCE S. ANDERSON, Ph.D.

cc: Lambert Yamashita, M & E Pacific, Inc.

DEPARTMENT OF PUBLIC WORKS
COUNTY OF HAWAII • 25 AUPUNI STREET • HILO, HAWAII 96720 • TELEPHONE (808) 961-8321

BERNARD K. AKANA
Mayor

HUGH Y. ONO
Chief Engineer

BRUCE C. McCLURE
Deputy Chief Engineer

February 7, 1989

MR. BRUCE S. ANDERSON, Ph.D.
DEPUTY DIRECTOR FOR ENVIRONMENTAL HEALTH
DEPARTMENT OF HEALTH
STATE OF HAWAII
P.O. BOX 3378
HONOLULU, HAWAII 96801

SUBJECT: HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES DRAFT SUPPLEMENTAL EIS

Thank you for your letter dated November 22, 1988 concerning the subject Draft Supplemental Environmental Impact Statement. The response to your comments are provided below.

Drinking Water

We acknowledge your comment about the method of effluent disposal. We are pleased that the Department of Health concurs with the continued use of the ocean outfall method of effluent disposal.

Water Pollution

The adopted revisions to Chapter 11-54, Water Quality Standards for enterococcus limitations for recreational marine waters and specific criteria for Class A open coastal waters will be addressed in the Final Supplemental EIS.

We appreciate the comments expressed by your agency.

HUGH Y. ONO, P.E.
Chief Engineer

JOHN WAIHEE
GOVERNOR OF HAWAII

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

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WATER AND LAND DEVELOPMENT

NOV 1 5 1988

DOC. NO.: 4607E
FILE NO.: 89-214

The Honorable Hugh Y. Ono
Chief Engineer
County of Hawaii
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

SUBJECT: Draft Supplemental Environmental Impact Statement
Hilo Wastewater Treatment and Conveyance Facilities

Dear Mr. Ono:

Thank you for giving our Department the opportunity to comment on this matter. We have reviewed the materials you submitted and have the following comments.

Our Department's Historic Sites Section believes that the project will have "no effect" on significant historic sites, as concluded in previous reviews.

In addition, our Division of Aquatic Resources has no programmatic objections to the present proposal at this time, which upgrades sewage treatment from advanced primary to secondary before disposal.

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

Very truly yours,

WILLIAM W. PATY

cc: Mr. Lambert Yamashita

DEPARTMENT OF PUBLIC WORKS
COUNTY OF HAWAII • 25 AUPUNI STREET • HILO, HAWAII 96720 • TELEPHONE (808) 961-8321

BERNARD K. AKANA
Mayor

HUGH Y. ONO
Chief Engineer

BRUCE C. McCLURE
Deputy Chief Engineer

February 7, 1989

MR. WILLIAM W. PATY, CHAIRPERSON
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE OF HAWAII
P. O. BOX 621
HONOLULU, HAWAII 96809

SUBJECT: HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES
DRAFT SUPPLEMENTAL EIS

Thank you for your letter dated November 15, 1988 concerning the subject Draft Supplemental Environmental Impact Statement. Your "no effect" on significant historic sites comment from the Department's Historic Sites Section and no programmatic objections to the present proposal comment from the Division of Aquatic Resources is noted.

We appreciate the comments expressed by your agency.

HUGH Y. ONO, P.E.
Chief Engineer

University of Hawaii at Manoa

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

November 22, 1988
RE:0511

Mr. Hugh Y. Ono, P.E.
Chief Engineer
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Draft Supplemental Environmental Impact Statement
Hilo Wastewater Treatment Plan
Hilo, Hawaii

This document describes plans to construct a new Wastewater Treatment Plant (WWTP) to provide secondary treatment at a site near the east end of the runway at Hilo Airport. Also constructed will be a new pump station at the site of the existing WWTP and force and gravity mains connecting the treatment plant and the pump station. Our review was prepared with the assistance of Keith Chave, Oceanography; Frans Gerritsen and Hans-Jurgen Krock, Ocean Engineering; Reginald Young, Engineering; Richard Brock, Hawaii Institute of Marine Biology; Peter Flachsbart, Urban and Regional Planning; and Jacquelin Miller, Environmental Center.

Anaerobic Sludge Treatment

Our reviewers have serious reservations about the proposed method for treatment of the sewage solids. The anaerobic digestion method is a standard procedure used with consistent success on the mainland, but it has met with problems in local applications. The problem originates with the infiltration of significant amounts of brackish groundwater into the influent stream through the collection system. Page II-4 notes that "Large interceptor sewers are constructed at low elevations near the coastline". Quoted average daily flows on the same page indicate an infiltration rate of about 34 percent by volume. Much of the infiltering water is seawater or brackish water from the coastal mixing zone as indicated by the influent concentration of 2700-3800 mg Cl/l, roughly one fifth the chlorinity of seawater. High chloride content in the influent stream implies concomitant introduction of significant levels of sulphates. The presence of elevated sulphate concentrations in wastewater

targeted for anaerobic digestion has presented substantive problems in other treatment facilities in the State.

Bacterial organic metabolism, the process of solids digestion in sewage treatment, is governed by conventional chemical thermodynamics. Both the process and the product are determined by the nature of the terminal hydrogen acceptor in the metabolic reaction. In the presence of oxygen, the process is aerobic, and water (H_2O) is produced. Once oxygen is depleted, the next terminal hydrogen acceptor on the thermodynamic scale is nitrate (NO_3), which is metabolized by bacteria to ammonia (NH_4). Once nitrate is depleted, sulphate (SO_4) becomes the terminal hydrogen acceptor, and hydrogen sulphide (H_2S) is produced. Metabolism of carbon dioxide (CO_2) to produce methane (CH_4) will not occur until all of the sulphate has been used up.

Most solids treatment processes convert about 50 percent of the volatile solids (organic carbon) to methane and CO_2. However, in systems where high sulfate concentrations exist, such as that at Fort Kamehameha, anaerobic digestion only converts about 15 percent of the organic solids.

Sulfate interference causes other problems in addition to the deterrence of methane production. As noted earlier, participation of sulfate in organic anaerobic metabolism leads to evolution of H_2S which is both odiferous and toxic. H_2S will also precipitate heavy metals which will be carried in the recycled liquid stream back to the primary clarifier. When mixed with the activated sludge from the secondary clarifier, the precipitated metal sulfides will themselves be bacterially oxidized to release ionic metals which, due to their toxicity, will kill bacteria within the aerobic processing system.

For the solids treatment phase of the Hilo WWTP to operate successfully as designed, the proportion of seawater in the influent wastewater must be reduced substantially. This may not be practical, in which case the only alternative is to undertake aerobic digestion of the solids, which is costly. In addition, aerobic sludge treatment produces no useful product such as methane, and the resulting solids are gelatinous and difficult to dewater.

Outfall

Concerns have been raised about the outfall structure currently in place which will be used for disposal of treated effluent. This outfall has had a history of structural failures, amounting to a total of $1,418,574 in repair costs since its construction. However, no funds are allocated within the present plans for modification of the effluent pipe or the diffuser, and only $24,500/yr are earmarked for maintenance. There appears to be a substantive discrepancy between anticipated annual maintenance costs and historical evidence of need.

We appreciate the opportunity to comment on this Draft Supplemental Environmental Impact Statement, and we look forward to your responses to our comments.

Sincerely,

John T. Harrison by JM.

John T. Harrison
Environmental Coordinator

cc: OEQC
Lambert Yamashita, M & E Pacific
L. Stephen Lau
Keith Chave
Frans Gerritsen
Hans-Jurgen Krock
Reginald Young
Richard Brock
Peter Flachsbart
Jacquelin Miller

DEPARTMENT OF PUBLIC WORKS
COUNTY OF HAWAII • 25 AUPUNI STREET • HILO, HAWAII 96720 • TELEPHONE (808) 961-8321

BERNARD K. AKANA, Mayor
HUGH Y. ONO, Chief Engineer
BRUCE C. McCLURE, Deputy Chief Engineer

February 7, 1989

MR. JOHN T. HARRISON, ENVIRONMENTAL COORDINATOR
UNIVERSITY OF HAWAII AT MANOA
ENVIRONMENTAL CENTER
2550 CAMPUS ROAD, CRAWFORD 317
HONOLULU, HAWAII 96822

SUBJECT: HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES
DRAFT SUPPLEMENTAL EIS

Thank you for your letter dated November 22, 1988 concerning the subject Draft Supplemental Environmental Impact Statement. Your comments are appreciated. Response to your comments are provided below.

Anaerobic Sludge Treatment

Potential problems associated with the high chlorides level resulting from brackish water infiltration will be substantially reduced with the present repair effort which the County has implemented. The County, in its effort to initiate a sewer rehabilitation program to reduce excessive infiltration, has contracted a private consulting firm to conduct an in-depth assessment of the Hilo area collection system. This rehabilitation program will consist of additional data collection such as flow monitoring and TV inspection; and the development of a recommended program for grouting, replacement, improvements and repairs to the system. This scheduled repair work should reduce the quantities of brackish groundwater which is presently entering the system, which would in turn reduce the average chloride concentrations. (From initial assessments of the Hilo area collection system, a minimum 50 percent reduction of the quantity of brackish groundwater is anticipated.) A reduction of brackish groundwater by at least one half would reduce the average chloride concentration from approximately 3,100 mg/l to less than 1,600 mg/l.

Anaerobic digesters which are properly sized, operated and maintained have been successful in stabilizing sludge solids from domestic wastewaters with high chloride concentrations from brackish water infiltration. A local example is the anaerobic digesters at East Honolulu Wastewater Treatment Plant (EHWWTP), located in Hawaii Kai. Before the recent infiltration reduction program, the influent domestic wastewater had average chlorides concentrations of approximately 1,600 mg/l and digester volatile solids destruction averaged 52 percent (July 1986 to March 1987). Hence, brackish water infiltration is not expected to adversely affect an anaerobic digester at the new Hilo Wastewater Treatment Plant. Additionally, if sulfate interference should occur, a process to remove sulfides or hydrogen sulfide from the digester can be added.

Mr. John T. Harrison, Environmental Coordinator
University of Hawaii at Manoa
Environmental Center
February 7, 1989
Page Two

Outfall

The 1980 Facilities Plan assumed that the existing outfall would have to be extended to approximately 70-90 foot depth of water, which would involve an extension of about 2,000 feet. This, however, was contingent upon EPA approval of the Section 301(h) primary discharge permit. However, since receiving water quality data shows no significant impacts from the existing primary discharges and the proposed level of treatment will be upgraded to secondary, extension of the outfall may not be necessary. An ongoing monitoring effort is presently underway to further assess the existing water conditions in the Hilo Bay area.

Repairs to the ocean outfall were initiated in 1988 and is currently nearing completion. The estimated annual maintenance requirement of $24,500/year would include visual inspection and minor repairs which may be required. This annual maintenance cost does not include any repair costs which may be attributable to a natural catastrophic disaster.

It should be noted that the ultimate goal of effluent disposal for the County is to recycle and reuse the effluent. However, no potential recipients willing to offer firm commitments for utilizing the projected effluent discharge have been identified. Therefore, use of the ocean outfall will be continued as an interim effluent disposal method until such time that the recycling and reuse option becomes feasible and economically viable.

We appreciate the comments and concerns expressed by your agency and hope our responses have adequately addressed them.

HUGH Y. ONO, P.E.
Chief Engineer

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF HUMAN SERVICES
HAWAII HOUSING AUTHORITY
P. O. BOX 17907
HONOLULU, HAWAII 96817

EXECUTIVE DIRECTOR

IN REPLY REFER TO:

88:PLNG/523A JT

November 21, 1988

Mr. Hugh Y. Ono, P.E.
Chief Engineer
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Re: Draft Environmental Impact Statement (EIS) for the Proposed Hilo Wastewater Treatment and Conveyance Facilities

We have reviewed the subject supplemental EIS and have no comments to offer. Thank for the opportunity to comment.

Sincerely,

for MITSUO SHITO
Executive Director

cc: Lambert Yamashita, M & E Pacific, Inc.

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

Ref. No. 8831

October 25, 1988

The Honorable Hugh Y. Ono, P.E.
Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Subject: Hilo Wastewater Treatment and Conveyance Facilities
Draft Supplemental Environmental Impact Statement,
Hilo, Hawaii

We have reviewed the Draft Environmental Impact Statement for a new sewage treatment plant proposed for the east end of the runway at Hilo Airport, South Hilo, Hawaii. In general, we support your efforts to meet State regulations and the goals of the Federal Clean Water Act.

However, the proximity of the proposed wastewater treatment plant to the passenger terminal at General Lyman Field does cause some concern. Safeguards should be established to prevent odors associated with the plant from impacting this important gateway to the island.

Thank you for the opportunity to review and comment on this proposal. Please feel free to contact our office at 548-8466 if you have any questions regarding this matter.

Sincerely,

Murray E. Towill

Harold S. Masumoto
Director

cc:√Mr. Lambert Yamashita
M & E Pacific, Inc.

DEPARTMENT OF PUBLIC WORKS
COUNTY OF HAWAII • 25 AUPUNI STREET • HILO, HAWAII 96720 • TELEPHONE (808) 961-8321
BERNARD K. AKANA, Mayor
HUGH Y. ONO, Chief Engineer
BRUCE C. McCLURE, Deputy Chief Engineer

February 7, 1989

MR. HAROLD S. MASUMOTO, DIRECTOR
OFFICE OF STATE PLANNING
STATE OF HAWAII
STATE CAPITAL
HONOLULU, HAWAII 96813

SUBJECT: HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES
DRAFT SUPPLEMENTAL EIS

Thank you for your letter dated October 25, 1988 concerning the subject Draft Supplemental Environmental Impact Statement. Your comment is appreciated.

Please be assured that safeguards to prevent odors from the proposed wastewater treatment facility from impacting General Lyman Field passenger terminal will be provided. Odor control measures will be implemented at key process areas to mitigate any potential odor problems. Also, the prevailing tradewinds from the northwestern direction and a 6,000 feet buffer separation between these two facilities should further mitigate any potential odors from impacting the passenger terminal.

We appreciate the comment expressed by your agency.

Hugh Y. Ono

HUGH Y. ONO, P.E.
Chief Engineer

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUSINESS AND ECONOMIC DEVELOPMENT
HOUSING FINANCE AND DEVELOPMENT CORPORATION
P. O. BOX 29360
HONOLULU, HAWAII 96820-1760

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

IN REPLY REFER
TO:

88:PLNG/1717B JT

November 21, 1988

Mr. Hugh Y. Ono, P.E.
Chief Engineer
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Re: Draft Environmental Impact Statement (EIS) for the Proposed Hilo Wastewater Treatment and Conveyance Facilities

We have reviewed the subject supplemental EIS and have no comments to offer. Thank for the opportunity to comment.

Sincerely,

JOSEPH K. CONANT
Executive Director

cc: Lambert Yamashita, M & E Pacific, Inc.

Hawaii Island
Chamber of Commerce
Established in 1897 • 180 Kinoole St. Suite 118 • Hilo, Hawaii 96720 • Phone (808) 935-7178

RECEIVED DEC 21 1988

December 19, 1988

Mr. Hugh Ono
Chief Engineer
Department of Public Works
25 Aupuni Street
Hilo, HI 96720

RE: Environmental Impact Statement
Hilo Wastewater Treatment and Conveyance Facility
South Hilo, Hawaii

Thank you for the opportunity to comment on the EIS for the Hilo Wastewater Treatment and Conveyance Facility.

We reviewed the EIS and discussed the proposed project with Robert Cooper, our representative on your Citizens Advisory Committee.

We support the proposed project and verify its necessity in Hilo. The facility will alleviate some of the problems we have experienced in the past few months with our current wastewater treatment facility and is a necessary infrastructure improvement. We also believe the site selected for the treatment plan is satisfactory and the potential problem areas have been discussed thoroughly and addressed in the EIS.

We are interested in following this project through completion and would appreciate any new information you may obtain on this project. Thank you again for the opportunity to comment on the EIS.

Sincerely,

Barry K. Taniguchi
President

BKT:daf

cc: M & E Pacific, L. Yamashita
Robert Cooper

STATE OF HAWAII
OFFICE OF HAWAIIAN AFFAIRS
1600 KAPIOLANI BLVD., SUITE 1500
HONOLULU, HAWAII 96814
(808) 548-8960
(808) 946-2642

December 9, 1988

C-88-0015

Mr. Hugh Y. Ono, P.E.
Chief Engineer
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

Subject: Draft EIS: Hilo Wastewater Treatment and Conveyance Facilities, Hilo, Hawai'i.

Dear Mr. Ono:

Thank you for sending our office a copy of the Draft EIS and for the opportunity to comment.

The historical and archaeological evaluations and recommendations were made on the basis of a surface reconnaissance survey. There is the possibility that unidentified subsurface cultural/archaeological features and deposits exist that will be disturbed during the course of the proposed construction activities. These potential features include human skeletal remains. From an archaeological perspective, the goals of historic preservation are well served by a careful study of the deposits that are encountered during construction projects of this kind. A detailed, comprehensive report on these deposits would be useful to archaeologists in the State Historic Preservation Office by giving them basic data for predicting what kinds of archaeological remains might be encountered during excavations in different parts of Hilo.

Sincerely,

Kamaki A. Kanahele, III
Administrator

KAK:EN:klr

cc: Lambert Yamashita, M & E Pacific

DEPARTMENT OF PUBLIC WORKS
COUNTY OF HAWAII • 25 AUPUNI STREET • HILO, HAWAII 96720 • TELEPHONE (808) 961-8321

BERNARD K. AKANA
Mayor

HUGH Y. ONO
Chief Engineer

BRUCE C. McCLURE
Deputy Chief Engineer

February 7, 1989

MR. KAMAKI A. KANAHELE, III, ADMINISTRATOR
OFFICE OF HAWAIIAN AFFAIRS
STATE OF HAWAII
1600 KAPIOLANI BLVD., SUITE 1500
HONOLULU, HAWAII 96814

SUBJECT: HILO WASTEWATER TREATMENT AND CONVEYANCE FACILITIES
DRAFT SUPPLEMENTAL EIS

Thank you for your letter dated December 9, 1988 concerning the subject Draft Supplemental Environmental Impact Statement. Your comment is appreciated.

We concur that there is the possibility that unidentified subsurface cultural/archaeological features and deposits may be encountered during the course of construction. Should any of these items be unearthed during construction, the State Historic Preservation Office will be notified. Initial contacts with this agency has resulted in a determination of "no effect" on significant historic sites and compliance with the historic preservation laws were met.

We appreciate the comments expressed by your agency.

HUGH Y. ONO, P.E.
Chief Engineer

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APPENDIX A

BOTANICAL SURVEY

BOTANICAL SURVEY
HILO WASTEWATER TREATMENT FACILITY RELOCATION SITE
SOUTH HILO DISTRICT, ISLAND OF HAWAI'I

by

Winona P. Char

CHAR & ASSOCIATES
Botanical/Environmental Consultants
Honolulu, Hawaii

Prepared for: M & E PACIFIC, INC.

April 1988

Table of Contents

BOTANICAL SURVEY
HILO WASTEWATER TREATMENT FACILITY RELOCATION SITE
SOUTH HILO DISTRICT, ISLAND OF HAWAI'I

INTRODUCTION

The County of Hawaii proposes to relocate the Hilo Wastewater Treatment Facility to near the east end of the General Lyman Field on State-owned land. The site is located 3,200 ft. east of the end of the existing runway/taxiway and 2,000 ft. south of the centerline on the main runway. The proposed new wastewater treatment project site is 1,000 ft. long by 1,000 ft. wide or approximately 23 acres in size.

A field survey of the site to inventory and assess the botanical (or floral) resources was conducted on 28 March 1988. The primary objectives of the study were to 1) provide a general description of the vegetation; 2) inventory the terrestrial, vascular flora; and 3) search for rare, threatened or endangered plants on the project site.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. Existing topograhic maps were examined to determine access, terrain characteristics, boundaries, and reference points.

Access onto the site was by 4-wheel drive vehicle over a recently bulldozed tractor trail which begins near the sanitary landfill and a quarry. The tractor trail basically follows a number of transects cut and cleared originally during the construction of the airport many years prior. On the site, the western and northern boundaries have been surveyed and staked at 100 ft. intervals.

Notes were made on plant associations and distribution, substrate types, topography, exposure, etc. Species identification were made in the field; plants which could not be positively identified were collected for later determination in the herbarium (U. H., Manoa) and with comparison to the taxonomic literature.

DESCRIPTION OF THE VEGETATION

Mixed lowland forests occur along wet lower slopes from Hilo to Puna and on towards Kalapana. This forest type is a varied mosaic of plant associations rather than an integrated entity. It is usually composed of a mixture of native trees -- 'ohi'a, lama, hala -- and a number of introduced tree species, many of them originally from forestry plantings but now naturalized. Fosberg (1972) and Char and Lamoureux (1985) provide more detailed descriptions of these mixed lowland forests within the general Hilo-Puna region.

On the project site and the Hilo area, average annual rainfall is more than 150 inches per year (Dept. of Land and Natural Resources 1970), making possible a dense growth of vegetation. Thin organic soils overlay 'a'a and pahoehoe lava flows. The soils are very dark brown, almost black, stony, and mucky (Sato et al. 1973). The terrain is moderately undulating to rolling where pahoehoe is present. Small rocky outcrops or knolls and cracks and crevices are occasionally encountered on the site.

The mixed lowland forest on the site consists of an open canopy 'ohi'a-hala association with a dense shrub layer of Malabar melastome; a more detailed description follows.

Mixed Lowland Forest

Both the pubescent (Metrosideros collina var. incana) and glabrous (var. glaberrima) varieties of 'ohi'a occur on the site, although the former is more abundant. The trees are 35 to 50 ft. tall and straight-trunked; trunk diameter varies from 1 to 2 ft. Canopy cover is 40 to 50%. Scattered among the 'ohi'a are small stands of hala or pandanus (Pandanus odoratissimus), 18 to 20 ft. tall. Scattered trees of guarumo (Cercropia obtusifolia) as well as saplings and seedlings are commonly observed on the site.

A dense, almost impenetrable,shrub layer of Malabar melastome (Melastoma malabathricum), 12 to 15 ft. tall, occurs beneath the 'ohi'a trees. The melastome may become tree-like and form single-trunked specimens 18 ft. tall with trunks 6 to 10 in. in diameter. In places, strawberry guava shrubs (Psidium cattleianum) may form dense thickets, almost excluding the melastome.

The ground cover is composed largely of the introduced sword fern (Nephrolepis multiflora) with a mixture of various species such as blechnum fern (Blechnum occidentale), basketgrass (Oplismenus hirtellus), vervain (Stachytarpheta australis), and woodfern (Christella parasitica).

Under the stands of hala, there are few shrubs and ground cover is sparse. The substrate is usually very rocky and fallen hala leaves (lauhala) may be abundant. Ti plants (Cordyline terminalis) are most frequently associated with the hala stands, although they are scattered throughout the site.

Dense mats of the native uluhe fern (Dicranopteris linearis) are found in open, sunny areas. Plants of thimbleberry (Rubus rosaefolius), broomsedge (Andropogon virginicus), Glenwoodgrass (Sacciolepis indica), bamboo orchid (Arundina bambusaefolia), wawae-'iole (*Lycopodium cernuum*), ricegrass (*Paspalum scrobiculatum*), and hi'aloa (*Waltheria indica* var. *americana*) are found associated with these uluhe patches, especially along the edges of the uluhe mats.

Threatened and Endangered Plant Species

No listed, proposed or candidate threatened and endangered plant species designated by the federal and/or state governments (U. S. Fish and Wildlife Service 1985; Herbst 1987) occur on the site. Nor are any of the native species considered rare (Fosberg and Herbst 1975).

All those native species (i.e., endemic and indigenous) which occur on the proposed project site are found in similiar environmental habitats throughout the Hilo and Puna Districts.

DISCUSSION AND RECOMMENDATIONS

Although the native 'ohi'a and hala are the dominant components of the tree layer, the shrub layer and ground cover are dominated almost entirely by introduced plants. Malabar melastome and strawberry guava form dense thickets beneath the trees. Sword fern as well as a number of other introduced ferns, grasses, and herbaceous species make up the ground cover. Of a total of 46 species inventoried during this survey, 29 (63.1%) are introduced; 6 (13%) are endemic, i.e., native only to the Hawaiian Islands; 8 (17.4%) are indigenous, i.e., native to the islands and elsewhere; and 3 (6.5%) are of Polynesian introduction.

The proposed project is not expected to have a significant impact on the total island populations of the species involved as the majority of the plants are introduced. The native species occur in similiar environmental habitats throughout the Puna and Hilo regions as well as on the other islands. None are considered rare, threatened or endangered by the various government agencies.

The majority of the 'ohi'a trees on the site are tall, straight-trunked, "pole" specimens. The county should take into consideration use of this timber resource.

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APPENDIX A. PLANT SPECIES LIST.
HILO WASTEWATER TREATMENT FACILITY RELOCATION SITE
SOUTH HILO DISTRICT, ISLAND OF HAWAI'I

In the following species list, the plants are divided into three groups: Ferns and Fern Allies, Monocots, and Dicots. Taxonomy and nomenclature of the Ferns and Fern Allies follow Lamoureux's checklist of the Hawaiian pteridophytes. The flowering plants (Monocots and Dicots) are in accordance with Wagner et al. (in prep.). Common English names are in accordance with St. John (1973), in most cases; Hawaiian names follow Porter (1972) or St. John (1973).

The checklist provides the following information:

1. Scientific name with author citation.
2. Common English or Hawaiian name, when known.
3. Biogeographic status of each species. The following symbols are used:

   E = endemic = native only to the Hawaiian Islands

   I = indigenous = native to the islands and also to one or more other geographic area(s)

   P = Polynesian = plants of Polynesian introduction brought to the islands prior to Western contact (1778); not native

   X = introduced or exotic = brought here deliberately or accidentally after Western contact; not native.

Scientific name	Common name	Status
FERNS AND FERN ALLIES		
BLECHNACEAE (Blechnum Family)		
Blechnum occidentale L.	blechnum fern	X
DICKSONIACEAE (Tree Fern Family)		
Cibotium chamissoi Kaulf.	hapu'u 'i'i	E
GLEICHENIACEAE (Gleichenia Family)		
Dicranopteris linearis (Burm.) Underw.	uluhe	I
LYCOPODIACEAE (Club Moss Family)		
Lycopodium cernuum L.	wawae-'iole	I
NEPHROLEPIADACEAE (Sword Fern Family)		
Nephrolepis multiflora (Roxb.) Jarrett ex Morton	sword fern	X
OPHIOGLOSSACEAE (Adder's Tongue Family)		
Ophioglossum pendulum ssp. falcatum (Presl) Clausen	puapua-moe	E
POLYPODIACEAE (Common Fern Family)		
Phlebodium aureum (L.) J. Sm.	laua'e haole	X
Phymatosorus scolopendria (Burm.) Pic.-Serm.	laua'e	X
Pleopeltis thunbergiana Kaulf.	pakahakaha, 'ekaha-'akole	I
PSILOTACEAE (Psilotum Family)		
Psilotum nudum (L.) Beauv.	moa, pipi	I
PTERIDACEAE (Pteris Family)		
Pteris vittata L.	pteris fern	X

Scientific name	Common name	Status
THELYPTERIDACEAE (Downy Woodfern Family)		
Christella parasitica (L.) Levl.	oakfern, woodfern	X
MONOCOTS		
CYPERACEAE (Sedge Family)		
Machaerina mariscoides ssp. meyenii (Kunth) Koyama	'uki, 'aha-niu	I
Scleria testacea Nees	scleria	E
DIOSCOREACEAE (Yam Family)		
Dioscorea pentaphylla L.	pi'ia, pi'a	P
GRAMINEAE (Grass Family)		
Andropogon virginicus L.	broomsedge	X
Oplismenus hirtellus (L.) Beauv.	basketgrass, honohono-kukui	X
Paspalum scrobiculatum L.	ricegrass, mau'u-laiki	X
Sacciolepis indica (L.) Chase	Glenwoodgrass	X
LILIACEAE (Lily Family)		
Cordyline terminalis (L.) Kunth	ti, ki	P
ORCHIDACEAE (Orchid Family)		
Arundina bambusaefolia (Roxb.) Lindl.	bamboo orchid	X
Phaius tankerviliae (Banks ex L'Her.) Bl.		X
Spathoglottis plicata Bl.	Philippine ground orchid	X
PANDANACEAE (Pandanus Family)		
Pandanus odoratissimus L. f.	pandanus, hala	I

Scientific name	Common name	Status
ZINGIBERACEAE (Ginger Family)		
Zingiber zerumbet (L.) Roscoe	'awapuhi kua hiwi	P
DICOTS		
ARALIACEAE (Ginseng Family)		
Schefflera actinophylla Endl.	octopus tree	X
BEGONIACEAE (Begonia Family)		
Begonia sp.	wild begonia	X
COMPOSITAE (Daisy Family)		
Erechtites valerianaefolia (Wolf) DC.		X
Pluchea symphytifolia (Mill.) Gillis	pluchea, sour bush	X
EBENACEAE (Persimmon Family)		
Diospyros sandwicensis (A. DC.) Fosb.	lama	E
EUPHORBIACEAE (Spurge Family)		
Macaranga grandifolia (Blanco) Merr.	bingabing	X
LABIATAE (Mint Family)		
Hyptis pectinata (L.) Poit.	comb hyptis	X
MELASTOMATACEAE (Melastoma Family)		
Melastoma malabathricum L.	Malabar melastome	X
MENISPERMACEAE (Moonseed Family)		
Cocculus trilobus (Thunb.) DC.	huehue	I

Scientific name	Common name	Status
MORACEAE (Mulberry Family)		
Cecropia obtusifolia Sandmark	guarumo	X
MYRTACEAE (Myrtle Family)		
Metrosideros collina var. glaberrima (Levl.) Rock	'ohi'a-lehua, 'ohi'a	E
Metrosideros collina var. incana (Levl.) Rock	'ohi'a-lehua, 'ohi'a	E
Psidium cattleianum Sabine	strawberry guava	X
Psidium guajava L.	guava, kuawa	X
PASSIFLORACEAE (Passionfruit Family)		
Passiflora edulis Sims	passionfruit, liliko'i	X
ROSACEAE (Rose Family)		
Rubus rosaefolius Sm.	thimbleberry	X
STERCULIACEAE (Cocoa Family)		
Melochia umbellata (Houtt.) Stapf.	melochia	X
Waltheria indica var. americana (L.) R. Br. ex Hosaka	'uhaloa, hi'aloa	I(?)
ULMACEAE (Elm Family)		
Trema orientalis (L.) Bl.	gunpowder tree, trema	X
VERBENACEAE (Verbena Family)		
Lantana camara L.	lantana	X
Stachytarpheta australis Mold.	vervain	X

M&E Pacific, Inc.
Engineers & Architects

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Telephone (808) 961-2776

May 31, 1988

Ms. Winona Char
Winona Char & Associates
4471 Puu Panini Avenue
Honolulu, Hawaii 96816

Dear Winona:

Re: Hilo Wastewater Treatment System

Thank you for your earlier assistance in the botanical study required for our environmental assessment for the Hilo Wastewater Treatment project.

In conjunction with the over-all system which will include the construction of an access road and sewer pipelines, I have attached a map delineating the location of these items. The treatment plant will occupy 15 acres of the initally surveyed 23 acres at the east-end of the runway. The proposed access road to the plant site will be a continuation of the airport access road and would need to cross over State as well as Bishop Estate lands. The sewer pipelines are proposed to run from the County's existing sewage treatment plant at Puhi Bay in a southerly direction along Pua Avenue, easterly along the inside of the airport boundary fence to a point approximately 3,200 feet from the end of the runway, and continuing in a southerly alignment to the treatment plant site.

In your earlier field study and literature research, you determined that development at the proposed treatment plant site would not have any adverse environmental consequence. Based on your site investigation and your general knowledge of the characteristics of the area, would you anticipate any significant botanical impact resulting from construction along the corridor of the proposed access road and sewer pipelines.

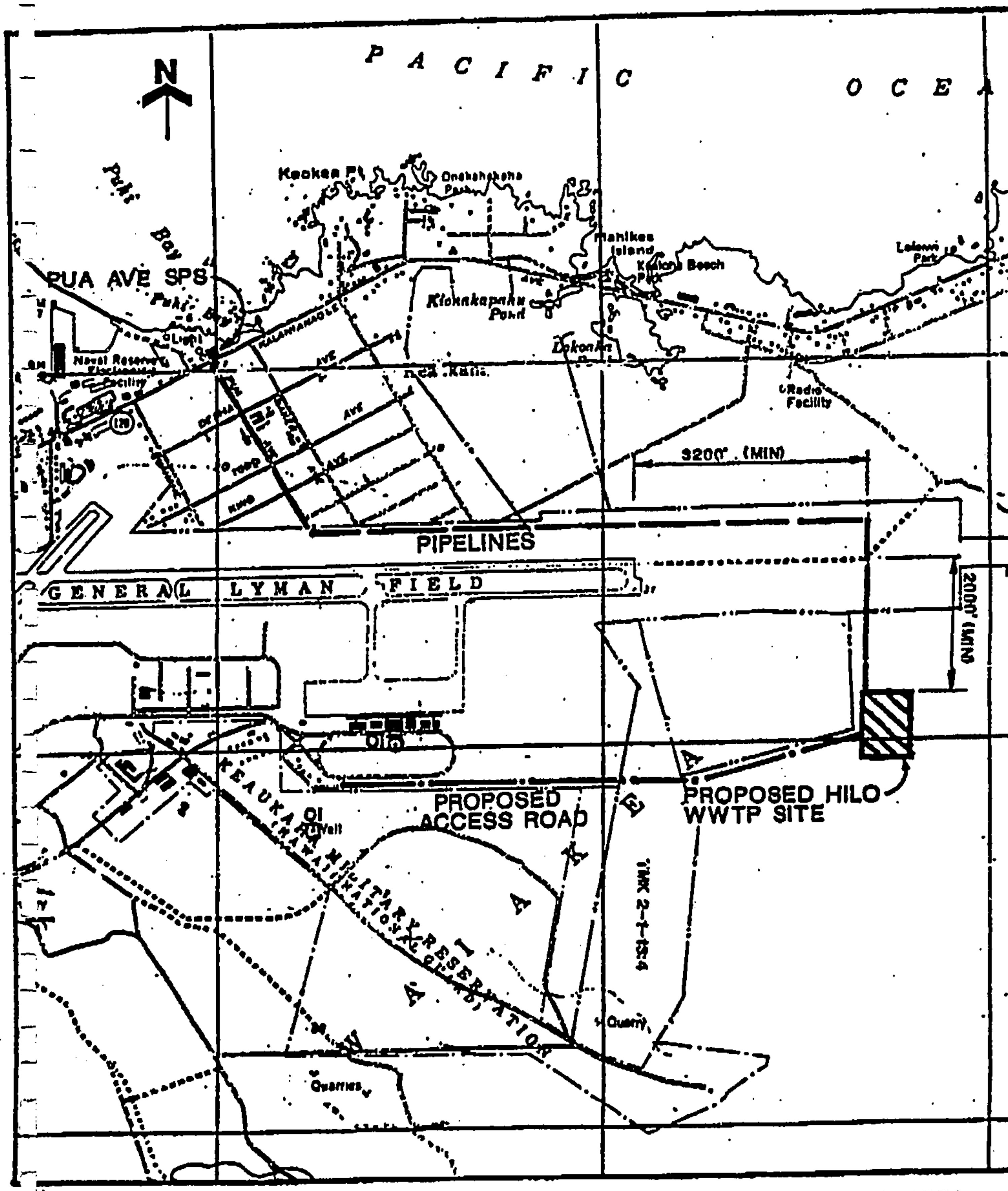
Your early review and comment on this matter would be most sincerely appreciated. Please call me should you have any questions.

Sincerely,

EK Harada

Edward K. Harada
Manager

mms
Attachment: 1
cc: Lambert Yamashita w/attachment



HILO WASTEWATER TREATMENT PLANT SITE

SCALE: 1" = 2000'

CHAR & ASSOCIATES
Botanical/Environmental Consultants
4471 Puu Panini Ave.
Honolulu, Hawaii 96816
(808) 734-7828

JUN 7 1988

MEMORANDUM

TO: Edward K. Harada
M&E PACIFIC, INC.

FROM: Winona P. Char WPChar

DATE: 06 June 1988

SUBJECT: Hilo Wastewater Treatment System

I have reviewed the map delineating the locations of the proposed access road and sewer pipe alignment.

Based on the March 1988 field studies of the area around the proposed treatment plant and from general observations of the flora in the airport area for other botanical studies, I do not anticipate any significant negative impacts on the botanical resources along the proposed access road and sewer pipeline corridors. Most of the vegetation in the area appears to have been disturbed at some time and introduced species such as Malabar melastome and strawberry guava dominate the shrub layer (see botanical report prepared for treatment plant). The native species associated with this vegetation type, i.e. 'ohi'a, uluhe, pandanus, wawae-'iole, etc., occur throughout the Hilo and Puna Districts as well as on the other islands with similiar environmental conditions.

Sould you have any further questions, please do not hesitate to contact me.

APPENDIX B

TERRESTRIAL VERTEBRATE ANIMALS

Terrestrial Vertebrate Animals of the Hilo Wastewater Treatment Facility Relocation

By Andrew J. Berger

This report was prepared upon instructions received from Mr. Edward Harada (M & E Pacific, Inc.) in letters received from him dated February 1, 1988, and March 7, 1988. My field studies were conducted on March 28, 1988.

The Habitat

With respect to endemic forests and their animal life, the entire region can be called a "wasteland." There is no endemic ecosystem anywhere near the site, which has been drastically disturbed for many years, probably going back to the last century.

One of the dominant plants, however, is ohia (Metrosideros collina), although these are rather young trees. Most of the other flowering plants in the forest consists of such introduced species as Melastoma malabathricum and strawberry guava (Psidium cattleianum). The screwpine or hala (Pandanus odoratissimus), which is native to Hawaii and many otherPacific islands, is very common in the forest, as well. Ms. Winona Char will give a complete listing of the plants in this relatively depauperate area with respect to the number of plant species present. St. John (1973) reported that more than 4,500 exotic flowering plants had been introduced to the Hawaiian Islands.

The Amphibians

There are no endemic amphibians in the Hawaiian Islands. All, therefore, have been introduced by man. None are endangered and none are of significance for an environmental impact statement. Four species of frogs have been introduced to the Hawaiian Islands. Of these, three have been introduced to the Big Island.

A. Family Ranidae, True Frogs

1. Bullfrog (Rana catesbeiana).

2. Wrinkled frog (Rana rugosa).

B. Family Buffonidae, True Toads

3. Giant Neotropical Toad (Bufo marinus)

The bullfrog is native to North America, the wrinkled frog is native to Japan, and the neotropical toad is native to Mexico southward into South America (McKeown, 1978). All require water for their breeding activities (Hunsaker and Breese, 1967). The bullfrog is known to be a predator on the downy young of the endangered Hawaiian duck or Koloa (Anas wyvilliana), and probably is so for the downy young of the other endangered Hawaiian waterbirds. The neotropical toad is (because of the highly toxic skin glands on their back) a hazard to dogs and to children who get the milk white poison in their mouth or eyes.

The Reptiles

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

A. Family Typhlopidae, Blind Snakes

1. Blind snake (Typhlina bramina)

"This small, secretive snake was apparently introduced from the Philippines in the dirt surrounding plants that were brought in for landscaping the campus of the Kamehameha Boys School in Honolulu. It was first found there in January of 1930"(Oliver and Shaw, 1933). These blind, worm-like snakes are rarely seen until they are flooded from underground burrows by heavy rains or unless one looks for them under branches and other debris on the ground. These small harmless snakes are of no significance for an environmental impact assessment and I did not look for them. They are found on all of the main islands in the chain (McKeown, 1978).

B. Family Iguanidae, Iguanid lizards

2. Green anole lizard (*Anolis carolinensis porcatus*)

C. FamilyGekkonidae, Geckos

3. Mourning gecko (*Lepidodactylus lugubris*)
4. Stump-toed gecko (*Gehyra mutilata*)
5. Tree gecko (*Hemiphyllodactylus typus*)
6. Indo-Pacific gecko (*Hemidactylus garnoti*)
7. House gecko (*Hemidactylus frenatus*)

D. Family Scincidae, Skinks

8. Metallic skink (*Leiolopisma metallicum*)
9. Snake-eyed skink (*Cryptoblepharus boutoni*)
10. Moth skink (*Lipinia noctua*)

These skinks and geckos of the Big Islands are irrelevant to an impact assessment, in part, because they adapt well to both urban and rural areas and because all are alien species in Hawaii.

The Birds

Three different groups of birds are found in the Hawaiian Islands: I. introduced; II. indigenous or native, and III, endemic or unique.

I. Introduced Birds

More than 170 species of exotic or alien bird species have been introduced to the Hawaiian Islands since 1796 (Berger, 1981). Approximately 50 species have established breeding populations in the islands. The following species of introduced birds have been recorded on the project site and on lands surrounding the site. I include birds seen on "lands surronding the site" for several reasons. First, the site itself covers only 23 acres (according to information on a map given to me by Mr. Harada); secondly, my field studies were conducted only on the morning of March 28, 1988; and thirdly, some of the species seen in surrounding area c.rtainly pass through or over the site at times, and others may move in after construction is finished.

A. Order Ciconiiformes

a. Family Ardeidae, herons and egrets

1. Cattle Egret (Bubulcus ibis). This species was imported to Hawaii from Florida to aid "in the battle to control house flies, horn flies, and other flies that damage hides and cause lower weight gains in cattle" (Breese, 1959). This egret is native to Spain, Africa, and Asia. The birds appeared in British Guiana about 1930, apparently being wind-borne from Africa, a natural colonization of the New World. By 1965,

the birds had reached California (Peterson, 1954; Van Tyne and Berger, 1976). A total of 105 birds were released on five islands between July 17 and August 24, 1959; . . . and two sites each on Oahu and Hawaii." On the island of Hawaii, I saw one cattle egret at an elevation of about 900 feet along Chain of Craters Road on November 21, 1970, and other egrets were seen at South Point and the Nakagawa Pond near Hilo in 1972. The population has increased greatly with the passing of years. During January of 1986, personnel of the State Division of Forestry and Wildlife recorded 682 egrets on the island of Hawaii (Bachman and Walker, 1986). The cattle egret became a serious threat at the Hilo airport but this threat apparently has been alleviated, as pointed out by Pratt (1988), who wrote: "Extensive efforts to reduce the Cattle Egret population near Hilo Airport, H. has resulted in a marked decrease in the species' numbers. Fewer than 10 were reported at their traditional roost in Lokoaka Pond near Hilo." Nevertheless, the cattle egret is a bird that lives near the project site.

B. Order Columbiformes

a. Family Columbidae, pigeons and doves

2. Rock dove or feral pigeon (Columba livia). The pigeon probably was the first exotic bird to be introduced to the Hawaiian Islands; their importation has been traced back to 1796. Schwartz and Schwartz (1949) wrote that feral pigeons roost and nest theyear around in sheltered portions of cliffs along the sea coast, in rocky gulches, and in collapsed lave

tubes up to 10,000 feet on Mauna Kea. These authors also found heavy parasitism of feral pigeons by tapeworms, and they stated that the tapeworm infestation retards proper nutrition and "occludes the intestine, produces undesirable toxins, and hinders breeding." They added that "in certain places where rookeries are accessible to humans, it was, and still is, the custom for local residents to periodically take the squabs for food." Navvab Gojrati (1970) reported infection by bird malaria, Haemaproteus, and Leucocytozoon in birds at the Honolulu zoo. Kishimoto and Baker (1969) reported finding the fungus Cryptococcus neoformans in 13 out of 17 samples of pigeon droppings collected on Oahu. The full significance of their findings was never determined, but, in man, this fungus causes a chronic cerebrospinal meningitis, and Hull (1963) remarked that "in all but the cutaneous forms the prognosis is very grave." The rock dove is found throughout the Hilo area.

3. Spotted or Lace-necked Dove (Streptopelia chinensis).

Also called the Chinese dove, this Asian species was released in the Hawaiian Islands at an early date; the exact date appears to be unknown, but the birds are said to have been very common on Oahu by 1879. Although this species does occur where the rainfall exceeds 100 inches per year, the highest densities are found in drier areas, especially where the alien kiawe or mesquite (Prosopis pallida) is one of the dominant plants. Schwartz and Schwartz (1949), for example, reported densities as great as 100 birds per square mile in dry areas on Molokai. Although it is considered a game bird in Hawaii, only 14 birds were shot during the 1986-1987 game bird season (Bachmon and Walker, 1987). The spotted dove is common in the general Hilo area.

4. Barred Dove or Zebra Dove (<u>Geopelia striata</u>). This dove is native to Australia and the Orient. The species is said to have been introduced to Hawaii sometime after 1922 (Bryan, 1958). It now is an abundant species on all of the islands. This dove also prefers the drier areas. Schwartz and Schwartz (1949) reported densities as great as 400 to 800 birds per square mile in some areas on Oahu: for example, Barber's Point to Makaha. The barred dove also is classified as a game bird in Hawaii, although, because of its small size, only two birds were shot on Hawaii during the 1986-1987 gamebird season (Backman and Walker, 1987). One study of the food habits in Hawaii revealed that the diet consists of 97 percent seeds and other plant materials; the 3 percent animal matter included several species of beetles, weevils, and wireworm larvae. Kocan and Banko (1974) reported on zebra doves from the Big Island that were infected with trichomonas; this parasite has "catastrophic" effects on doves in North America. The barred dove is very common throughout the Hilo region, including the airport area, and along the edges of the projett site.

C. Order Strigiformes

a. Family Tytonidae, Barn Owls

5. Barn Owl (Tyto alba pratincola). Barn owls differ from other owles in that they have a heart-shaped facial disc of feathers, hence the name of "monkey-faced owl." Barn owls were first released on the island of Hawaii during 1958 (Tomich, 1962; Berger, 1981). Like the mongoose much earlier, the owls were released in the hope that they would help to control rats in the sugarcane fields. Few studies of the food habits of the barn owl have been made in Hawaii, but one study on the island of Hawaii revealed that about 90 percent of the food consisted of house mice (Tomich, 1971). Byrd and Telfer (1980) reported that barn owls had killed more than 100 seabirds and their chicks on Kauai and Kaula Island."The known spread of the Barn Owl in Hawaii to grazing land and to forested areas suggests . . . that this species has done no more in controlling rats in the sugarcane fields than did the mongooses" (Berger, 1981:132). Barn owls are nocturnal in habits, and I did not happen to see one during my daytime field work. This owl does occur in the Hilo region and may well seek food in the project area.

D. Order Passeriformes

a. Family Zosteropidae. White-eyes and Silver-eyes.

6. Japanese White-eye (Zosterops japonicus). This white-eye is native to the main islands of Japan, from Honshu to Kyushu and the islands lying between Japan and Korea. The very first Japanese white-eyes (also Mejiro) were released

on Oahu by the Territorial Board of Agriculture and Forestry in 1929 (Caum, 1933). At least 252 white-eyes were released on the island of Hawaii during June 1937 (Berger, 1975b).

The white-eye presents an example par excellence of the success of introduced birds. This species now occurs on all of the main islands, is found from sea level to tree line on Maui and Hawaii, and inhabits very dry regions (e.g., Kawaihae) and those with 300 or more inches of rain per yer. There is virtually no habitat in Hawaii that is not occupied by the Japanese white-eye. I believe it to be the most abundant song bird in the islands. It therefore occurs throughout the project site and the Hilo region.

White-eyes eat insects, nectar, soft fruits, the pulp of berries, and flower buds, so that they can be a serious pest to farmers. The California State Department of Agriculture is greatly concerned about the accidental release of a related species (gray-backed white-eye, Z. palpebrosa) at San Diego. Two pairs escaped there in 1973 or 1974; 150 offspring had been captured in less than 10 years. "Estimates of the potential loss in soft-fruit crops, should white-eyes even begin to multiply rapidly and establish large populations, run as high as $2 million a year" (Audubon Magazine, September 1982).

b. Family Sturnidae, Starlings and Mynas

7. Common Indian Myna (Acridotheres tristis) This myna is native to India, West Pakistan, Nepal, and adjacent regions. The myna was introduced from India "in 1865 by Dr. William

Hillebrand to combat the plague of army worms that was ravaging the pasture lands of the islands. It has spread and multiplied to an amazing extent; reported to be abundant in Honolulu in 1879, it is now extremely common throughout the territory" (Caum, 1933). The myna is common to abundant in lowland areas of all of the inhabited islands, being most common in residential areas and in the vicinity of houses and barns in rural areas. I have seen mynas sitting on the backs of cattle at South Point as well as at elevations of 7,500 feet on Mauna Kea. Mynas are common in the region of the airport, on the nearby land fill, along roads near the project site as well as in the region surrounding Hilo.

c. Family Ploceidae, Weaverbirds and Their Allies

8. Warbling Silverbill (Lonchura malabarica cantans).

This silverbill is native to Africa, being found from Senegal to western and southern Sudan (Traylor, 1968). Silverbills have been characterized as being "preeminently desert birds."

There are no published records of the release of this species in Hawaii (Bryan, 1958; Berger, 1975a). It is assumed that cage birds were released on the Puuwaawaa Ranch, probably during the 1960s. I first discovered this silverbill near Kawaihae on March 22, 1972 (Berger, 1975a). Later observations have revealsed that large populations have become established on the leeward slopes of the Kohala Mountain, on Mauna Kea including Pohakuloa), Hualalai, and south Kona. I know of no actual reports of the occurrence of this silverbill in the Hilo area, but it is only a matter of time before the species establishes itself in that area.

Silverbills are seed eaters, and with the other seed eaters already established on the Big Island will make the harvesting of small grain crops virtually impossible on the island of Hawaii. (see house finch, to follow.)

9. Nutmeg Mannikin or Ricebird (Lonchura punctulata). Also known as the spotted munia, this species has a wide dustribution in Sri Lanka, India, Nepal, Burma, and southward into Malyasia and the Indo-Chinese subregion, and in the Philippines. The species was introduced to Oahu by Dr. William Hillebrand in 1965. Caum (1933) wrote that this species feeds "on seeds of weeds and grasses and does considerable damage to green rice." Although rice is no longer grown in Hawaii, this seed-eating bird continues to be a pest for certain agricultural crops (see explanation under house finch). Ricebirds are highly gregarious and flocks of 75 or more birds are not uncommon at certain times of the year. This is a prolific species, and I have found active nests in every month of the year. Ricebirds are not inhabitants of dense forests and thickets but are found wherever there are weed seeds in fairly open spaces: for example, pastures, golf courses, along dirt roads and cane haul roads, weedy fields, and in residential areas. The ricebird is common in Hilo, the area around the airport, and on Hawaii Island in general.

10. House Sparrow (Passer domesticus). Incorrectly called the English sparrow (it has a wide distribution in

Europe and Asia, as well as England), this sparrow was first imported to Oahu in 1371, when nine birds were brought in from New Zealand (where they had been introduced earlier from England). Caum (1933) wrote that the species was reported to be numerous in Honolulu in 1879. In North America, the house spwarrow (first introduced in Brooklyn, New York, in 1852) became a serious pest and tens of thousands of dollars were spent in attempting to control the population (Dearborn, 1912). This sparrow apparently never became a pest in Hawaii. It' is omnivorous in diet, eating weed seeds as well as insects and their larvae. The house sparrow typically is found in the vicinity of man and his buildings but they also forage in outlying areas, such as the land fill region.

d. Family Fringillidae, New World Sparrows, Cardinals, Buntings.

11. Cardinal (<u>Cardinalis cardinalis</u>). This cardinal also is called the Virginia Cardinal, Kentucky Cardinal, and Kentucky Redbird. Its native range is the eastern part of North America, east of the plains and northward into Ontario. Cardinals were released several times on Hawaii between 1929 and 1931 (Caum, 1933; Berger, 1975b, 1981). On Hawaii it occurs from sea level to at least 7,500 feet on Mauna Kea and Mauna Loa. It inhabits very dry areas and those with a high annual rainfall. This cardinal is a very common bird in the project area, and they were especially conspicuous because of their singing.

12. House Finch (Carpodacus mexicanus frontalis). This seed-eating finch is native to western North America. Birds were first brought to Hawaii "prior to 1870, probably from San Francisco" (Caum, 1933). It now is an abundant species on all of the islands, in residential areas, rural areas, and in the high ranch and open forest lands on Maui and Hawaii. It probably is the second most abundant song bird in the islands. Although the birds sometimes eat overripe papaya (hence, the local name "Papayabird"), the house finch is predominantly a seed-eater. House finches and ricebirds caused great damage to experimental crops of sorghum planted on Kauai and Hawaii during 1971-1972. "A report by the Senate Committee on Ecology, Environment, and Recreation says that ricebirds and linnets [equals house finch] caused a 30 to 50 percent loss in the sorghum fields at Kilauea on Kauai last year. . . . Seed-eating birds at Kohala ate about 50 tons of sorghum grain in a 30-acre experimental field that was expected to produce 60 tons" (Honolulu Advertiser, March 14, 1972, page B-2). Hence, the growing of small grain crops in the islands is not a promising potential for the much talked-about "diversified agriculture" in the State. Two other seed-eating birds (silverbill and Java sparrow) also have become established on the island of Hawaii since 1972. The house finch is an abundant bird throughout the project area and the Hilo region.

II. Indigenous Birds

These are species that are native to the Hawaiian Islands but whose total range also includes other islands in the Pacific Basin and/or North America. These are the black-crowned night heron, 22 species of seabirds, and a number of migratory species that nest in Alaska or Siberia and which spend the winter season in the islands.

A. Order Ciconiiformes

a. Family Ardeidae, Herons and Egrets

1. Black-crowned Night Heron (Nycticorax hoactli).

This subspecies has a breeding range that includes Hawaii and the Western Hemisphere from Washington and Oregon southward to northern Chile and south-central Argentina. Because the Hawaiian birds are considered to be the same subspecies as the continental birds, they are not classified as endangered, even though their continued survival in Hawaii depends on the preservation of the same wetlands on which the other Hawaiian waterbirds depend.

These herons feed on a wide variety of aquatic and terrestrial life: for example, fish, frogs, crayfish, mice, and insects. In Hawaii, they also eat the downy young of some of the seabirds and probably the downy young of the endangered Hawaiian waterbirds. They also relish prawns, and the State Land Board gave prawn producers a "120-day permit to destroy black-crowned night herons which have been causing economic havoc at Oahu's Kahuku prawn farm as well as other aquaculture farms statewide." (Honolulu Star-Bulletin, October 26, page A-8, and October 30, 1985, front page.)

This heron is uncommon on the Big Island. Personnel of the State Division of Forestry and Wildlife counted only nine herons on the island during their semiannual waterbird census on July 27, 1983; and only eight birds during January 1986 (Bachman and Walker, 1986). There is no habitat for this heron at the project site, but they do occur at the nearby ponds.

B. Seabirds.

None of the seabirds nest or forage in the vicinity of the project site.

C. Migratory Birds

The most conspicuous of the migratory species is the lesser golden plover (*Pluvialis dominica fulva*), which occurs from sea level to elevations of nearly 10,000 feet on Maui and Hawaii during the winter season. This plover frequents lawns in residential areas, golf courses, weedy pastures, open areas in the mountains, mud flats, cane haul roads, and grassy areas around the air field. There is no habitat for these winter visitants in the forest of the project site at present but the plover is a common bird in surrounding suitable habitat.

The other migratory species (other shorebirds, ducks) are restricted to ponds, mud flats, and mountain streams. I did not see any during my field studies and I did not expect to find any in that habitat.

III. Endemic Birds

These are birds that are unique to the Hawaiian Islands; they do not occur naturally in any other part of the world. At least 40 percent of these unique birds already are extinct and another 40 percent are now classified as endangered or threatened with extinction. Most of these endangered species are forest birds and there is no native forest ecosystem anywhere near the project site.

There is no suitable habitat for any of the endangered Hawaiian waterbirds at the project site.

Two species of endemic birds forage over the general region of the project site.

A. Order Falconiformes

a. Family Accipitridae, Hawks

1. Hawaiian Hawk or 'Io (Buteo solitarius).

This endemic hawk is an adaptable species, feeding on spiders, insects, mammals (especially mice), and both endemic and introduced birds (Berger, 1981). Similarly, Scott and his coworkers wrote (1986) that the "'I'o occupies a broad range of habitats from papaya and macadamia orchards through virtually all types of forest including ohia rain forest and subalpine mamane-naio woodland." Moreover, Griffin (1985, Abstract to Thesis) found "no differences . . . in success of 'io nests in habitats dominated by native (77%) versus exotic (65%) vegetation. Griffin also found the home range of this hawk to be 1,104 acres, and he wrote that "given the abundance, wide distribution, and high reproductive success of this species

. . . , it seems appropriate to reevaluate its endangered status" (Griffin, 1985:166; see, also, 1984).

Regardless of its status (i.e., endangered or non-endangered), this hawk has a large home range where it forages for food, and it has adpated to man's orchards and pastures. I saw two hawks in the ohia treees as we were driving to the project area. The proposed construction in the area will have no adverse effects on the Hawaiian hawk.

B. Order Strigiformes

a. Family Strigidae, Typical Owls

2. Hawaiian owl or Pueo (Asio flammeus sandwichensis).

The Pueo is a subspecies of the North American short-eared owl. It is a permanent resident on all of the main islands. The birds occur from sea level to at least 8,000 feet on Mauna Kea and Mauna Loa. The Pueo is not considered an endangered species on Hawaii island. This owl differs from most other owls in that it is diurnal in habits, typically being seen soaring either low or high over pastures and brushland looking for prey, which consists largely of rats and mice. I did not see any Pueo during my field studies on March 28, 1980, but I have seen the owl in this general district in the past. In any event, change of use of the small plot in the project area will have no adverse effects on the Pueo.

The Mammals

I. Endemic Mammals

The only endemic land mammal in the Hawaiian Islands is the Hawaiian bat (Lasiurus cinereus semotus), a subspecies of the American hoary bat. This bat occurs primarily on the islands of Kauai and Hawaii. It is most common on Hawaii, and has been seen from sea level to 13,200 feet elevation (Kramer, 1971; Tomich, 1986). Tomich wrote that "rarity of the hoary bat is a myth which stems from a lack of understanding by the casual observer of how a nonsocial and scattered population should appear." He added (1974): "The Hawaiian hoary bat is typically a solitary, tree-roosting animal. Occasional specimens are found singly in rock crevices or even in buildings. Thus, the population is widely scattered." Since he wrote that, the bat also has been found to use lava tubes for roosting. The bats are nocturnal in habits and I did not see any during my daytime field studies. The bats feed on insects at night and they would continue to do so whether the land is covered by the present mixed forest or whether there was a treatment plant there.

II. Introduced Mammals

All of the introduced mammals have proven highly detrimental to man, his buildings, products and agricultural crops and/or to the native forests and their animal life. None of these alien mammals is an endangered species and none is of concern as far as detrimental effects on them of any construction or change in land use in the project area. It would,, in fact, be a great boon to the islands if it were possible to exterminate all of them, which it is not.

Some of these mammals were first released in the islands by Captains Cook and Vancouver 200 years ago. Feral cattle

(*Bos taurus*), goats (*Capra hircus*), sheep (*Ovis aries*), and pigs (*Sus scrofa*) have been destroying the Hawaiian native forests since 1800, and they continue to do so today. Pigs may inhabit these forests but I did not see any or any of their "signs." The other introduced mammals occur only in the higher mountain country.

With the possible exception of the house mouse (*Mus musculus*) all of the smaller alien mammals prey on birds, their eggs, and nestlings. These small mammals include the roof rat (*Rattus rattus*), the Norway rat (*Rattus norvegicus*), Polynesian rat (*Rattus exulans*), small Indian mongoose (*Herpestes auropunctatus*), feral cat (*Felis catus*), feral dog (*Canis familiaris*). The birds that serve as prey for these small mammals include the endangered forest birds, the endangered Hawaiian waterbirds, as well as poultry and other domestic birds.

The mongoose is active during the daytime, and I saw several during my field studies. I did not attempt to trap the nocturnal rodents because their presence is irrelevant to an impact assessment and because all are alien and pestiferous species. It seems certain that all of them occur in the project area (Kramer, 1971; Tomich, 1986).

Summary and Conclusions

1. The majority of the plants in the project area are introduced or alien species, a number of which are pest speices. More than 4,500 exotic plants have been introduced to the

Hawaiian Islands (St. John, 1973). There is no semblance of any native ecosystem anywhere near the project site. The change in use of the site, therefore, will have no adverse effects on any native ecosystem.

2. Because there are no endemic amphibians or land reptiles in the Hawaiian Islands, all of those that are present are alien or introduced species. Some (e.g., the bullfrog) pose a threat to endangered waterbirds; the neotropical toad has poison glands that are a threat to dogs and to young children. All of these introduced animals are irrelevant to an impact assessment.

3. None of the 12 species of introduced birds discussed in this report is an endangered species and a number have proven to be serious pests to agriculture in Hawaii. The destruction to sorghum crops by the ricebird and the house finch has been discussed above. The two species of doves and the myna have been implicated in the spread of the seeds of such noxious plants as Lantana camara. The Japanese white-eye causes considerable damage to ornamental flowers and to fruit crops (see Keffer, et al, 1976). The barn owl has been reported to kill seabirds on Kauai, and may well kill other birds on Hawaii. It seems reasonable to conclude that the presence of these alien bird species is irrelevant to an impact assessment.

4. No indigenous bird species now inhabit the project

site. There is no suitable habitat there for the seabirds or for the migratory winter residents.

5. I saw two Hawaiian hawks near the project site; I did not happen to see a Pueo during my brief field trip in the area. Nevertheless, because of my discussion above of these two species, it is my considered opinion that change in the landuse of the project site would have absolutely no significant impact on either of these raptorial birds.

6. The only endemic land mammal in Hawaii is the Hawaiian hoary bat, now classified as an endangered species. The nocturnal, insect-eating bat inhabits urban areas as well as outlying regions and they will continue to do so if the present forest is removed and is replaced by a treatment facility.

7. All of the remaining mammals in the project area are introduced species and all are serious pests to man, his buildings, products, agriculture and to the native flora and fauna. The three species of rats prey on the nests of ground-nesting birds and even some tree-nesting birds, and the mouse and the rats cause great damage to agriculture as well as to homes and businesses. The very common diurnal mongoose is a serious predator on some of the endangered Hawaiian waterbirds as well as on poultry and other domestic birds. If it were possible to exterminate all of the

alien animals, it would be a great benefit to the Hawaiian Islands. There presence, therefore, in and adjacent to the project site is irrelevant to an environmental impact assessment.

8. Therefore, I can see no biological reason for opposing any change in the use permit for this project.

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May 31, 1988

Dr. Andrew Berger
1349 Kainui Drive
Kailua, Hawaii 96734

Dear Dr. Berger:

Re: Hilo Wastewater Treatment System

Thank you for your earlier assistance in the biological study required for our environmental assessment for the Hilo Wastewater Treatment project.

In conjunction with the over-all system which will include the construction of an access road and sewer pipelines, I have attached a map delineating the location of these items. The treatment plant will occupy 15 acres of the initially surveyed 23 acres at the east-end of the runway. The proposed access road to the plant site will be a continuation of the airport access road and would need to cross over State as well as Bishop Estate lands. The sewer pipelines are proposed to run from the County's existing sewage treatment plant at Puhi Bay in a southerly direction along Pua Avenue, easterly along the inside of the airport boundary fence to a point approximately 3,200 feet from the end of the runway, and continuing in a southerly alignment to the treatment plant site.

In your earlier field study and literature research, you determined that development at the proposed treatment plant site would not have any adverse environmental consequence. Based on your site investigation and your general knowledge of the characteristics of the area, would you anticipate any significant biological impact resulting from construction along the corridor of the proposed access road and sewer pipelines.

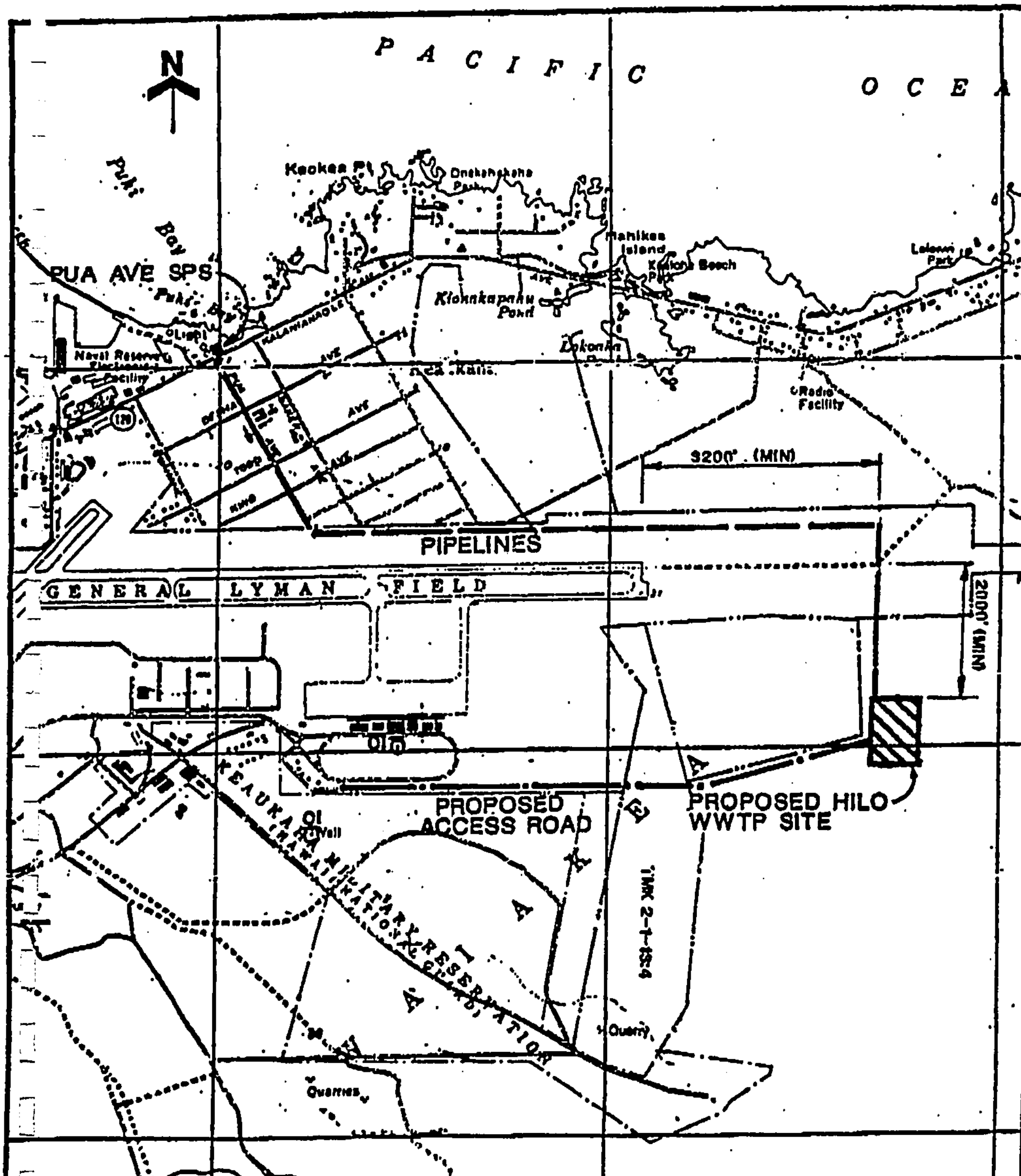
Your early review and comment on this matter would be most sincerely appreciated. Please call me should you have any questions.

Sincerely,

Ed Harada

Edward K. Harada
Manager

mms
Attachment: 1
cc: Lambert Yamashita w/attachment



HILO WASTEWATER TREATMENT PLANT SITE

SCALE: 1" = 2000'

June 2, 1988

Mr. Edard K. Harada
M & E Pacific, Inc.
100 Pauahi St., Suite 212
Hilo, HI 96720

JUN 3 1988

Dear Mr. Harada:

This is in response to your letter and enclosure of May 31, 1988: Re: Hilo Wastewater Treatment System.

My conclusions with respect to the pipelines is the same as for my earlier report: there would be no significant impact on either the flora or the fauna of the area.

Sincerely,

A. J. Berger

Andrew J. Berger
1349 Kainui Drive
Kailua, HI 96734

phone: 262-8325

APPENDIX C

ARCHAEOLOGICAL
RECONNAISANCE SURVEY

PAUL H. ROSENDAHL, Ph.D., Inc.
Consulting Archaeologist

Report 415-050588

ARCHAEOLOGICAL RECONNAISSANCE SURVEY FOR ENVIRONMENTAL IMPACT STATEMENT (EIS) HILO WASTEWATER TREATMENT FACILITY SITE

Land of Waiakea, District of South Hilo
Island of Hawaii
(TMK:2-1-13:Por.12,13,20,22)

by

Margaret L.K. Rosendahl, B.A., S.O.P.A.
Supervisory Archaeologist

Prepared for

M & E Pacific, Inc.
Big Island Office
100 Pauahi Street, Suite 212
Hilo, Hawaii 96720

May 1988

305 Mohouli Street • Hilo, Hawaii 96720 • (808) 969-1763 or 966-8038

INTRODUCTION

BACKGROUND

At the request of Mr. Edward Harada, Manager of the Big Island office of M & E Pacific Inc., Paul H. Rosendahl, Ph.D., Inc. (PHRI) recently conducted an archaeological reconnaissance survey of the Hilo Wastewater Treatment Facility Site project area, located in the Land of Waiakea, District of South Hilo, Island of Hawaii (TMK:2-1-13:Por.12,13,20,22). The primary objective of the reconnaissance survey was to make a general assessment, in conjunction with the preparation of an Environmental Impact Statement (EIS), concerning the presence or absence of, and potential impacts of the project on, any sites of possible archaeological significance within the immediate project area.

Approximately 66 man-hours of labor were expended in conducting the field work. Upon completion of field work, findings and preliminary conclusions--including tentative evaluations and recommendations--were discussed with Dr. Ross Cordy, chief archaeologist in the Department of Land and Natural Resources-Historic Sites Section (DLNR-HSS), and with Ms. Connie Kiriu, staff planner in the Hawaii County Planning Department (HCPD). Dr. Cordy and Ms. Kiriu will formally review project findings upon submission of this final report.

SCOPE OF WORK

The basic objective of the reconnaissance survey was to identify--to discover and to locate on available maps--sites and features of potential archaeological significance. A <u>reconnaissance survey</u> comprises the initial level of archaeological investigation. It is extensive rather than intensive in scope, and is conducted basically to determine the presence or absence of archaeological resources within a specified project area. A reconnaissance survey indicates the general nature of and variety of archaeological remains present, and the general distribution of such remains; it permits a general significance assessment of the archaeological resources, and facilitates formulation of realistic recommendations and estimates for such further work that might be necessary or appropriate. Such further work could include <u>intensive survey</u>--data collection involving detailed recording of sites and features--and selected test excavations; and possibly <u>mitigation</u>--data recovery research excavations, construction monitoring, interpretive planning and development, and/or preservation of sites and features with significant scientific research, interpretive, and/or cultural values.

The specific objectives of the Hilo Wastewater Treatment Facility Site reconnaissance survey, were (a) to review and evaluate available archaeological and historical literature relevant to the proposed site, (b) to conduct a surface reconnaissance survey to determine the presence/absence of significant archaeological sites within the proposed site, and (c) to assess what effect, in any, the proposed project might have on existing archaeological sites.

The reconnaissance survey was conducted in accordance with the minimum requirements for reconnaissance-level survey as recommended by the Society for Hawaiian Archaeology (SHA). These standards are currently used by the DLNR-HSS and HCPD as guidelines for the review and evaluation of archaeological reconnaissance survey reports submitted in conjunction with various permit applications.

PROJECT AREA DESCRIPTION

The Hilo Wastewater Treatment Facility Site project area is situated in the Land of Waiakea, District of South Hilo, Island of Hawaii (Figure 1). The project area is located southeast of General Lyman Field, 3,200 ft east of the eastern end of the existing main runway, and 2,000 ft south of the centerline of the main runway. The project area is comprised of a square parcel and a sewerline corridor which extends seaward from the parcel. The parcel measures c. 1,000 ft (305.0 m) on a side and comprises about 23 acres. The corridor is c. 12,535 ft (3,810 m) long. It extends northward from near the northeast corner of the project area for about 2,250 ft, at which point it turns and extends westward for c. 7,000 ft (2,134.0 m), and finally turns and extends to the northwest for c. 3,285 ft (1000.0 m). The northwesterly running segment, which parallels Pua Avenue, cuts through a Hawaiian Homes subdivision and terminates at the present sewer plant at Puhi Bay.

Vegetation within the 23-acre square parcel and within the north-south running leg of the corridor is very dense and consists primarily of mature ohi'a (Metrosideros collina [Forst.] Gray subsp. polymorpha [Gaud.] Rock), pandanus (Pandanus odoratissimus L.), clerodendron (Clerodendron fragranus), uluhe (Dicranopteris linearis [Burm.] Underw.), ti (Cordyline terminalis L.), and 'ie'ie (Freycinetia arborea Gaud.). Vegetation in the east-west leg of the corridor is fairly open. Vegetation in the northwesterly running leg of the corridor is very open and is comprised of various landscaping ornamentals.

Rainfall in the project area is c. 125 to 150 inches per year (Armstrong 1983:63). The terrain in the 23-acre square parcel portion of the project area, except for an area of fairly level pahoehoe in the southwest portion of the parcel, is irregular and is characterized by series of pahoehoe ridges and low areas.

A long-time resident of a nearby subdivision, who was part of the crew who excavated a trench along the east-west corridor, described how they

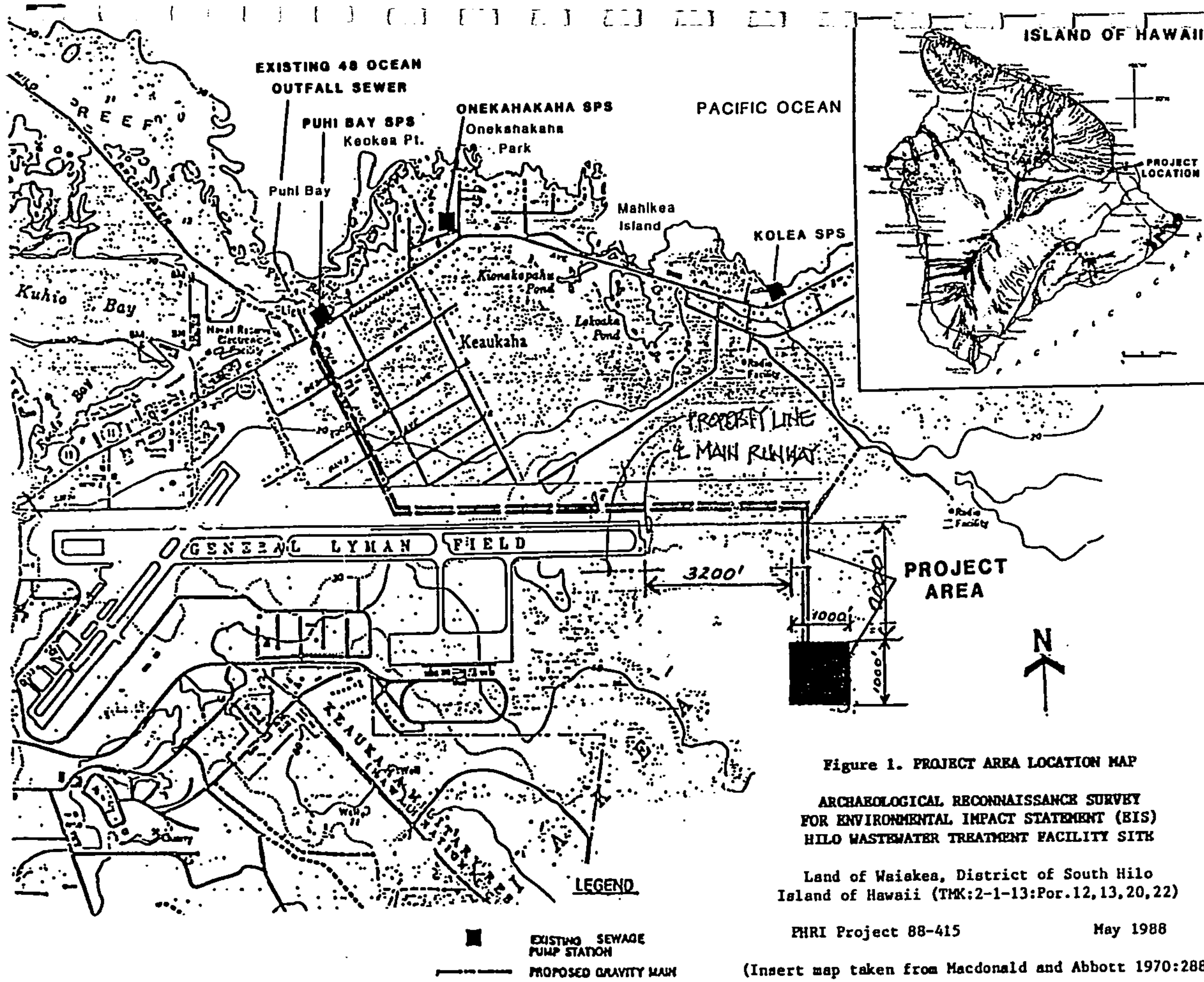


Figure 1. PROJECT AREA LOCATION MAP

ARCHAEOLOGICAL RECONNAISSANCE SURVEY
FOR ENVIRONMENTAL IMPACT STATEMENT (EIS)
HILO WASTEWATER TREATMENT FACILITY SITE

Land of Waiakea, District of South Hilo
Island of Hawaii (TMK:2-1-13:Por.12,13,20,22)

PHRI Project 88-415 May 1988

(Insert map taken from Macdonald and Abbott 1970:288) had to dig through solid rock in order to open the trench, and how portions of the trench were up to 12 ft below ground surface. The trench, he said, was situated immediately inside of the existing fence which surrounds the perimeter of the General Lyman Field main runway. The trench appears to correspond approximtely with the planned sewerline corridor.

PREVIOUS ARCHAEOLOGICAL AND HISTORICAL RESEARCH

A review of archaeological reports at Hawaii County Planning Department and DLNR-HSS indicated that only limited archaeological study has been conducted in Hilo and that no archaeological work of any kind has been conducted within or immediately adjacent to the project area. In addition, background research indicates that no Land Commission Award (LCA) parcels have been granted in the present project area.

The earliest archaeological investigation concerning Hilo was conducted by Hudson in the early 1930s (Hudson Ms.). In his study, Hudson describes sites in an area north of the present survey area--an area extending along the coast from Hilo to Leleiwi. Hudson did not identify any archaeological remains in Hilo town.

In 1982, J.S. Athens conducted an archaeological walk-through survey in Hilo for the U.S. Army Engineer Division-Pacific Ocean (Athens 1982). In conjunction with Athens' study, under the same cover, was historical research by Kelly. Kelly conducted research on Alenaio Stream and the Hilo Boarding School ditch, and reviewed Hilo's development (Kelly 1982). The research by Kelly provides some information on the early history of Hilo (a more detailed history of Hilo is presented in "Hilo Bay: A Chronological History" [Kelly et al. 1981]). An 1825 map of Hilo by C.R. Melden, included in Kelly's research (1982:4), indicates that the present project area had no specific uses--no houses or villages are depicted within the area.

The two most recent archaeological studies conducted in Hilo were by M.L.K. Rosendahl (1988), and Rosendahl and Talea (1988). The former study was a reconnaissance survey of five potential judiciary sites in Hilo. During that survey, no archaeological remains of any kind were identified. The latter study was a reconnaissance survey of three potential irradiation plant sites. All the sites were in the Land of Waiakea; two of the sites were located immediately adjacent to and west and south of General Lyman Field. During the survey, no archaeological remains were identified (Rosendahl and Talea 1988).

FIELD METHODS AND PROCEDURES

Field work for the current project was conducted on April 6 and 8, 1988, by PHRI Supervisory Archaeologist Margaret L.K. Rosendahl, assisted by PHRI Field Archaeologists Roy Pua-Kaipo, Eric Pearthree, Mikele Fager, and Jack Harris. The field work consisted of conducting pedestrian sweeps across the 23-acre square parcel, and conducting a walk-through survey of the corridor. To facilitate the survey, crew members used copies of a topographic map (scale 1"=200'). Professional surveyors had earlier hand-cut their way through the densely vegetated north and west boundaries of the square parcel and had flagged the boundaries every 100 ft with orange flagging tape. The archaeological crew hand-cut an additional line along the south boundary and flagged it with pink flagging tape. The pedestrian sweeps were initiated from the south boundary and proceeded toward the north. During the sweeps, the distance between sweeping crew members varied between 10-15 meters, depending on vegetation and topography. The corridor survey covered c. 5.0 meters on either side of the corridor centerline. A line had to be hand-cut through the dense vegetation in the north-south leg of the corridor prior to that leg being surveyed.

FINDINGS

No archaeological remains of any kind were identified within the Hilo Wastewater Treatment Facility Site project area; the ground surface of the project area evidenced no traces of prehistoric or early historic land use patterns.

CONCLUSION

Based on the negative results of the present archaeological surface reconnaissance survey, it is concluded that no further archaeological work of any kind is necessary at the Hilo Wastewater Treatment Facility Site project area. It is recommended that the project area be granted full archaeological clearance.

It should be noted that the above evaluations and recommendation have been made on the basis of a surface reconnaissance survey. There is always the possibility, however remote, that previously unidentified subsurface cultural features or deposits of significance might be encountered in the course of subsequent land modification activities. In such a situation, archaeological consultation should be sought immediately.

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M&E Pacific, Inc.
Engineers & Architects

Big Island Office
100 Pauahi St., Suite 212
Hilo, Hawaii 96720
Telephone (808) 961-2776

May 31, 1988

Dr. Paul Rosendahl
Archaeologist
305 Mohouli Street
Hilo, Hawaii 96720

Dear Paul:

Re: Hilo Wastewater Treatment System

Thank you for your earlier assistance in the archaeological study required for our environmental assessment for the Hilo Wastewater Treatment project.

In conjunction with the over-all system which will include the construction of an access road and sewer pipelines, I have attached a map delineating the location of these items. The treatment plant will occupy 15 acres of the initially surveyed 23 acres at the east end of the runway. The proposed access road to the plant site will be a continuation of the airport access road and would need to cross over State as well as Bishop Estate lands. The sewer pipelines are proposed to run from the County's existing sewage treatment plant at Puhi Bay in a southerly direction along Pua Avenue, easterly along the inside of the airport boundary fence to a point approximately 3,200 feet from the end of the runway, and continuing in a southerly alignment to the treatment plant site.

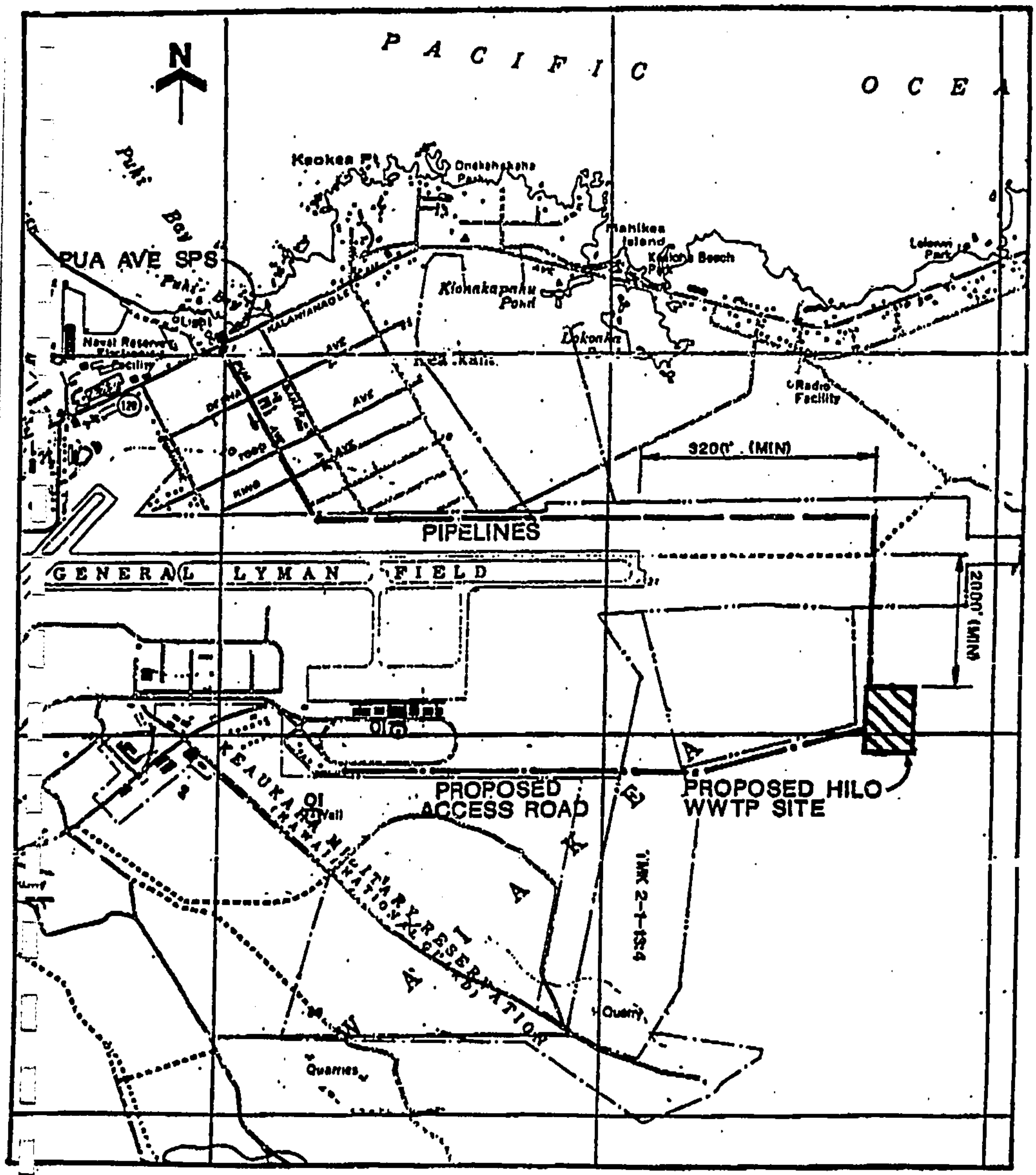
In your earlier field study and literature research, you determined that development at the proposed treatment plant site would not have any adverse environmental consequence. Based on your site investigation and your general knowledge of the characteristics of the area, would you anticipate any significant archaeological impact resulting from construction along the corridor of the proposed access road and sewer pipelines.

Your early review and comment on this matter would be most sincerely appreciated. Please call me should you have any questions.

Sincerely,

Edward K. Harada
Manager

mms
Attachment: 1
cc: Lambert Yamashita w/attachment



HILO WASTEWATER TREATMENT PLANT SITE

SCALE: 1" = 2000'

PAUL H. ROSENDAHL, Ph.D., Inc.
Consulting Archaeologist

June 8, 1988
88-415

Mr. Edward K. Harada, Manager
Big Island Office
M & E Pacific, Inc.
100 Pauahi St., Suite 212
Hilo, Hawaii 96720

JUN 8 1988

Subject: Hilo Wastewater Treatment System

Dear Mr. Harada:

We have reviewed the map attached to your letter of May 31, 1988 to Dr. Paul Rosendahl. In your letter, you asked whether--based on our recent field survey of the proposed wastewater treatment plant site and knowledge of the area--we would anticipate any significant impact upon any archaeological resources by the proposed access road corridor and sewer-line corridor. The access road corridor and sewerline corridor are identified on this map. As part of Hilo Wastewater Treatment project, the sewerline corridor was inspected during the recent archaeological reconnaissance survey conducted by Paul H. Rosendahl, Ph.D., Inc. (PHRI) in April 1988. The reconnaissance survey of the unstaked sewerline corridor involved cutting a survey line through thick vegetation from the proposed wastewater treatment site to the northeast corner of the General Lyman Field property. The remaining pipeline corridor was also inspected. The proposed access road corridor was not included in the identified areas to be surveyed. Based on a review of existing literature and the recent archaeological surveys, it is our opinion that the potential for archaeo-logical sites within this access road corridor is extremely remote. To date no archaeological sites have been identified in this forested area.

It is our recommendation that the access road corridor be examined in conjunction with the survey and design work. This work would be conducted as part of monitoring the access road vegetation grubbing, and would involve inspecting the alignment after it has been flagged but before the initial grubbing. Based on our experience to date in this area, there appears to be extremely low probability for archaeological sites, and this approach would be appropriate.

If you have any questions, please feel free to contact me at our Hilo office at 969-1763.

Sincerely,

Margaret L.K. Rosendahl

Margaret L.K. Rosendahl
Vice President and Supervisory
Archaeologist

305 Mohouli Street • Hilo, Hawaii 96720 • (808) 969-1763 or 966-8038

AU250 2.102 ✓

JOHN WAIHEE
GOVERNOR OF HAWAII

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

LIBERT K. LANDGRAF
DEPUTY

MAY 23 1988

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

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

RECEIVED MAY 24 1988

Mr. James J. Lutz, Program Manager
Barrett Consulting Group Inc.
12 South King Street, Suite 200
Honolulu, Hawaii 96813

Dear Mr. Lutz:

SUBJECT: Historic Preservation Review -- Hilo Wastewater Treatment Plant Project
Waiakea, South Hilo, Hawaii
TMK: 2-1-13: parts 12, 13, 20 & 22

Thank you for your letter of May 12, 1988. Our staff has reviewed the report.

If federal involvement exists, then compliance with the National Historic Preservation Act will have to occur. If State involvement or direct County involvement or funding occurs, then Chapter 6E, H.R.S., has to be complied with. This letter covers either possibility.

The archaeological report (M. Rosendahl 1988. Archaeological Reconnaissance Survey for Environmental Impact Statement (EIS), Hilo Wastewater Treatment Facility Site) indicates that the archaeological survey adequately covered the project area and that no historic sites were found. Thus, your project will have "no effect" on significant historic sites, and compliance with the historic preservation laws is met. (Note: The wording in the last sentence should be used in your Draft EIS, not the phrases "archaeological clearance" or "no further archaeological work is necessary". The latter phrases have no meaning in the legal framework of the laws in this case.)

Thank you for your early coordination with our Historic Sites Section on this matter.

Very truly yours,

WWPaty

WILLIAM W. PATY
Chairperson and State
Historic Preservation Officer

APPENDIX D

STATE OF HAWAII
WATER QUALITY STANDARDS

CLASSIFICATION OF WATER USES

MARINE WATER

(A) CLASS AA - it is the objective of this class that these waters remain in their natural pristine state as nearly as possible with an absolute minimum of pollution or alteration of water quality from any human-caused source or actions. To the extent practicable, the wilderness character of such areas shall be protected. No zones of mixing shall be permitted in this class within a defined reef area, in waters of a depth less than ten fathoms or in waters up to a distance of 1,000 feet offshore if there is no defined reef area and if the depth is greater than ten fathoms.

The uses to be protected in this class of waters are oceanographic research, the support and propagation of shellfish and other marine line, conservation of coral reefs and wilderness areas, compatible recreation, and aesthetic enjoyment.

The classification of any water area as Class AA shall not preclude other uses of such waters compatible with these objectives and in conformance with the criteria applicable to them.

(B) CLASS A - It is the objective of this class of waters that their use for recreational purposes and aesthetic enjoyment be protected.

Any other use shall be permitted as long as it is compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters. Such waters shall not act as receiving waters for any discharge which has not received the best degree of treatment or control compatible with the criteria established for this class. No new industrial or sewage discharges will be permitted within embayments.

Source: Chapter 54 of Title 11, Administrative Rules, Department of Health, State of Hawaii

1. <u>Class A Open Coastal Waters</u>

Parameters	Geometric Mean not to exceed the given value	Not to exceed the given value more than 10% of the time	Not to exceed the given value more than 2% of the time
Total Kjeldahl Nitrogen (ug N/l)	150.00* 110.00**	250.00* 180.00**	350.00* 250.00**
Ammonia Nitrogen (ug NH_4-N/l)	3.50* 2.00*	8.50* 5.00**	15.00* 9.00**
Nitrate + Nitrite Nitrogen (ug (NO_3 + NO_2)-N/l)	5.00* 3.50**	14.00* 10.00**	25.00* 20.00*
Total Phosphorus (ug P/l)	20.00* 16.00**	40.00* 30.00**	60.00* 45.00**
Light Extinction*** Coefficient (k units)	0.20* 0.10**	0.50* 0.30**	0.85* 0.55**
Chlorophyll a (ug/l)	0.30* 0.15**	0.90* 0.50**	1.75* 1.00*
Turbidity (Nephelometric Turbidity Units)	0.50* 0.20**	1.25* 0.50**	2.00* 1.00**

* "Wet" criteria apply when the open coastal waters receive more than three million gallons per day of fresh water discharge per shoreline mile.

** "Dry" criteria apply when the open coastal waters receive less than three million gallons per day of fresh water discharge per shoreline mile.

*** Light Extinction Coefficient is only required for dischargers who have obtained a waiver pursuant to Section 301(h) of the Federal Water Pollution Control Act of 1972 (33U.S.C.1251), as ammended, as are required by EPA to monitor it.

Temperature - Shall not vary more than $1^{o}C$ for ambient conditions.

Salinity (ppm) - shall not vary more than 10% from natural or seasonal changes considering hydrologic input and oceanographic factors.

2. <u>Class II Reef Communities (Marine Bottom)</u>

A. Oxidation-reduction potential (E_H) in the uppermost 10 cm sand patches shall not be less than +100 mv.

B. No more than 50% of the grain size distribution of sand patches shall be smaller than 0.125 mm in diameter.

C. Episodic deposits of flood-borne soil sediment shall not occur in quantities exceeding equivalent thickness for longer than 24 hours after a heavy rainstorm as follows:

(i) No thicker than an equivalent of 2 mm. (0.02 inch) on living coral surfaces.

(ii) No thicker than an equivalent of 5 mm. (0.02 inch) on other hard bottoms.

(iii) No thicker than an equivalent of 10 mm. (0.02 inch) on soft bottoms.

(iv) The director of health shall determine parameters, measures, and criteria for bottom biological communities which may be affected by proposed actions. Permanent benchmark stations may be required where necessary for monitoring purposes. The water quality standards for this subsection shall be deemed to be met if time series surveys of benchmark stations indicated 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.

3. <u>Marine Recreational Waters Criteria</u> (within 1,000 feet of shoreline)

A. Enterococci content shall not exceed a geometric mean of 35 per 100 ml in five or more samples as collected during any 30-day period.

B. Raw or inadequately treated sewage or other pollutants of public health significance, as determined by the Director of Health, shall not be present in natural public bathing or wading areas.

APPENDIX E

SUITABILITY OF HILO STP SITE FOR INJECTION WELLS

SUITABILITY OF HILO STP SITE FOR INJECTION WELLS

by

John F. Mink
Frank L. Peterson

February 29, 1988

SUMMARY

1. The proposed Hilo injection well site has exceedingly high injection capacity and low clogging potential.

2. Wastewater injection at the site is not expected to contaminate potable groundwater supplies as the site is well seaward of the UIC line and greater than 10,000 feet from the nearest drinking water wells.

3. Two options for wastewater injection at the site are: (1) injection directly into the basal lens, and (2) injection into the salt water underlying the lens.

4. Because of its buoyancy, wastewater injected into the underlying salt water will rapidly rise into the basal lens; hence in both cases the same general processes will prevail, resulting in a wastewater plume that will flow with the ambient groundwater and discharge into the ponds and along the coast.

5. Because of the very high transmissivities and groundwater flow rates in the region, the wastewater plume will be restricted over a relatively narrow distance (about 1000 feet at the coast) and mixing effects will be minor; thus essentially a continuous slug of undiluted wastewater can be expected to discharge into the ponds and along the coast.

INJECTION WELLS AND THEIR PERFORMANCE

by

Frank L. Peterson

SUMMARY OF INJECTION WELL PERFORMANCE IN HAWAII

The history of injection well use for disposal of domestic sewage wastewater in Hawaii is extensive. More than 500 injection wells have been constructed and operated for this purpose during the past 25 years in Hawaii. The nature of Hawaiian injection well practices and problems has been described extensively in the literature, and some of the more significant publications include: Larson, et al, 1977; Oberdorfer and Peterson, 1985; Peterson, et al, 1978; Peterson and Oberdorfer, 1985; Petty and Peterson, 1979; and Takasaki, 1974. The conclusions of Peterson and Oberdorfer (1985) are especially relevant for this project, and they are summarized below (reprint of this paper is attached).

Wastewater injection poses two distinct potential problems in the Hawaiian environment: (1) possible contamination of potable groundwater supplies and nearshore coastal waters, and (2) formation clogging and subsequent reduction of injection well capacity. Contamination of fresh groundwater bodies by injected wastewaters is not known to be a problem at the present time. The extent of nearshore coastal water contamination is uncertain. Certainly wastewaters injected into coastal aquifers within a few tens or hundreds of meters from the shore must discharge virtually undiluted into the coastal waters. However, to date the extent of this problem, if it occurs, has not been documented.

Conversely, problems of formation clogging and significant reduction of injection well capacity have been severe, and well over half of all Hawaiian wastewater injection wells have experienced significant clogging problems. Petty and Peterson

(1979) determined that the following factors are most responsible for injection well failures: (1) unfavorable hydrogeology, (2) underdesign of sustainable injection well capacity, (3) poor effluent quality, and (4) lack of proper injection well maintenance. Peterson and Oberdorfer (1985) state that

> "although clogging will undoubtedly continue to be a major obstacle to the successful operation of existing and future injection wells,.........it is possible to achieve considerable improvement in injection well performance if steps are taken to eliminate existing deficiencies. The most important of these involve better site selection, more realistic injection capacity prediction and design, better control of injectant quality, and the use of more diligent well maintenance and rehabilitation practices."

They go on to conclude

> "it is now quite clear that injection wells are not the low-cost maintenance-free wastewater disposal alternative they were once thought to be. Furthermore, it is quite likely that under all but the most favorable of conditions, the useful lifetime of injection wells is quite short, probably only a few years at the most, and perhaps their use should be considered only as an interim disposal solution. Nonetheless, at favorable sites, the use of wastewater injection wells can be moderately successful if adequate effort and money are expended to ensure their proper operation."

HYDROGEOLOGIC SETTING OF HILO PROJECT AREA

The Hilo project area is underlain by basaltic lava flows of the Mauna Loa Kau Volcanic Series. Davis and Yamanaga (1968) characterize the water-bearing properties of these rocks as extremely permeable with large coastal spring discharge. Drawdowns are minute even at pumping rates of several thousand gallons per minute, and hydraulic conductivity (K) values of several thousand feet per day are likely. This author's personal experience with pump testing of the nearby Hawaii Electric wells confirms the existence of the very high K values in this area. A series of pump tests conducted in 1973 on Hawaii Electric wells 4203 (located approximately 15,000 feet south west of the proposed STP, see Figure 1) demonstrated that pumping rates of about 4500 gallons per minute (gpm) produced no observable drawdown in an observation well 100 feet away and only about 0.5 inches of drawdown in an observation well 25 feet from the pumped well (Peterson, 1973, Unpublished report to Hilo Electric Co.). Pump test results from several of the Hawaii Electric wells are listed in Table 1, and show specific capacities (pumping rate/drawdown) ranging from 1000-5500 gpm/ft.

Further evidence of the very high permeabilities in the Hilo area is the extensive basal groundwater discharge along the coast, which is thought to be on the order of at least 30 mgd per lineal mile of coast. In fact, several investigators have estimated that the spring discharge at Waiakea Pond alone exceeds 100 million gallons per day (Davis and Yamanaga, 1968).

Groundwater in the Hilo coastal area occurs as unconfined basal water with heads of only a few feet above sea level. The head at the proposed injection site has not been measured, but it is thought to be about 4-5 feet, and thus the hydraulic gradient must be about 4-5 feet per mile. The direction of groundwater flow is not well known in detail, but generally is toward the coast and in the project area is thought to move in a general north-northwesterly direction.

Groundwater quality in the area is generally brackish right at the shore but rapidly freshens inland. For example, water at well 4202-01 has about 200 mg/l Cl while water at Hawaii Electric wells 4203 have only about 25 mg/l Cl. Figure 1 shows the location of known nearby wells and Table 1 gives hydrologic data for the wells.

SUITABILITY OF THE HILO PROJECT AREA FOR WASTEWATER INJECTION

In order to demonstrate the suitability of the project site for wastewater injection several potential problems must be evaluated. These are: (1) injection capacity, (2) clogging potential, (3) contamination of potable groundwater supplies, and (4) contamination of coastal waters.

Injection Capacity

As described in the previous section on the hydrogeologic setting, the subsurface formations within the Hilo project area are extremely permeable (K is estimated to range between 1000-10000 ft/day), and hence injection capacity should be high. As shown in Table 1, pump test results from the Hawaii Electric wells give specific capacities in the range of 1000-5500 gpm/ft (note:

injection capacity = injection rate/head build-up, which, in a given well, theoretically is the same as specific capacity, but in actual practice usually is somewhat lower). Injection capacity is site specific and future injection testing would be required at the actual injection well sites selected, but all indications are that injection capacity at the proposed project site is fully capable of handling the anticipated wastewater volume of 5 mgd.

Clogging Potential

Generally, clogging potential of an injection system is inversely related to injection capacity, thus clogging at this site would not be expected to pose serious problems. It must be remembered, however, that clogging at any site can become a serious problem if the injected wastewater quality is allowed to deteriorate or if the injection wells are not properly maintained and serviced. As described by Peterson and Oberdorfer (1985), injection wells quite clearly are not the maintenance-free low-cost disposal alternative they were once thought to be. As an example, if during the course of a power outage or some other STP malfunction, raw sewage enters injecton wells it will rapidly clog them, often beyond the point of easy rehabilitation. This is unlike an ocean outfall system which normally can survive short periods of raw sewage disposal without serious long-term consequences.

Groundwater Contamination

As described above, because of the high injection capacity and low potential for clogging, this site appears to be well suited for successful injection well operations. However, these very properties that are so favorable for injection can be expected to cause the injected wastewater to move rapidly away from the injection site with only minor mixing and dilution. Hence contamination of groundwater and/or coastal waters are potential problems. At this site contamination of potable groundwater is not expected to be a problem. Although abundant quantities of low salinity groundwater exist within a few thousand feet of the proposed injection site, the entire project area is located well within the zone designated for injection by the UIC line (see Figure 2). Furthermore, there are no wells used for potable water supply within at least 2 miles of the proposed injection site (Figure 1 and Table 1), and the wastewater plume that is expected to form as a result of injection (see accompanying report by J. Mink) will move rapidly toward the coast and away from the more potable inland groundwaters.

Coastal Water Contamination

The most serious problem associated with wastewater injection at the proposed site is possible contamination of nearshore coastal and pond waters. Given the very high permeability of the lava formations in this region, it is extremely likely that a plume of injected wastewater will rapidly migrate from the injection well site to the coastline. It is anticipated that the plume will become permanently established and discharge a stream of virtually undiluted wastewater into the coastal and pond waters north-northwest of the injection site. The extent of contamination of these waters will depend on several factors: the quality and quantity of wastewater discharge, the area of shoreline (or pond) over which the discharge occurs, and the amount of turbulence and hence mixing of the coastal and pond receiving waters. Coastal waters thought to be most susceptible to contamination are shown in Figure 1. If wastewaters enter Lokoaka and Kionakapahu ponds the pond waters will be particularly susceptible to contamination because mixing in the ponds is minimal.

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Pacific Science (1985), vol. 39, no. 2

Uses and Abuses of Wastewater Injection Wells in Hawaii[1]

FRANK L. PETERSON[2] and JUNE A. OBERDORFER[3]

ABSTRACT: During the past two decades in Hawaii, more than 500 injection wells for the disposal of domestic sewage wastewater have been constructed and operated. Thus far, contamination of potable groundwater supplies has not been a problem. Many of the injection wells, however, have not performed as designed, and aquifer clogging and reduced injection capacity have produced numerous well failures resulting in public health, legal, and financial problems. Factors most commonly responsible for the well problems have been unfavorable hydrogeology, underdesign of injection well capacity, poor effluent quality, and lack of injection well maintenance. Detailed study of clogging mechanisms in the immediate vicinity of injection wells suggests that binding of pore spaces by nitrogen gas is the most important cause of aquifer clogging. Other clogging mechanisms also operating are filtration of solid particles and growth of microorganisms.

THE HAWAIIAN ISLANDS ARE principally dependent on groundwater for potable water supplies. Consequently, the disposal of liquid wastes into the subsurface is of great concern. The principal mode of groundwater occurrence is the basal (or Ghyben-Herzberg) lens of fresh water overlying and displacing the denser saline water. The basal groundwater body is generally *thickest and freshest* where recharge (i.e., rainfall) is greatest, which is generally in the interior portions of the islands. Along the coastal margins of the islands, groundwater bodies are generally thinner and more saline. The predominant aquifers are highly permeable basaltic lava flows. However, in the coastal portions of the older islands, especially Oahu and Kauai, less permeable marine and alluvial sediments, commonly referred to as caprock, often occur and may confine fresh basal water beneath them. The caprock materials may also contain some fresh groundwater, but more commonly contain brackish water.

Because the Hawaiian Islands are surrounded by the Pacific Ocean and the vast majority of the population lives in the coastal region, disposal of municipal wastewaters has been achieved mainly by ocean outfalls in the urban sewered areas and by cesspools in the rural unsewered regions. During the last two decades, however, numerous hotels, apartments, and condominiums have been constructed in outlying unsewered areas, generally along the coast. These new facilities have produced volumes of sewage that for the most part are too great for cesspool disposal, but too small for economic ocean outfall disposal. As a result, the use of injection wells for subsurface disposal has proliferated, often with less than satisfactory results (Figures 1 and 2).

HAWAIIAN INJECTION WELLS

At present there are more than 250 injection facilities that utilize over 500 injection wells in the state. These wells are used for a variety of industrial and domestic wastes, but the majority are for the disposal of treated sewage effluent. Figure 3 shows the generalized location of injection well facilities in the State of Hawaii.

Most wells are privately owned and operated and are characterized by shallow depth

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[3] San Jose State University, Department of Geology, San Jose, California 95192.

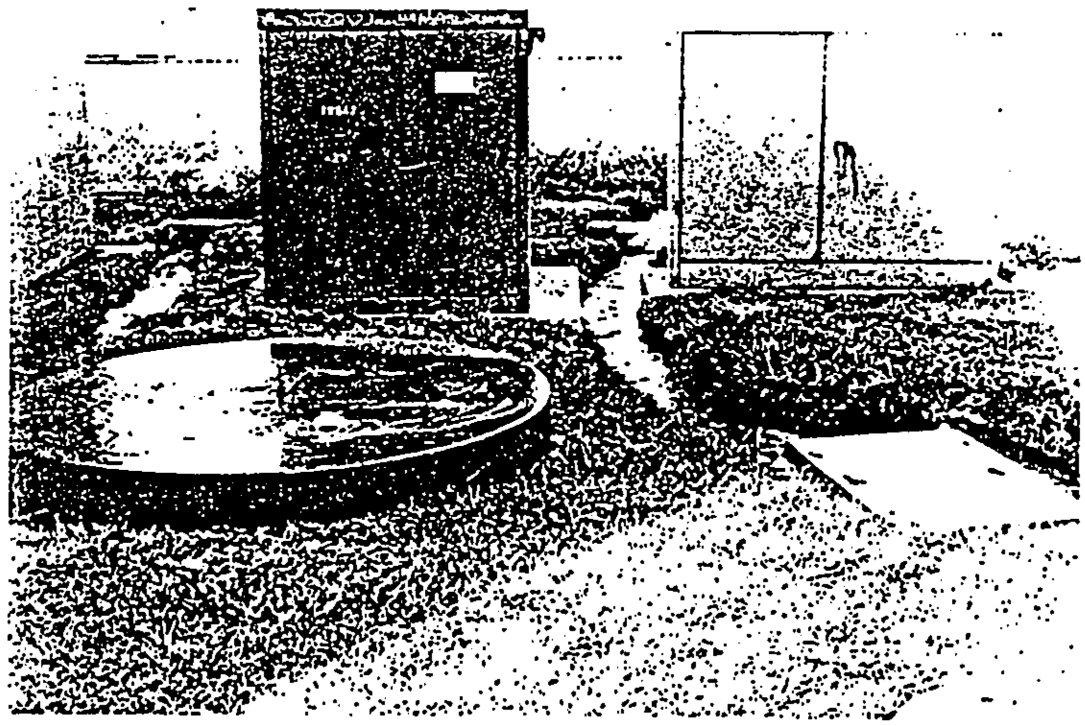

FIGURE 1. Overflow of sewage effluent from clogged injection wells, Ewa Beach, Oahu.

(usually less than 30 m), small diameter (0.10 m being the most common), and injection rates of only a few hundred liters per minute. In addition, there are several municipal injection well facilities on Oahu and Maui. The wells at these facilities are generally deeper and larger than the private installations, and typically inject several hundred thousand to a few million liters per day of wastewater.

Most of the injection wells in Hawaii, especially those for disposal of treated sewage effluent, are located in the coastal region where the receiving waters are brackish or completely saline. In this environment the groundwater table usually lies only a few meters below the ground surface; therefore, water table fluctuations resulting from ocean tides and storms and seasonal changes in groundwater recharge often significantly affect injection well performance. The receiving formations are generally sedimentary caprock materials, but in some regions, especially on Hawaii Island, the receiving formations are lava flows. Figures 4*A* and 4*B* show a hydrogeologic cross section and a plan view of wastewater injection into a typical coastal aquifer environment.

INJECTION WELL PROBLEMS

Wastewater injection poses two distinctly different types of potential problems in the Hawaiian environment. If the injectant migrates too far from the injection wells without sufficient dilution by the resident groundwater, contamination of potable groundwater supplies and the shallow nearshore coastal waters may result. Contamination of fresh groundwater bodies by injected wastewater has been investigated in detail by Peterson, Williams, and Wheatcraft (1978) and Wheatcraft and Peterson (1979), and is not known to be a significant problem at the present time. Fortunately, because virtually all wastewater injection is restricted to coastal areas where the groundwater is generally brackish or saline, freshwater aquifers have not been

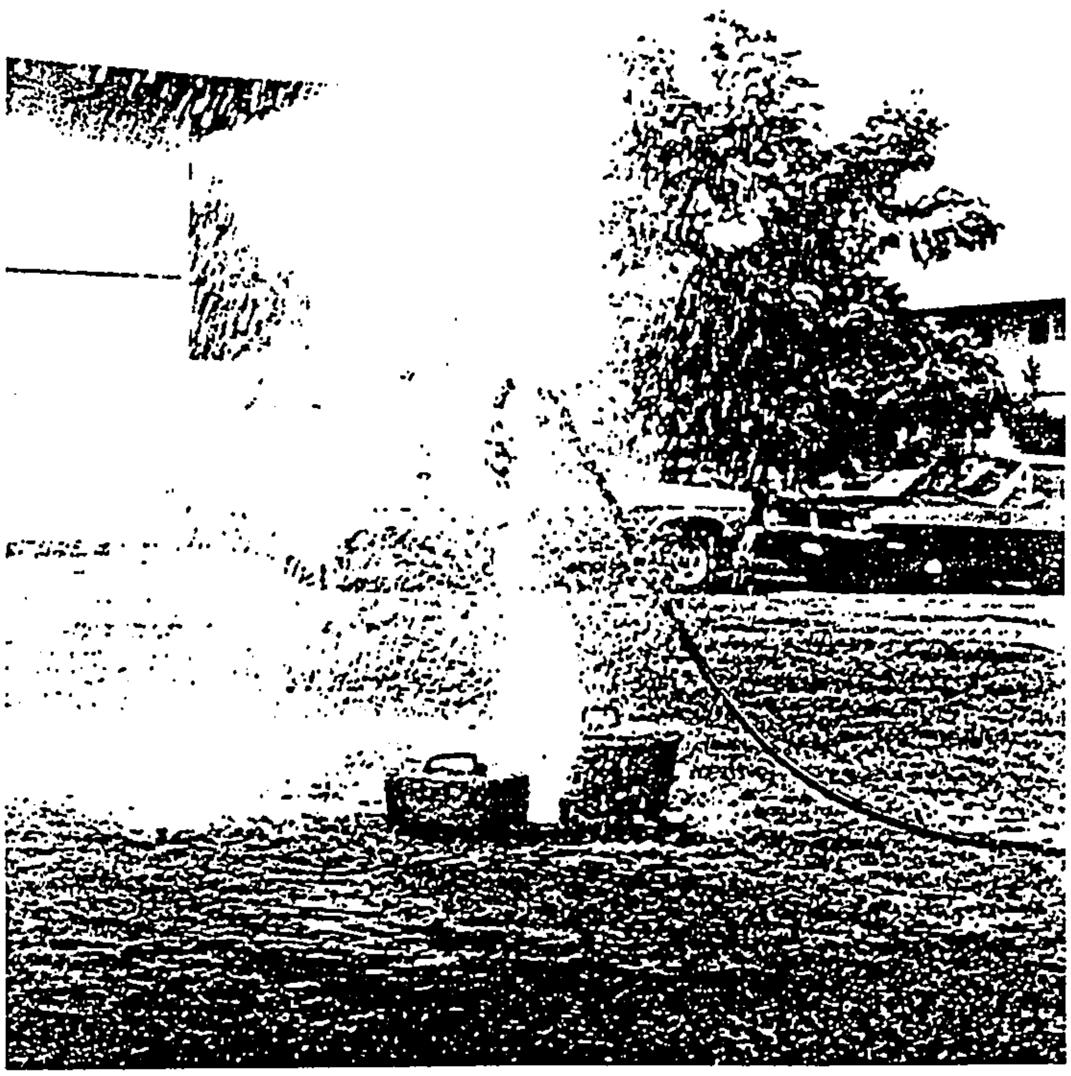

FIGURE 2. Compressed air used to unclog injection well, Ewa Beach, Oahu.

threatened. The Honolulu Board of Water Supply (1982) and the Hawaii State Department of Health (1984) have set stringent controls on the placement of injection wells (Figure 5). Wastewater injection is generally allowed only in those areas where the chloride content in the groundwater exceeds 5000 mg/liter. Furthermore, in areas where basaltic aquifers containing potable water underlie sedimentary caprock, injection into the caprock is permitted only where at least 15 m of nonpermeable material separates the

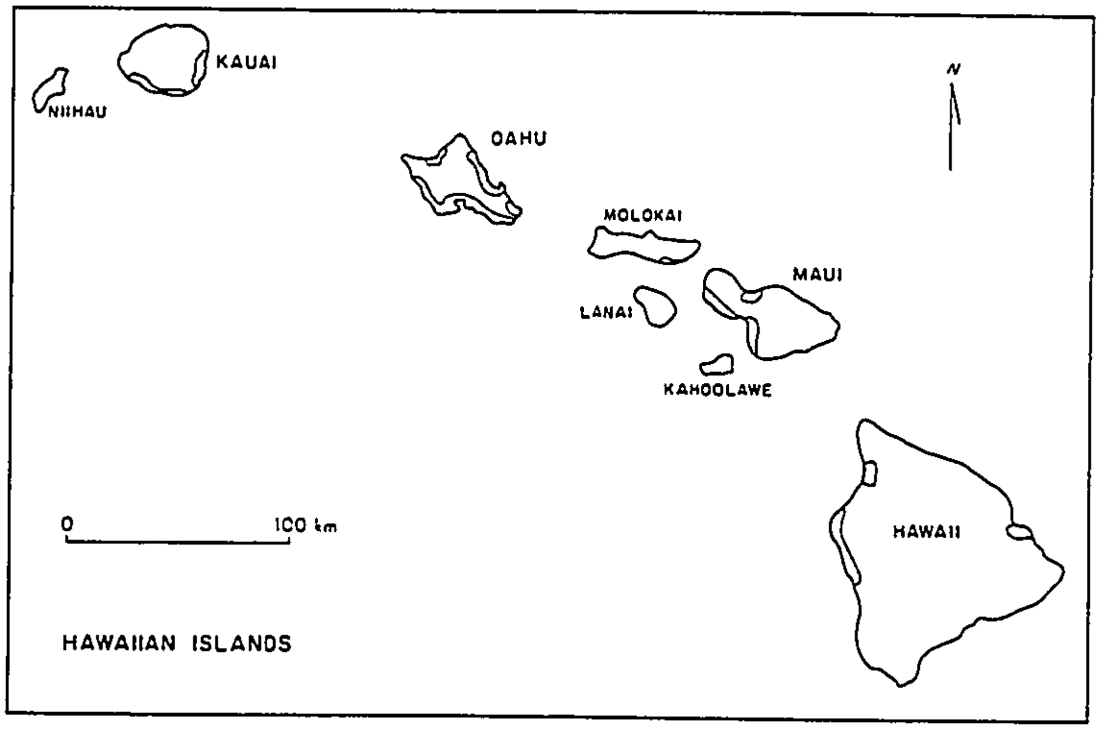

FIGURE 3. Generalized location of injection well facilities (stippled areas) on the islands of Kauai, Oahu, Molokai, Maui, and Hawaii.

potable groundwater from the bottom of the injection wells.

The extent of shallow coastal-water contamination is more problematic. Wastewater injected into coastal aquifers only a few tens or hundreds of meters from the shore must discharge, virtually undiluted, directly into the coastal waters (Figure 4A, B). The effects of coastal discharge are primarily a function of how deep and how disperse the discharge is, with deeper and more disperse discharge having less impact on shallow nearshore waters. In areas of extensive injection well development there have been few, if any, complaints of coastal-water contamination; however, no comprehensive study has been conducted to evaluate this problem. Clearly, more work is needed in this area.

A second and more serious problem posed by subsurface waste injection in Hawaii is clogging and rapid reduction of injection capacity in the immediate vicinity of the wells (Figures 1 and 2). Work by Petty and Peterson (1979) indicates that with the exception of a very few areas (the most notable being the Kona Coast region of Hawaii Island), well over half of all Hawaiian wastewater injection wells have experienced significant clogging problems. The problems are manifest at small private facilities as well as at larger municipal plants, and have ranged in severity from slow, gradual loss of injection capacity over many months or a few years, to rapid and sometimes almost complete loss of injection capacity due to catastrophic events, such as treatment plant failures. A frequent result of severe clogging is well overflow, where a portion of the effluent discharges onto the ground near the well head. Public health and aesthetic problems often ensue, and legal action has resulted in several instances.

Given the rather dismal past record of injection well operation, the question must be asked, "Can injection wells be used successfully in the Hawaiian environment, and if so, under what conditions?" To answer these questions we must understand how and why clogging occurs.

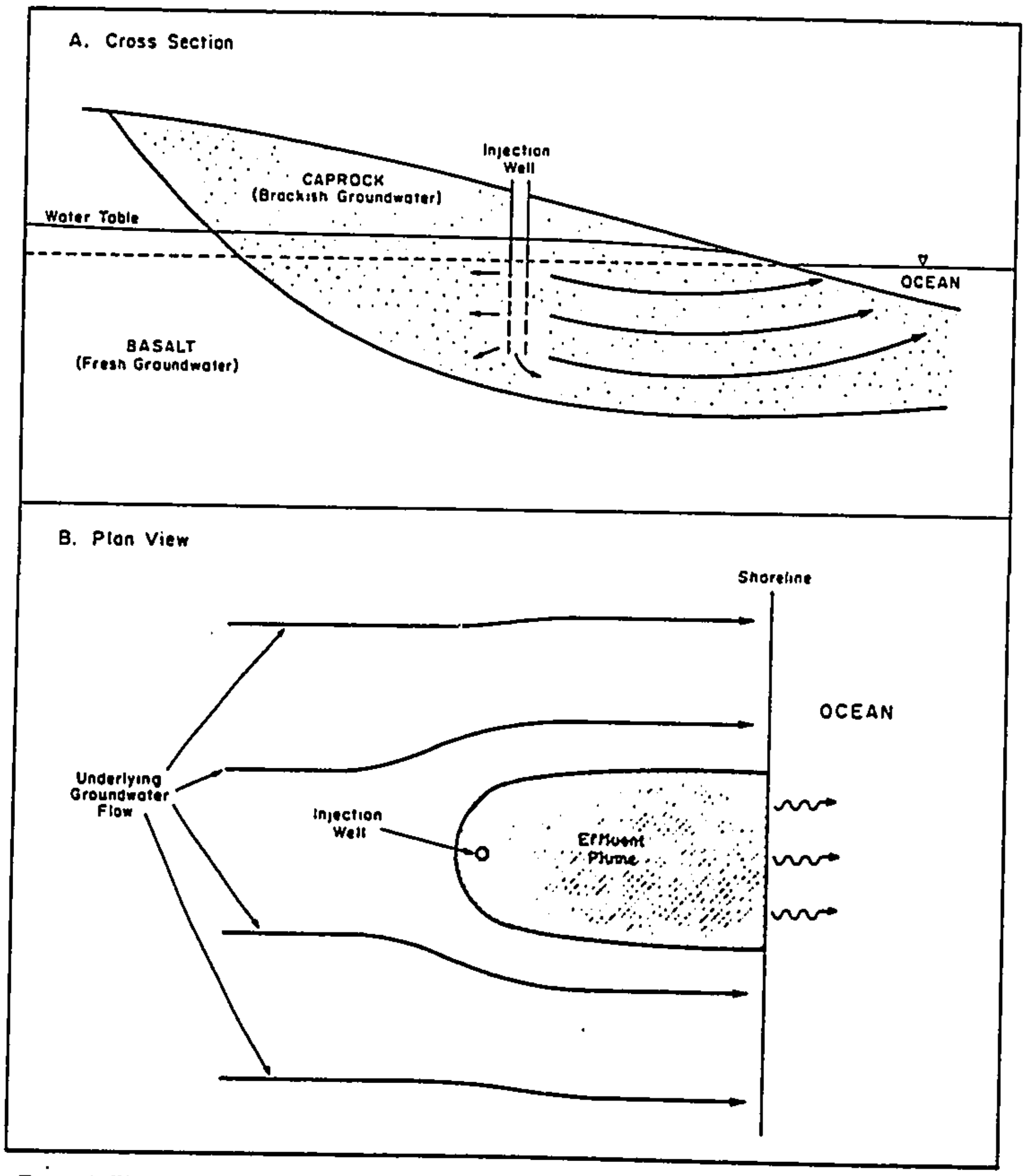

FIGURE 4. Wastewater injection into a typical coastal aquifer in Hawaii. *A*, cross-sectional view; *B*, plan view of wastewater movement and coastal discharge.

CAUSES OF CLOGGING

Virtually all the research done in Hawaii and elsewhere indicates that some degree of clogging of injection wells is inevitable, regardless of the suitability of the receiving formation, the quality of the injectant, or the sophistication of the injection operation (e.g., see Ehrlich, Vecchioli, and Ehlke 1977, Harpaz 1971, Oberdorfer and Peterson 1982, Olsthoorn 1982, Petty and Peterson 1979, Ragone 1977, Rebhun and Schwartz 1968, Vecchioli and Ku 1972, Vecchioli, Ku, and Sulam 1980). However, past experience also

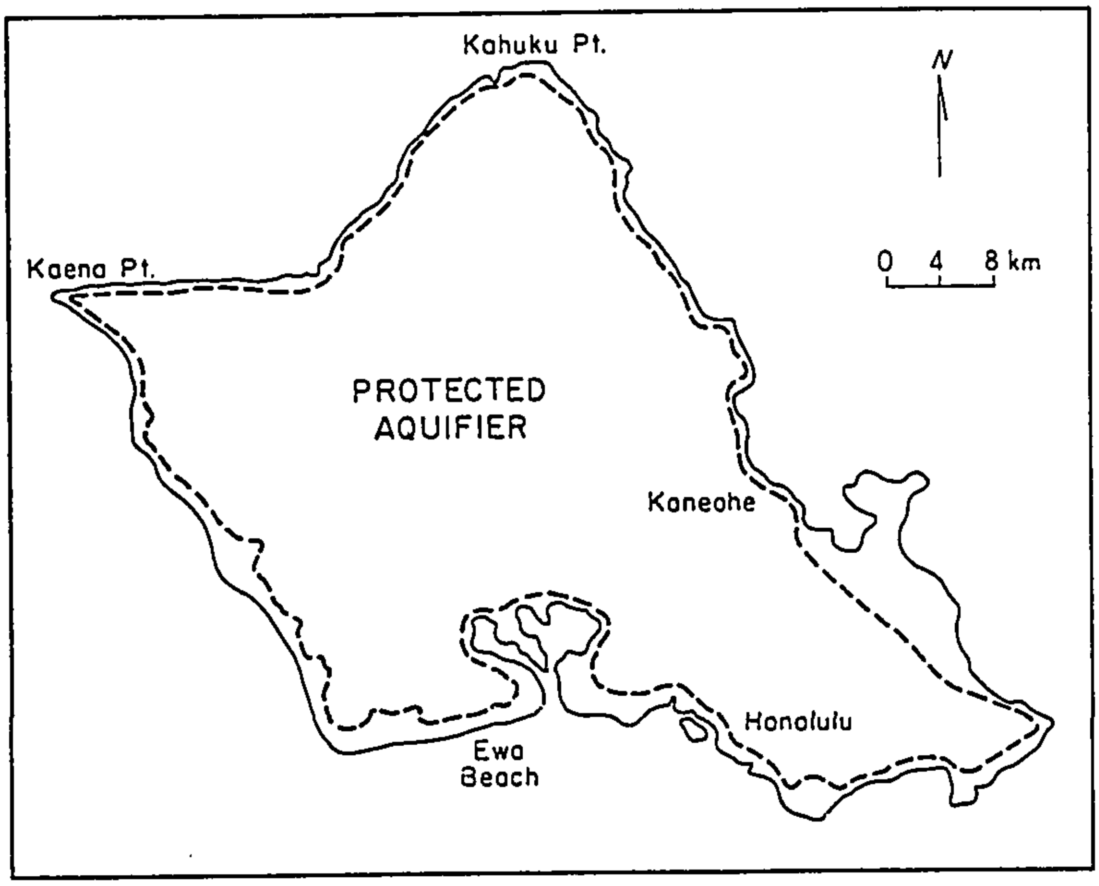

FIGURE 5. Proposed underground injection control line for Oahu. No injection wells are allowed inland of the dashed line. After Hawaii State Department of Health (1984).

clearly indicates that the selection of favorable injection sites, proper injection well operation and maintenance, and effluent quality control greatly enhance injection well success.

In their study of Hawaiian wastewater injection well problems, Petty and Peterson (1979) determined that several factors were largely responsible for injection well failures. The most important of these are (1) unfavorable hydrogeology, (2) underdesign of sustainable injection well capacity, (3) poor effluent quality, and (4) lack of proper injection well maintenance.

Most commonly, unfavorable hydrogeologic conditions result from low-permeability receiving formations. Generally, volcanic rocks comprise the most favorable injection formations, but in some cases poorly permeable lavas, especially ponded flows and weathered zones, have experienced severe clogging problems. In the caprock, coral reef and reef rubble material are most suitable for injection, with the fine-grained sediments experiencing the greatest clogging problems. An additional factor of critical importance that is often overlooked in selecting injection well sites is that virtually all geologic formations undergo substantial reductions in permeability during injection. Thus, formations that initially have only modest permeability may be totally unsuitable for wastewater injection. Oberdorfer and Peterson (1982) recommend that a minimum injection capacity of 100 liters/min per well be required for all Hawaiian wastewater injection sites.

Shallow groundwater tables also contribute to injection well failures. In coastal regions the water tables usually are less than 5 m below

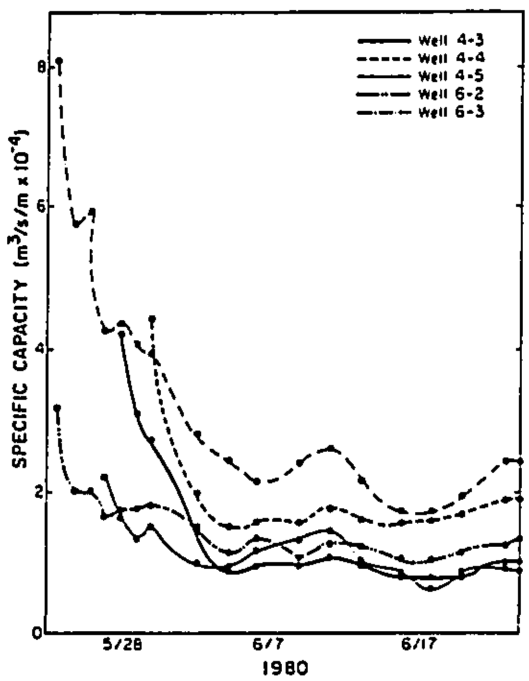

FIGURE 6. Injection capacity versus time for Waimanalo, Oahu, experimental injection wells. After Oberdorfer and Peterson (1982).

the ground surface and often are only 1–2 m deep. Because most injection systems in Hawaii operate by gravity flow, these shallow groundwater tables leave little room for the additional injection head buildup that almost inevitably results from well and aquifer clogging effects. Fluctuations of the groundwater table because of tidal effects, storm waves, and groundwater recharge further add to the problem. At some injection sites very close to the shore, water table fluctuations of 2 m or less, when combined with clogging effects, have resulted in well overflows.

Another common cause of failure of existing injection wells has been the consistent underdesign of injection well capacity. Oberdorfer and Peterson (1982) conclusively demonstrate that clogging effects commonly reduce initial injection well capacities by 50% and, in some cases, by as much as 90% (Figure 6). A set of recommended reduction factors (Table 1) to be applied to the injection test results was determined for Hawaiian injection situations as a way of predicting the maintainable injection capacity. For example, from Table 1, an injection test flow rate of $40 \times 10^{-4}\ m^3/sec$ translates into an injection capacity of only 25% of that, or $10 \times 10^{-4}\ m^3/sec$. If these clogging factors are not recognized and accounted for in the design, failure is inevitable.

TABLE 1

INJECTION TEST REDUCTION FACTORS TO DETERMINE INJECTION CAPACITY

TEST FLOW RATE OF SINGLE WELL		% OF TESTED CAPACITY
$m^3/sec \times 10^{-4}$	gal/min	
>60	>100	33.3
30–60	50–99	25
15–29	25–49	20
<15	<25	*

SOURCE: Oberdorfer and Peterson (1982).
*Should not be used for injection.

Inconsistent and often poor-quality effluent, especially at many of the small private injection systems, has greatly accelerated the clogging process. All injected effluent supposedly undergoes secondary biological treatment, usually some combination of extended aeration and/or aerobic digestion; however, high concentrations of suspended solids, 5-day biochemical oxygen demand (BOD_5), nitrogen compounds, and oil and grease often persist. Table 2 shows the concentrations of selected constituents in wastewater at several Oahu injection well sites. As can be seen from this table, a significant portion of the sites did not meet the Environmental Protection Agency standards for secondary effluent of a maximum of 30 mg/liter of suspended solids and BOD_5. Most of the sites not meeting these standards have experienced severe clogging problems, including well overflow. Although clogging of most injection wells appears to be inevitable, in many cases the adverse effects of clogging can be significantly reduced and the overall lifetime of the well lengthened considerably if appropriate well maintenance and rehabilitation practices are followed. In Hawaii, regular injection well maintenance has been only rarely practiced, and well rehabilitation measures often have been undertaken only after a well is completely clogged, thus making the clean-out effort less effective

TABLE 2

INFLUENT WATER QUALITY FROM SELECTED OAHU WASTEWATER TREATMENT PLANTS, FEBRUARY 1980 - DECEMBER 1981

	EWA VILLA	EWALANI	HALEIWA SURF	KAHUKU SUGAR MILL	KUILANA VILLAGE	MAKAHA VILLAGE	MOKULEIA SANDS	PAALAA KAI WWTP	PAT'S AT PUNALUU	WAIMANALO WWTP
Number of samples	7	7	9	8	7	9	9	4	9	10
BOD_5	41	52	33	6	15	27	25	10	9	13
	(3 86)	(19 100)	(5 70)	(1 12)	(8 20)	(8 61)	(6 100)	(5 19)	(3 23)	(2-32)
Suspended solids	81	81	38	29	13	44	23	9	10	10
	(23 214)	(16 239)	(6 86)	(2 60)	(4 24)	(1-260)	(4 57)	(3-15)	(1-22)	(4 29)
Dissolved solids	543	606	574	430	594	351	597	509	314	296
	(490 613)	(512 678)	(411 776)	(365 550)	(563 632)	(282-454)	(382 795)	(318 738)	(267 408)	(148 388)
Oil and grease	4	3	9	9	3	4	7	2	5	3
	(1 7)	(3 4)	(5 19)	(3 18)	(2-3)	(0 11)	(2-17)	(1-4)	(2-8)	(1-5)
pH	7.3	7.2	7.2	7.7	7.3	7.2	7.1	7.0	6.9	6.8
	(6.9 7.6)	(6.9 7.7)	(6.7 7.7)	(6.7 8.3)	(7.1 7.7)	(6.6-7.9)	(6.7 7.5)	(6.4 7.4)	(6.4 7.6)	(6.0-7.6)
Alkalinity (as $CaCO_3$)	152	121	133	38	182	88	30	141	38	72
	(122 178)	(68 218)	(38 159)	(7 59)	(101 210)	(53 127)	(3 68)	(91-198)	(16-72)	(28-133)
Chlorides	180	130	190	90	150	90	190	140	70	70
	(140 340)	(50 170)	(120 260)	(90 100)	(80 180)	(70-110)	(110 220)	(120-170)	(40-100)	(50-80)
$NO_2 + NO_3$-N	0	5	0	8	2	3	17	2	7	8
	(0 2)	(1 9)	(0 1)	(5-11)	(0 9)	(0 11)	(7-23)	—	(1-18)	(0-12)
Total Cl residual	0.2	0.1	0	0.7	0	0	0.2	1.1	0	1.5
	(0 0.4)	(0 0.3)	0	(0.2 1.3)	0	0	(0 0.4)	((0.5 1.5)	0	(0-45.)

SOURCE: Oberdorfer and Peterson (1982).
NOTE: Averages; ranges within parentheses; all figures are in milligrams per liter except number of samples and pH.

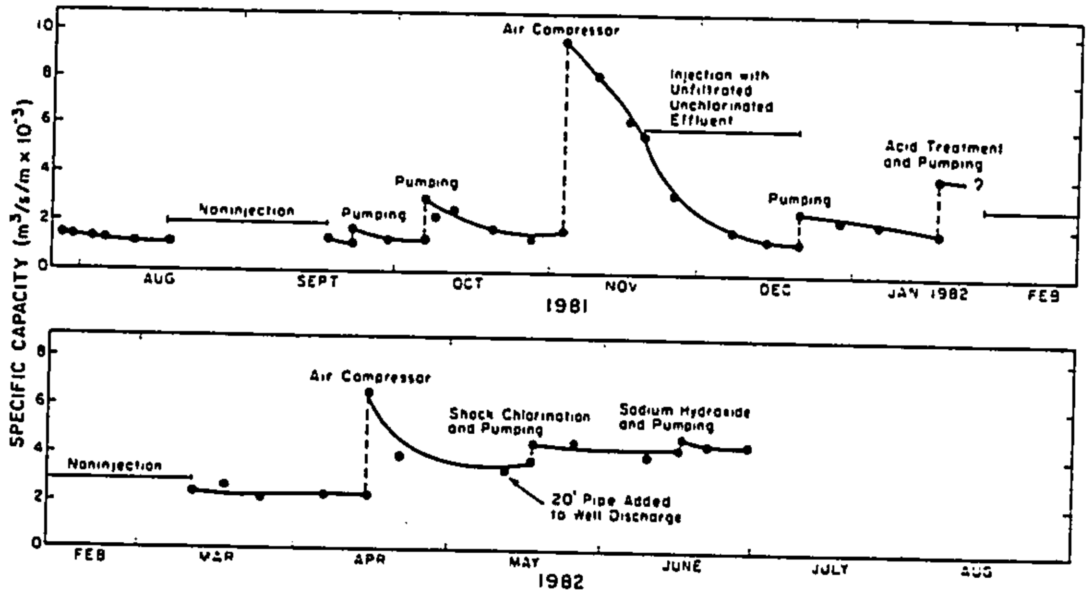

FIGURE 7. Injection history for the Paalaa Kai, Oahu, experimental injection well. After Oberdorfer and Peterson (1982).

than earlier attempts might have been. Findings from our own work (Oberdorfer and Peterson 1982) and those of others indicate that several physical and chemical techniques have been successful for Hawaiian injection wells. In particular, physical flow reversal methods, such as pumping or blowing out the water with compressed air, and chemical methods, such as acid and shock chlorination treatments, have proved successful in restoring most injection capacity. Figure 7 illustrates the restorative effects of various injection well rehabilitation methods.

To understand what the precise clogging mechanisms are, one must examine the detailed geochemical and biochemical processes that occur in the near-well environment during injection. Although injection wells are widely used in the United States and throughout the world, few detailed investigations of injection well clogging have been reported. Perhaps the most comprehensive study of this sort is a compilation by Olsthoorn (1982) of clogging problems associated with recharge wells. Other work pertinent to Hawaii's injection problems has been done by the U.S. Geological Survey on injection well clogging at Bay Park, New York (Ehrlich, Vecchioli, and Ehlke 1977, Ragone 1977, Vecchioli and Ku 1972, Vecchioli, Ku, and Sulam 1980). The most significant conclusions from these studies are the following:

1. The major cause of clogging at most sites is filtration by the porous media of suspended solids contained within the injectant.
2. A second major cause of clogging results from microbial growth at the well face and within the aquifer pores.
3. Chemical precipitation processes are of lesser significance for clogging.
4. Clogging may occasionally result from entrapped air and gas bubbles introduced by the injectant.
5. Most of the clogging activity occurs at or very near the injection well aquifer boundary and, in many instances, a mat of filtration material forms directly on the well or aquifer surface.

To determine whether these same factors are important in clogging injection wells in Hawaii, the authors conducted a series of injection well field experiments. In these experiments, which ran for almost 2 yr, secondary-treated sewage effluent was injected into sedimentary caprock receiving formations under conditions typical of those at most small private Hawaiian injection facilities. Data on injection head distribution and biochemical constituents in sediment cores and pore water within about 2 m of the injection wells, the zone most likely to experience severe clogging, were collected. These data suggest that during the first few days or weeks of injection, clogging by filtration of suspended solids and by microbial growth are most important. Over the long term, however, it appears that nitrogen gas is produced by denitrifying bacteria in sufficient quantities to be an important contributor to clogging of pore spaces by gas binding.

These results, which are described in detail by Oberdorfer and Peterson (1982, in press) and Oberdorfer (1983), are based on experiments at only two injection sites and must be further verified. If, however, nitrogen gas binding proves to be a significant clogging mechanism at other sites, we need to rethink some of our ideas on clogging control and injection well rehabilitation. To better control clogging in the first place, perhaps more emphasis should be placed on control of nitrogen compounds and denitrification processes; and to achieve more efficient well rehabilitation, more emphasis might be given to treatments that reduce gas binding.

OUTLOOK FOR THE FUTURE

Based on injection well experience in Hawaii during the past two decades, several observations seem appropriate. First, because of stringent control on the location of injection wells, contamination of potable groundwater bodies by injected effluent has not been, and in the future should not be, a significant problem. Likewise, with the possible exception of a few localized areas, contamination of shallow coastal waters should not pose a significant problem. Clogging will undoubtedly continue to be a major obstacle to the successful operation of existing and future injection wells.

It is possible, however, to achieve considerable improvement in injection well performance if steps are taken to eliminate existing deficiencies. The most important of these involve better site selection, more realistic injection capacity prediction and design, better control of injectant quality, and the use of more diligent well maintenance and rehabilitation practices.

In conclusion, it is now quite clear that injection wells are not the low-cost maintenance-free wastewater disposal alternative they were once thought to be. Furthermore, it is quite likely that under all but the most favorable of conditions, the useful lifetime of injection wells is quite short, probably only a few years at the most, and perhaps their use should be considered only as an interim disposal solution. Nonetheless, at favorable sites, the use of wastewater injection wells can be moderately successful if adequate effort and money are expended to ensure their proper operation.

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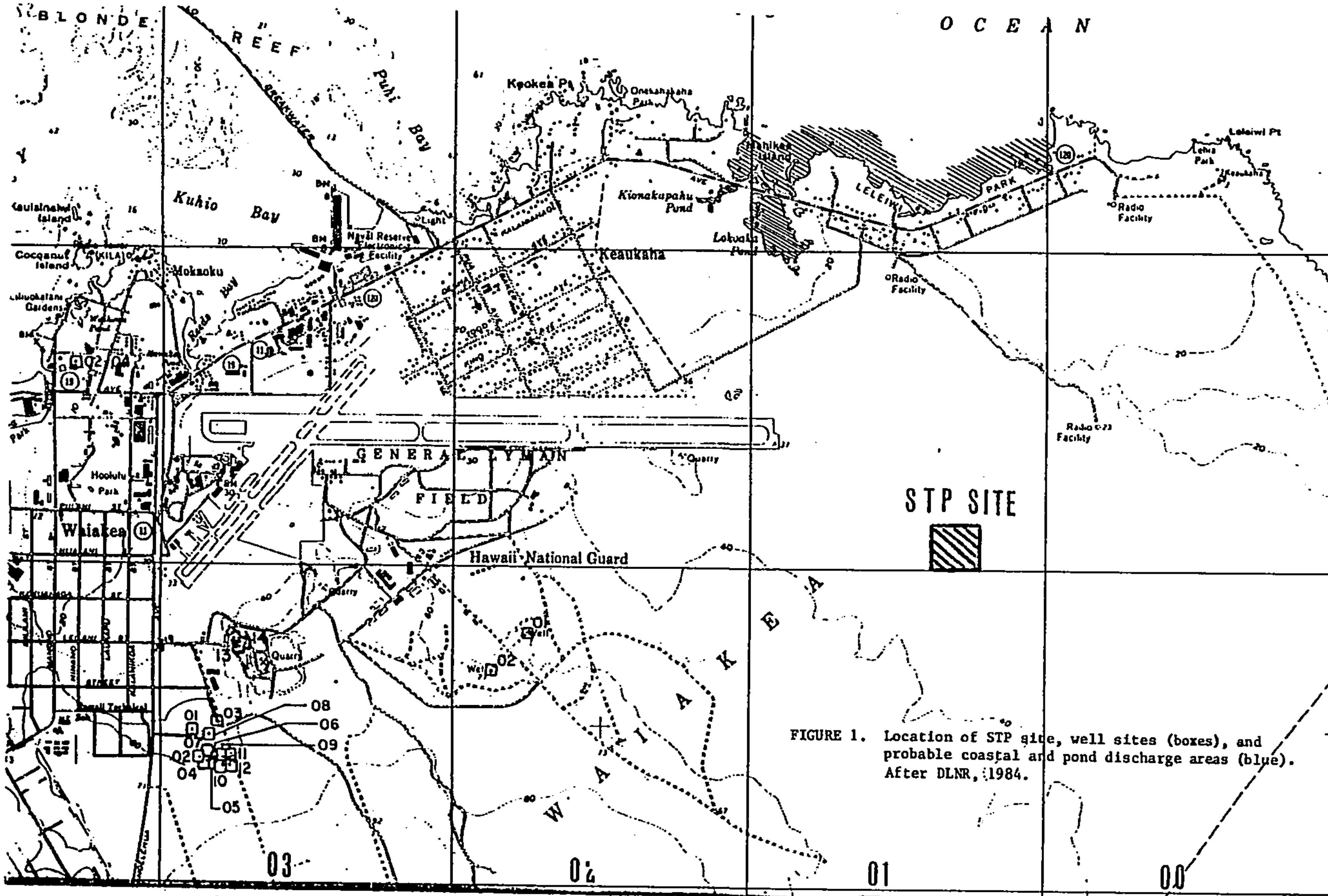

FIGURE 1. Location of STP site, well sites (boxes), and probable coastal and pond discharge areas (blue). After DLNR, 1984.

FIGURE 2. JIC line (heavy dashed line) in project area.

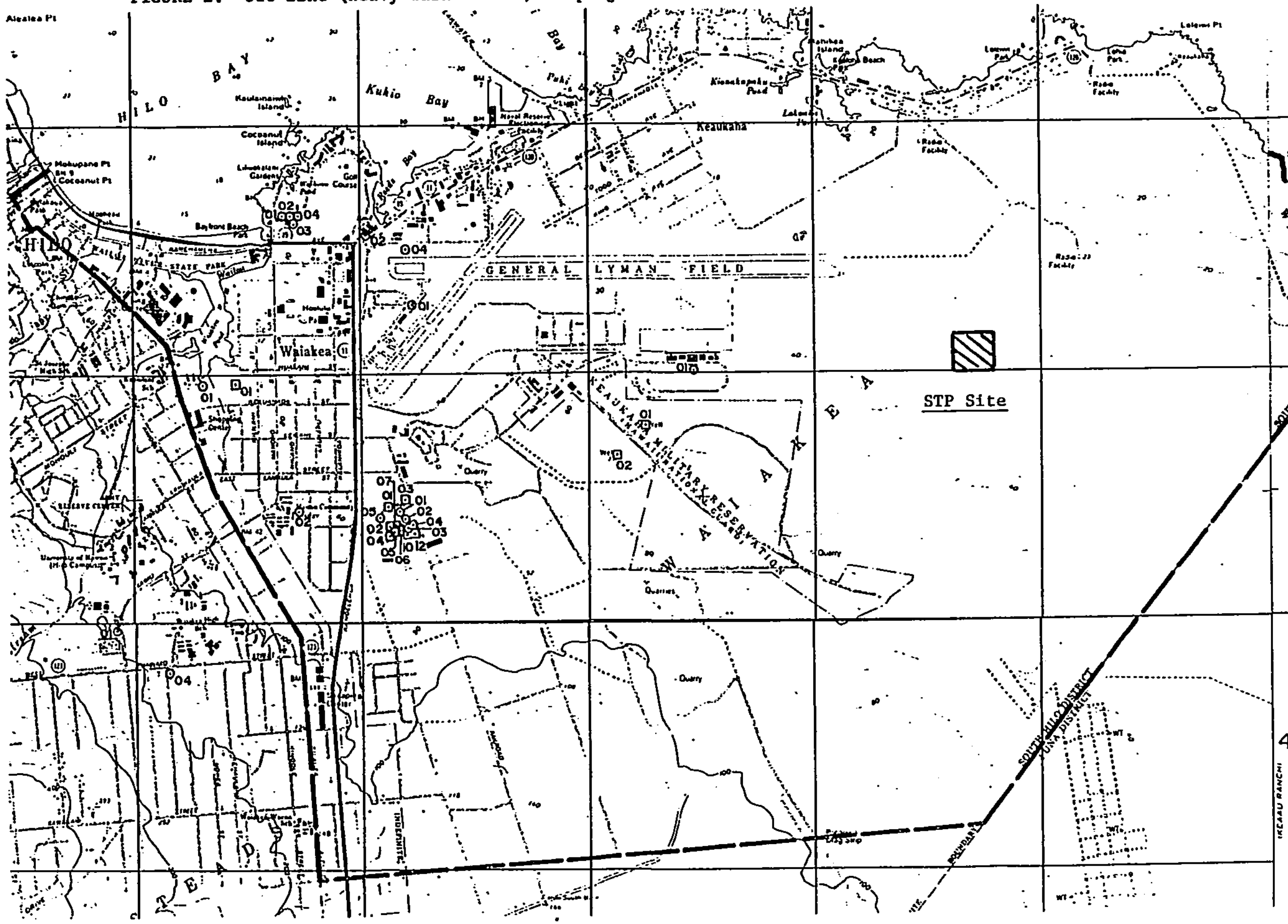

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TABLE 1. Information from wells in project area. (after DLNR, 1984)

Well No.	Owner	Ground Elev. (ft)	Static Head (ft)	Pump Test Results: Rate (gpm)	Drawdown (ft)	Spec. Cap. (gpm/ft)	Cl (mg/l)	Use
4202-01	Haw. DWS	59	4.0	900	14.0	64	110,186	Unused
4202-02	Haw. Elec.	71	5.0	1000	1.0	1000	2	Unused
4203-01	Haw. Elec.	40	6.7	36	1.0	36	6	Unused
4203-02	Haw. Elec.	41	9.1	50	0.6	83	6	Unused
4203-03	Haw. Elec.	41	5.8	50	0.2	250	8	Lost
4203-04	Haw. Elec.	47	7.1	4660	0.3	5533	40	Sealed
4203-05	Haw. Elec.	50	---	---	---	---	12,28	Industrial
4203-06	Haw. Elec.	50	6.5	6500	6.5	1000	11,24	Industrial
4203-07	Haw. Elec.	50	---	---	---	---	---	Industrial
4203-08	Haw. Elec.	39	---	---	---	---	---	Disposal
4203-09	Haw. Elec.	55	6.0	---	---	---	---	Industrial
4203-10	Haw. Elec.	55	6.0	6100	3.5	1743	---	Industrial
4203-11	Haw. Elec.	43	6.0	5800	4.3	1349	---	Disposal
42-3-12	Haw. Elec.	49	6.0	6000	0.1	60000	---	Industrial
4203-13	Jas. Glover	23	---	---	---	---	13	Industrial
4203-14	Jas. Glover	23	---	---	---	---	13	Industrial

CONTAMINATION MODELS OF INJECTED WASTEWATER

by

John F. Mink

Path and Strength of the Injection Plume

The region where the wastewater injection well is proposed is underlain by an extremely permeable aquifer composed of basaltic lavas belonging to the Mauna Loa volcanic series. Groundwater occurs as an unconfined basal lens having a head of 5 to 7 feet at the injection site. The rate of flow in the lens is extraordinarily great, at least as much as in any other aquifer in Hawaii. The groundwater is fresh and cool, and downgradient of the injection site it discharges into Lakaoka Pond and along the coast fronting Leleiwi Park.

Hydraulic conductivity of the basalt is so great that its accurate determination from pump test data is impossible. Drawdowns are minute even at pumping rates of several thousand gallons per minute. The only reasonable ways to estimate hydraulic conductivity is by analogy with similar aquifers elsewhere in Hawaii whose characteristics are known, and by employing recharge calculated from a water balance in combination with Darcy's law. In other better known basaltic aquifers, hydraulic conductivity exceeds 1000 ft/day; younger basalts show higher conductivities. Lavas composing the local aquifer are recent in age and likely have a hydraulic conductivity far greater than 1000 ft/day. Estimates have ranged as high as 12,000 ft/day.

The groundwater hydraulic gradient is approximately 4/5000 while the flow per lineal mile parallel to the coast is at least 30 mgd, but may be substantially more. The recharge region is very large and includes an area where average annual rainfall exceeds 300 inches. Only a small fraction of the rain escapes to the sea as overland flow.

Given a hydraulic gradient of 4/5000 and depth of flow of 200 feet, which assumes the local head to be 5 feet, and employing these parameters in combination with a flux of 30 mgd/mi yields a transmissivity value of 950,000 sq ft/day and hydraulic conductivity of 4748 ft/day. The Darcy velocity for these conditions is 4 ft/day. For effective porosity of 10 percent, particle velocity is 40 ft/day, an exceptionally high value. In most other Hawaiian aquifers the velocities are a magnitude lower, and in a typical sedimentary aquifer elsewhere about two magnitudes less. The combination of large flux and high velocity would work to minimize the dimensions and extent of dispersion of a plume originating at the injection well.

An aerial survey by the US Geological Survey (Fischer, et al., 1966) in which infra red imaging was employed to detect spring outflow along the coast indicated that the largest discharges down gradient of the injection site are in Lokoaka and Kianakapahu Ponds. Spring emissions along the coast are not as marked, but fresh water outflows are undoubtedly masked by the much larger movements of the sea. The cold water (65 to 68 F) of the springs contrasts in the infra red images with the warmer water of the sea. Much of the water passing beneath the injection site may discharge at and near Lokoaka Pond. It would be prudent to make the assumption that the pond is the main discharge down gradient of the proposed well and that the injectant will move in that direction.

Models of Injections Plumes

Injection could take place either in the dynamic fresh water lens, in which case the plume would mix with and ultimately displace the ambient flow because the two fluids have the same specific gravities, or in the static salt water beneath the lens. In the salt water domain, however, the injectant, because of its lower specific gravity, would rise as an essentially coherent plume from the interval of injection to merge with the brackish to fresh water at the base of the lens. It would not mix with the salt water except in a narrow width at the interface between the two fluids. Even without a positive potential relative to the salt water, the plume would have an upward buoyancy velocity of,

$$V = k\{g(s)-g(f)\}/g(s)$$

in which V is the bulk velocity, k is hydraulic conductivity, g(s) is specific gravity of sea water and g(f) is specific gravity of fresh water. For a fresh water plume in sea water and hydraulic conductivity of 5000 ft/day, the buoyant velocity is 122 ft/day.

The above suggests that the plume would quickly rise to the lens, there to mix with and displace the transition zone, then to flow to the discharge front at the ponds and along the coast. This type of phenomenon was documented by sand box models at the University of Hawaii (Peterson, Williams and Wheatcraft, 1978).

In either case -- injection into the lens itself or into the salt water below the lens -- the injected fluid will mix with and displace a portion of or all of the ambient flow, forming a plume that will discharge into Lokoaka Pond and at the coast. The plume will tend to retain its concentration identity because the ambient velocity and flux are very high. Hydrodynamic dispersion will be modest.

Two simple models describing plume domensions and dispersion phenomena are given below to illustrate the expected behavior and disposition of the injected fluid. The first model assumes no dispersion takes place and that the plume retains its initial identity all the way to the discharge front. With respect to contaminant concentration at the outflow, this is the worst case. It is important, however, because it indicates the width of the plume down gradient of injection and thus the portion of the coast where the wastewater will discharge. The second model, based on EPA nomographs, considers dispersion and yields the concentration of the effluent along the center line of the plume at any distance down the flow gradient. In both models the plume is assumed to flow throughout the entire thickness of the lens.

The dissolved substance used in the dispersion model is nitrogen (N), which averages about 30 mg/l in wastewater. The upper limit for potable use is 10 mg/l, but even a few mg/l may affect the biota in a coastal pond. Injection rate is assumed as 5 mgd. Parameters in the models are as follows:

Hydraulic conductivity (k)....... 5000 ft/day

Groundwater gradient (dh/dx)..... 4/5000

Injection rate (Q).......... 5 mgd (668,450 cu.ft./day)

Longitudinal dispersivity {a(x)} 250 ft

Transverse dispersivity {a(y)} 25 ft

Effective porosity (n)........... .10

Darcy velocity (V)............... 4 ft/day

Particle velocity (v)............ 40 ft/day

Depth of flow (b)................ 160 ft

Model 1: Advection Plume (no dispersion).

The steady state stagnation point is determined as follows:

$r = Q/2 \quad bV$

such that r = 166 feet. This means that the injection slug will move 166 feet up gradient before stabilizing.

The maximum width of the plume will be:

$L = 2 \quad r = 1045$ feet

This means that far enough downstream of the injection well the plume width will stabilize at 1045 feet. The maximum width of Lokoaka Pond is about 1000 feet.

Further refinement of the model permits calculation of plume widths at distances down gradient of the injection source. These widths are as follows:

Distance	Plume Width
70	600
3500	1000
6000	1020

Lokoaka Pond lies about 3500 feet downgradient of the injection site, suggesting that the entire plume could discharge into the pond if its trajectory carried it there.

The unperturbed basal lens discharges in a very narrow zone along the coast, no more than a few feet wide. Similarly, the plume, no matter how it was generated, will discharge in this same narrow zone. The width of the discharge band is:

$$x = q/2ak$$

wher x is band width, q is specific flow per foot of discharge front, a is .025 (difference between specific gravities of fresh and salt water) and k is hydraulic conductivity. For the given parameters, the width of discharge is 2.7 feet. Thus all of the plume will discharge virtually at the shore of the ponds and the coast; none could be expected to find its way a significant distance off shore unless large scale heterogeneities, such as lava tubes captured the plume.

Model 2: Concentration on Center Line of Plume (Dispersion).

The EPA nomograph method (EPA, 1985) is employed to determine steady state concentration of nitrogen along the center line of the plume, where concentration is maximal, at distances of 1000, 3500 and 5000 feet down gradient of the injection well. Lokoaka Pond lies about 5000 feet from the proposed well. Concentrations at the intermediate distances illustrate the tendency of the plume to withstand dissemination of dissolved constituents by dispersion. Computed values are:

Distance(ft)	Concentration(mg/l)
1000	30
3500	15
5000	10

This suggests that the plume strongly retains its identity all the way to the discharge front.

In the model, assigned values of dispersivities are large, reflecting the open and heterogeneous character of the basaltic aquifer. If smaller dispersivities were assumed, concentrations would be greater at the same distances.

Whatever model is used to predict plume movement, width and dispersion, the salient conclusion is that the plume will tend to retain its identity and to be confined to a relatively narrow width in the distance between the injection site and the discharge front at Lokoaka and the coast. Mixing and dispersion will not alter the plume so greatly that its concentration characteristics would be unrecognizable where the lens discharges.

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APPENDIX F

EVALUATION OF INJECTION WELLS
FOR DISPOSAL OF WASTEWATER EFFLUENT

A Report Prepared for

Barrett Consulting Group, Inc.
12 South King Street, Suite 200
Honolulu, Hawaii 96813

EVALUATION OF INJECTION WELLS
FOR DISPOSAL OF WASTEWATER EFFLUENT
AT HILO WASTEWATER TREATMENT PLANT
HILO, HAWAII

HLA Job No. 17458,006.06

by

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August 30, 1988

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I INTRODUCTION

A primary treatment facility located at Puhi Bay presently treats wastewater from the city of Hilo sewer system. After primary treatment, the effluent from this facility is discharged into the ocean through a 48-inch-diameter outfall extending 4,500 feet offshore to a depth of 56 feet below sea level (M & E Pacific, 1988). The County of Hawaii decided to construct a new secondary treatment facility near the east end of General Lyman Field (Plate 1) to comply with the Clean Water Act of 1972 (Public Law 92-500). The continued use of the existing ocean outfall has been selected as the method of disposal for the treated secondary effluent.

There has been some community concern over the potential environmental impacts associated with the continued use of the outfall. In response to these concerns, Peterson and Mink (1988) assessed the use of subsurface injection wells for the disposal of the treated effluent. Continued community concern has resulted in a second assessment on the use of subsurface wastewater disposal.

The purpose of this report is to present the results of the second evaluation on the feasibility of subsurface injection. The scope of services for this work included:

1. Literature review of hydrogeologic data, regulatory requirements for subsurface injection and water quality standards for receiving waters;

2. Discussion of injection capacity, well clogging, and reliability of injection wells; and

3. Ground-water transport modeling of the wastewater effluent plume to predict the dispersion of the plume and to estimate contamination to surface water bodies down-gradient from the project site.

II HAWAII UNDERGROUND INJECTION CONTROL PROGRAM

Subsurface injection of wastewater is regulated by Title 11, Chapter 23, Underground Injection Control (UIC), established by the State of Hawaii Department of Health. The purpose of this chapter is to protect the quality of the State's underground sources of drinking water (USDW). Plate 1 shows the location of the UIC line near the project site. This line separates USDW aquifers from exempted aquifers. Exempted aquifers are not considered to be sources of drinking water. Exempted aquifers are located seaward of the UIC line and USDW aquifers are located inland of this line.

Injection wells for the treatment facility would be classified as Class V, subclass AB, sewage injection wells. Wells of this class are only permitted into exempted aquifers. The new wastewater treatment facility is located seaward of the UIC line, overlying an exempted aquifer. A UIC permit application must be submitted to the Department of Health prior to construction of injection wells at the project site. The UIC permit would describe the nature and source of injected waste, design of the injection well system, operation of the system and injection test results.

III SURFACE WATER BODIES DOWN-GRADIENT OF PROJECT SITE

The surface water bodies down-gradient from the project site include Kionakupahu Pond, Lokoaka Pond, and the coastline between these ponds and Leleiwi Park (Plate 1). The total area of Lokoaka and Kionakupahu Ponds is approximately 27 acres. The ancient Hawaiians raised fish in these ponds, and Kionakupahu Pond is still maintained as a fishpond. Basal fresh-water springs discharge into these ponds. The ponds are also connected to the ocean by channels and, subsequently, water in the ponds is brackish (U.S. Fish and Wildlife, 1979).

Mullet and milkfish are raised in Kionakupahu Pond. Other fishes commonly found in the two ponds include aholehole, o'opu, eleotrid, tilapia, carp and top minnow. Invertebrates residing in the ponds include opae, prawns, gastropod mollusks, dragonflies and damselflies. Crabs and other brackish water crustaceans occasionally reside in the ponds (U.S. Fish and Wildlife, 1979).

The most common waterbirds found at the ponds are herons and cattle egrets. Other waterbirds residing at the ponds include the endangered Hawaiian coot, Pacific golden plover, wandering tattler, widgeon, scaup, shoveler, and black-crowned night heron (U.S. Fish and Wildlife, 1979).

IV SURFACE WATER QUALITY REGULATIONS IN HAWAII

Surface water quality is regulated by Title 11, Chapter 54, Water Quality Standards, established by the State of Hawaii Department of Health. All surface waters shall be free of substances attributable to domestic pollutants which are harmful to aquatic life and produce objectionable color, turbidity and conditions in receiving water bodies.

Kionakupahu and Lokoaka Ponds are defined as coastal wetlands by Chapter 54. Circulation in these natural ponds is influenced by ground-water spring discharge and tidal fluctuations. The basic criteria set forth in Section 11-54-04 of Chapter 54 applicable to coastal wetlands are presented in Appendix A.

The coastline between the ponds and Leleiwi Park is defined as a Class A marine embayment by Chapter 54. This coastline forms the eastern section of Hilo Bay and is protected from open coastal waters. The following is a description of the protected uses for Class A waters as specified in Chapter 54:

> It is the objective of Class A waters that their use for recreational purposes and aesthetic enjoyment be protected. Any other use shall be permitted as long as it is compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters. These waters shall not act as receiving waters for any discharge which has not received the best degree of treatment or control compatible with the criteria established for this class. No new sewage

> discharges will be permitted within embayments. No new industrial discharges, acceptable non-contact thermal and floating drydock marine railway discharges, shall be permitted within embayments.

In addition to the basic criteria set forth in Section 11-54-04, total nitrogen, ammonia nitrogen, nitrate (nitrite), total phosphorus, light extinction coefficient, chlorophyll, and turdidity are regulated for marine embayments by Chapter 54. The standards for these water quality parameters are presented in Appendix A.

V HYDROGEOLOGY

The proposed site for the wastewater treatment facility is underlain by thin-bedded basaltic lava flows of a'a and pahoehoe from the Kau and Kahuku volcanic series of Mauna Loa. Lava flows from the Kau volcanic series cover the surface of the project site and overlie lava flows from the Kahuku volcanic series. The Kau volcanic series is 50 feet thick in Olaa, approximately 5 miles south of the project site (Stearns and MacDonald, 1946). Table 1 presents a lithologic log for Well 4203-01 (Plate 1) at the Hilo Electric Company.

The occurrence of ground water in the Hilo coastal aquifer is illustrated in Plate 2. The basal lens of freshwater, commonly called the Ghyben-Herzberg lens, floats on top of the heavier salt water. Ground water flows toward the coast and discharges into surface-water bodies near the coast. Large concentrated coastal spring discharges have been identified by infrared images (Fischer et al., 1966) in the Hilo area at Waikakea Pond, Reeds Bay, Puhi Bay, Kionakapahu Pond and Lokoaka Pond. East of Leleiwi Point, ground water primarily discharges as diffused flow along the coast.

A ground-water elevation contour map was constructed based on water elevation data for wells in the area and is

Table 1. Lithologic Log for Well 4203-01, Hilo Electric Company

Depth Below Ground Surface (Ft.)	Lithology
0 - 27	Hard blue rock
27 - 35	Very hard blue rock
35 - 50	Loose cinders
50 - 54	Hard blue rock

Data from: Files of the U.S. Geological Survey, Water Resources Division, Honolulu, Hawaii shown on Plate 1. The ground-water gradient near the site is approximately 5 feet per mile and the static ground-water level is almost 4 feet above mean sea level. Ground water flows generally north towards the ocean and discharges along the coast down-gradient from the project site between Kionakupahu Pond and Leleiwi Park.

The basal ground-water flux is large in the Hilo area because of high rainfall and recharge over the Hilo-Puna watershed. Much of the average annual precipitation of 120 inches (Davis and Yamanaga, 1968) falling in this watershed infiltrates rapidly to the basal aquifer through the permeable basalts. Average ground-water flux per mile of shoreline is at least 30 million gallons per day (mgd) (Mink and Peterson, 1988).

The young basalt rocks comprising the Hilo basal aquifer are extremely permeable. Drawdowns in wells are generally minute for pumping rates of several thousands of gallons per minute. Hydraulic conductivity of the basal aquifer is likely to be much greater than 1,000 ft/day, and may range up to 12,000 ft/day (Mink and Peterson, 1988). A hydraulic conductivity of 3,400 ft/day was estimated for this study, as presented in Appendix B.

VI INJECTION WELL CAPACITY AND AQUIFER CLOGGING

Aquifer tests results for wells in the Hilo area can be used as a preliminary guide in determining the injection rate at the site. Table 2 presents the results of tests for wells in the vicinity of General Lyman Field. These results demonstrate that specific capacities (pump discharge/drawdown) greater than 1,000 gallons per minute per foot (gpm/ft) are not uncommon for wells in the area. Aquifer tests must be conducted on site before actual design of the wastewater injection well system to determine the injection capacity at the site.

The proper design of wastewater injection wells must account for a reduction in injection capacity over the life of the well due to aquifer clogging. The initial injection rate for most wells drilled in Hawaii decreases over the life of the well by at least 50 percent. For initial injection rates greater than 100 gpm, Oberdorfer and Peterson (1982) recommend a design injection rate of a third of the initial injection rate. In other words, the design of the injection well should allow for a loss of 66 percent of the initial injection well capacity over the life of the well due to aquifer clogging. Aquifer clogging can be moderated with proper operation and maintenance of the well and quality control of the wastewater effluent entering the well.

Table 2. Aquifer Test Results for Wells in the Hilo Area

Well Number	Ground Elevation (Ft.)	Initial Static Head (Ft.)	Test Flow Rate (GPM)	Drawdown (Ft.)	Specific Capacity (GPM/Ft.)
4202-01	59	4.0	900	14.0	64
4202-02	71	5.0	1,000	1.0	1,000
4203-01	40	6.7	36	1.0	36
4203-02	41	9.1	50	0.6	83
4203-03	41	5.8	50	0.2	250
4203-04	47	7.1	4,660	0.3	5,533
4203-06	50	6.5	6,500	6.5	1,000
4203-10	55	6.0	6,100	3.5	1,743
4203-11	43	6.0	5,800	4.3	1,349
4203-12	49	6.0	6,000	0.1	60,000

Data from: Mink and Peterson, 1988.

The ground-surface elevation at the project site is 35 feet above mean sea level. Assuming an allowable head buildup in the injection wells of ten feet* and using a conservative estimate of 300 gpm/ft for the specific capacity, an initial injection rate of 3,000 gpm is calculated. The design capacity of the injection well should be a third of this initial injection rate or 1000 gpm. Consequently, to accommodate the wastewater design flow of 3,470 gpm (5 mgd), a total of four wells would be required. An additional injection well should be provided to serve as a standby unit for emergency and maintenance purposes. The modeling of contaminant transport conducted for this study was based on an subsurface injection system comprising 4 operating wells.

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* A head buildup of 10 feet would allow a freeboard between the ground surface and water level in each well of 21 feet.

VII CHARACTERISTICS OF THE WASTEWATER EFFLUENT

The new wastewater treatment plant near General Lyman Field will be designed for an average wastewater flow of 5 mgd. The following target concentrations were established by M & E Pacific, Inc. for the wastewater effluent:

Constituent	Concentration (mg/l)
Nitrogen	7.6 to 9.1
Phosphorus	3.8 to 4.5
Suspended Solids	22
BOD_5	24
Density of effluent at 25°C	0.999 gm/cm^3

Nitrogen and phosphorus are nutrients that are consumed in the aquatic environment by blue-green algae. High concentrations of these nutrients will stimulate the growth of algae and can result in algae blooms, reduced dissolved oxygen in the water, and the growth of undesirable aquatic plants that deteriorate the water environment.

VIII CHEMICAL AND BIOLOGICAL TRANSFORMATION OF NUTRIENTS

The nutrients, nitrogen and phosphorus, would be present in the effluent from the proposed treatment facility injected into the subsurface. These nutrients would be transported by fluid advection and removed from solution through chemical and biological reactions within the aquifer's solid matrix. There have been few, if any, in-depth studies of nutrient transport through basalt aquifers. Because of the wide variability in the reactions and amounts of nutrient removals from solution, it is assumed for this study that no nutrients are lost from solution as they move through the aquifer. When more information is known about removal of nutrients in the aquifer, this information can be used to more accurately simulate the transport of nutrients. The following paragraphs provide some background information on nitrogen and phosphorus in land treatment systems.

In general, species of total nitrogen (N), include organic N, NH_4^+, NO_3^-, and NO_2^-. These may undergo biological transformations (immobilization, ammonification, nitrification, nitrate reduction and denitrification, and nitrogen fixation) and chemical reactions (ammonia volatilization, ammonium exchange, ammonium fixation, and chemical denitrification) while moving through a soil matrix (Keeney, 1981). These reactions are influenced by the presence of oxygen, organic carbon sources, certain soil organisms, plants and bacteria. Research has been conducted on the fate of nitrogen due to application of wastewater effluent from secondary treatment on agricultural crops or open fields in land treatment systems or overland flow type of systems (Iskandar, 1981).

The land treatment system most similar to the injection well system is a rapid infiltration system. There are significant differences between the two systems such as 1) a wet-dry cycle in rapid infiltration that is not present in well injection and 2) the types of soil present in rapid infiltration systems are different from basalt. In rapid infiltration, the major loss of total dissolved nitrogen from the wastewater would be by sorption of NH_4^+ to the soil matrix and denitrification of NH_4^+ and NO_3^- (Selim, 1981).

Based on a study of two wastewater injection well sites in Hawaii, the loss of total dissolved nitrogen from the wastewater is probably due to denitrification and an estimated reduction of approximately one third in total nitrogen may occur in the near vicinity of the well (Oberdorfer, 1985). This study also indicated that nitrogen loss due to ion exchange or bacterial uptake should be minimal in a quasi steady-state system after one to two years of injection. It must be emphasized that this study was done for aquifers composed of carbonate sand, coral and recemented reef rubble; and not basalt. The compositions of these formations may influence nitrogen transformation.

The removal of phosphorus in a soil system is controlled by precipitation-dissolution, sorption-desorption, immobilization-decomposition and plant uptake. The process of sorption-desorption is considered to be the most important (Iskandar, 1981). In sorption processes, the phosphate ion is removed from solution and adsorbed to the surface of the soil particle.

Many theories and models describing the sorption of phosphate to the soil have been developed. However, it is difficult to determine what portion of the phosphate would be adsorbed and removed from solution in a basaltic aquifer without specific field tests. Widely varying capacities of different soil systems were demonstrated in a study by Tofflemire and Chen (1976) where soil capacities from New York varied up to 100-fold (Ryden et al., 1981). In addition, the effects of parameters such as pH and the presence of certain anions (Syers and Iskandar, 1981) in the wastewater can significantly influence removal of phosphate in volcanic ash. Due to the widely varying capacities, no attempt is made to determine the proportion of phosphorus removed by the basalt aquifer.

IX MATHEMATICAL MODEL OF CONTAMINANT TRANSPORT

A computer code based on the extended pulse model of Domenico and Robbins (1985) was used to simulate the ground-water transport of nitrogen down-gradient from the injection wells. The transport of nitrogen was simulated because nitrogen concentrations are higher than phosphorus concentrations in the wastewater effluent. The transport characteristics of nitrogen and phosphorus are assumed to be similar.

The following assumptions were incorporated into the modeling of nitrogen transport:

1. The aquifer is homogeneous and isotropic.
2. The aquifer has infinite areal extent.
3. Ground-water flow is uniform and constant in direction and velocity.
4. The injection well can be represented as a line source in plan view with a width equal to the distance between the boundary of the ground-water divide at the well perpendicular to the direction of flow (see Appendix C).
5. The well fully penetrates the freshwater aquifer.
6. The concentration of the wastewater effluent injected into the basal aquifer is constant over time.

The steady-state areal distribution of nitrogen down-gradient of the injection wells was modeled for a wastewater injection system of four wells. The wells were equallyspaced along a line perpendicular to the direction of ground-water flow. The direction flow was assumed to be towards Kionakupahu and Lokoaka Ponds, which are 6,000 feet down-gradient from the site. Contaminant transport was simulated by injecting wastewater effluent into the basal aquifer at each well. The effluent contained a constant nitrogen concentration equal to the maximum predicted concentration in the wastewater effluent of 9.1 mg/l (see Section VII).

Two scenarios of well spacings were simulated in this study. In the first scenario, the spacing between injection wells was large enough that the waste plumes from neighboring injection wells did not merge with or influence each other. This case is referred to as the no interference scenario in this study. In the second scenario, the spacing between injection wells was set at 200 feet. The waste plumes from neighboring injection wells in this scenario can merge with each other.

The only influential transport parameter in the steady-state solution to the extended pulse transport equation is the lateral dispersivity. Lateral dispersivity for basalt aquifers in Oahu ranges from 1 to 10 feet (Dr. C. Liu, 1988). It is assumed that the dispersivity of basalts in Hilo and Oahu are similar. Consequently, for each scenario of well spacing, transport of nitrogen was simulated for lateral dispersivities of 1 and 10 feet.

X RESULTS OF COMPUTER SIMULATIONS

A. Lateral Dispersivity of 1 Foot

Plate 3 shows the steady-state nitrogen concentration contours down-gradient of an injection well for the no interference scenario. The nitrogen concentration at Kionakupahu and Lokoaka Ponds located 6,000 feet down-gradient from the well, is 4.6 mg/l or 50 percent of the initial nitrogen concentration at the injection well (9.1 mg/l). The spacing of wells necessary to achieve no interference between the waste plumes from adjacent wells is approximately 600 feet.

Plate 3 also shows the steady-state nitrogen concentration contours down-gradient of the second injection well in the injection well system represented by the second scenario (well spacing of 200 feet). This spacing of wells results in a nitrogen concentration at the ponds of 6.8 mg/l, a reduction of only 25 percent of the initial concentration at the injection wells (9.1 mg/l). The waste plumes from neighboring wells in this scenario merged seaward of the project site. The concentration of nitrogen discharging along the shoreline varies from 6.6 to 6.8 mg/l.

B. Lateral Dispersivity of 10 Feet

Plate 4 shows the steady-state nitrogen concentration contours down-gradient from an injection well for the no interference scenario. The waste plume is more dispersed than the waste plume generated from a lateral dispersivity of 1 foot. Consequently, the nitrogen concentration at the ponds is reduced to 1.5 mg/l, an 84 percent reduction of the initial concentration at the injection well (9.1 mg/l). However, the spacing between wells necessary to ensure no interference between the waste plumes of adjacent wells is approximately 2,200 feet. Because of this large spacing, interference between waste plumes will probably occur at the project site for a lateral dispersivity of 10 feet.

Plate 4 also shows the steady-state nitrogen isochlors for the second injection well in the injection well system represented by the second scenario (well spacing of 200 feet). This spacing of wells results in a nitrogen concentration of 5.1 mg/l at the ponds, a reduction of 43 percent of the initial nitrogen concentration at the injection wells (9.1 mg/l). The concentration of nitrogen discharging along the shoreline varies from 4.6 to 5.1 mg/l.

XI SUMMARY AND CONCLUSIONS

The County of Hawaii is planning to construct a new secondary wastewater treatment facility near the southeast end of General Lyman Field. The project site is located seaward of the Underground Injection Control line and overlies a coastal basal aquifer with an estimated hydraulic conductivity of 3,400 feet per day. This high hydraulic conductivity of the aquifer is favorable to the design and operation of a wastewater injection system. An injection well system of five wells is proposed at the site, with one well serving as a standby well.

Nutrient contamination to down-gradient surface and coastal waters was investigated in this study. Kionakupahu Pond, Lokoaka Pond, and the coastline between the ponds and Leleiwi Park are the surface water bodies down-gradient of the project site. Kionakupahu Pond is maintained as a fishpond and both ponds serve as homes to many species of waterbirds, including the endangered Hawaiian coot. The two ponds and coastline are located approximately 6,000 feet down-gradient from the project site.

A computer code based on the extended pulse model of Domenico and Robbins (1985) was used to simulate the transport of nitrogen down-gradient of the project site for two scenarios of well spacings. In the first scenario, the spacing between injection wells was large enough that the waste plumes from neighboring wells did not merge with or influence each other (no interference scenario). In the second scenario, the spacing between wells was set at 200 feet. For each scenario, the transport of nitrogen was simulated for lateral dispersivities of 1 and 10 feet.

For the no interference scenario and a lateral dispersivity of 1 foot, the nitrogen concentration at the ponds is 4.6 mg/l, or 50 percent of initial concentration at the injection wells (9.1 mg/l). The well spacing required to achieve no interference for a lateral dispersivity of 1 foot is 600 feet. When the lateral dispersivity is increased to 10 feet for this scenario, the nitrogen concentration at the ponds decreases to 1.5 mg/l, or 16 percent of the initial concentration at the wells. However, the well spacing required to achieve no interference for a lateral dispersivity of 10 feet increases to 2,200 feet.

For the second scenario (a well spacing of 200 feet) and a lateral dispersivity of 1 foot, the nitrogen concentration at the ponds is 6.8 mg/l, or 75 percent of the initial concentration at the injection wells. When lateral dispersivity is increased to 10 feet for the second scenario, the nitrogen concentration at the ponds decreases to 5.1 mg/l or 57 percent of the initial concentration at the injection wells.

The results of these computer simulations can be used as a preliminary guide in evaluating the feasibility of a subsurface injection system at the proposed wastewater treatment plant. The ground-water transport model used in this study is sensitive to the ground-water flow field (direction of flow) and the lateral dispersivity.

The direction of ground-water flow is assumed to be towards the ponds because (1) there is evidence of large concentrated ground-water discharge at the ponds; and (2) increased nutrients would probably cause more environmental impact to the ponds than to coastal waters. The ground-water flow field should be verified by measuring water levels in monitoring wells drilled in the vicinity of the project site. These wells should be located so that variations in the flow pattern seaward of the site can be estimated. In addition, aquifer tests should be conducted in the well(s) drilled at the site to determine the injection capacity at the site.

The range for the lateral dispersivity used in the simulations is based on current research being conducted for basalt aquifers on Oahu. It is assumed that the dispersivity of basalts in Hilo and Oahu are similar. However, lateral dispersivity should also be assessed by field tracer tests.

The concentrations of nutrients down-gradient of the project site resulting from the disposal of wastewater effluent into the basal aquifer were estimated in this study. Biological studies are needed to evaluate potential environmental impacts that the increased concentrations of nutrients would have on the ecosystems in Lokoaka Pond, Kionakapahu Pond, and the coastal waters.

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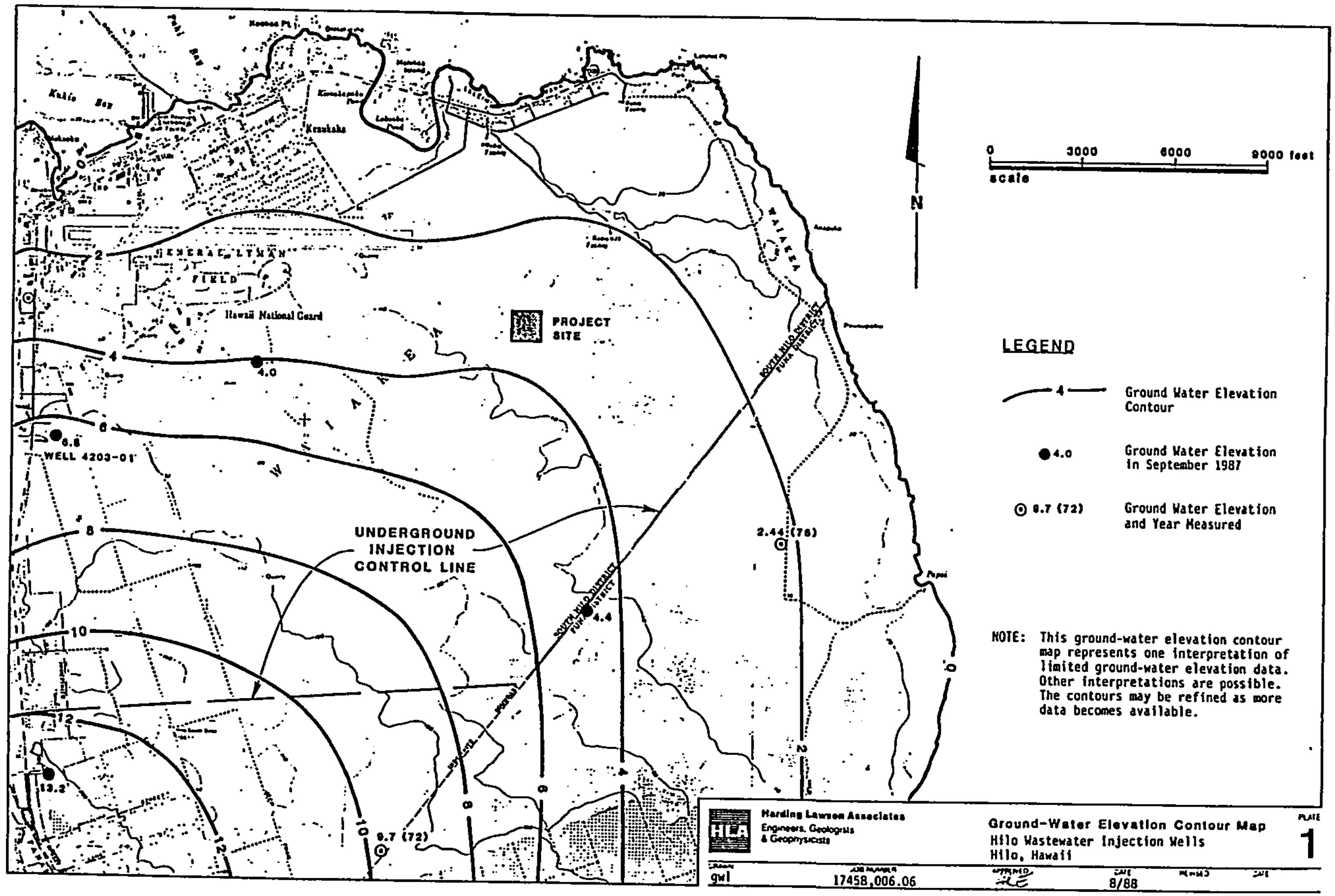
ILLUSTRATIONS



Kalie Bay
Puhi Bay
Keaukaha
GENERAL LYMAN FIELD
Hawaii National Guard
WAIAKEA
PROJECT SITE
UNDERGROUND INJECTION CONTROL LINE
WELL 4203-01
SOUTH HILO DISTRICT
PUNA DISTRICT
0
2
4
6
8
10
12
4.0
6.8
4.4
13.2
2.44 (76)
9.7 (72)
N
0 3000 6000 9000 feet
scale
LEGEND
Ground Water Elevation Contour
Ground Water Elevation in September 1987
Ground Water Elevation and Year Measured
NOTE: This ground-water elevation contour map represents one interpretation of limited ground-water elevation data. Other interpretations are possible. The contours may be refined as more data becomes available.
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Ground-Water Elevation Contour Map
Hilo Wastewater Injection Wells
Hilo, Hawaii
PLATE 1
gwl
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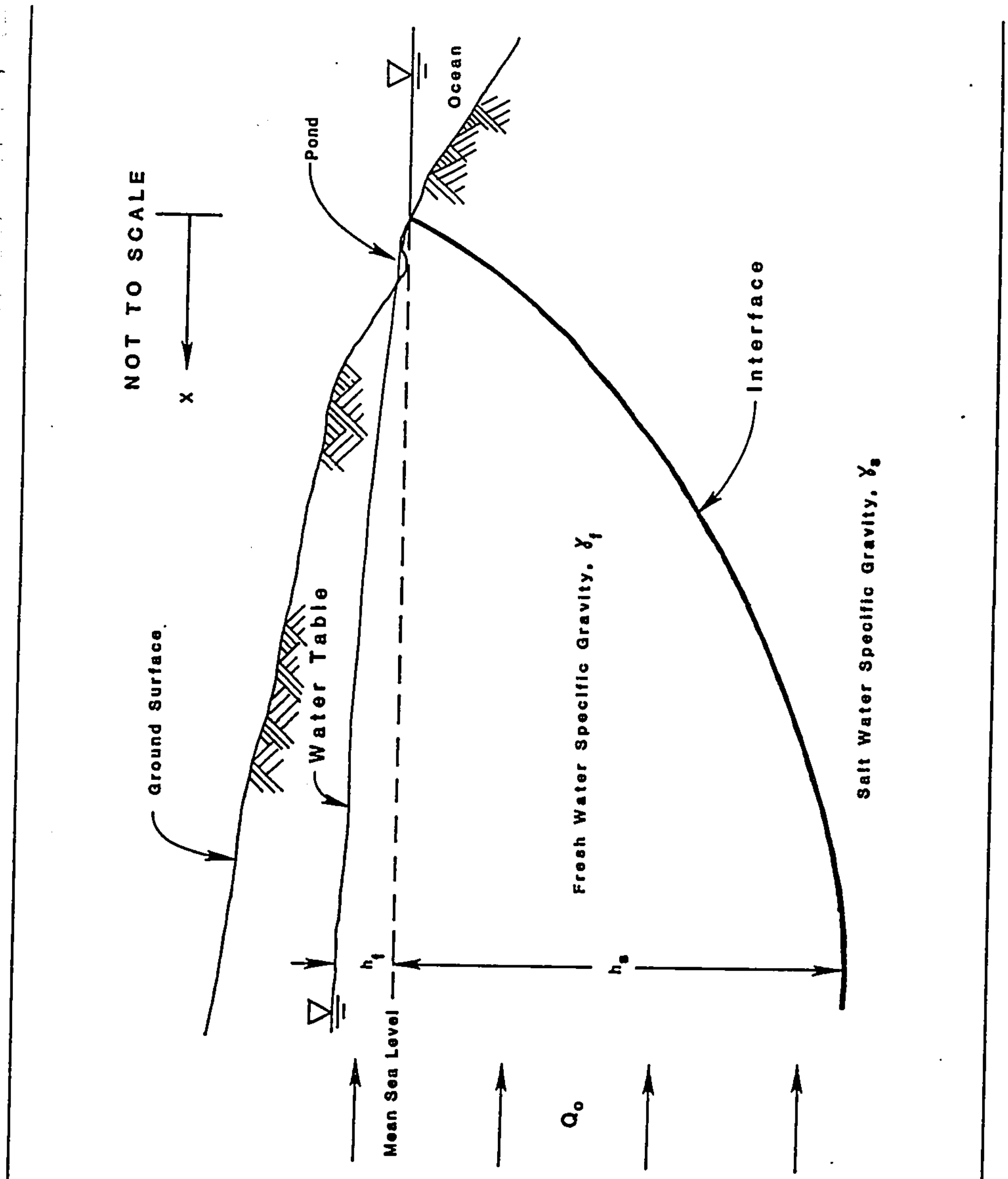

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Ground Water Basal Lens
Hilo Wastewater Injection Wells
Hilo, Hawaii

PLATE
2

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
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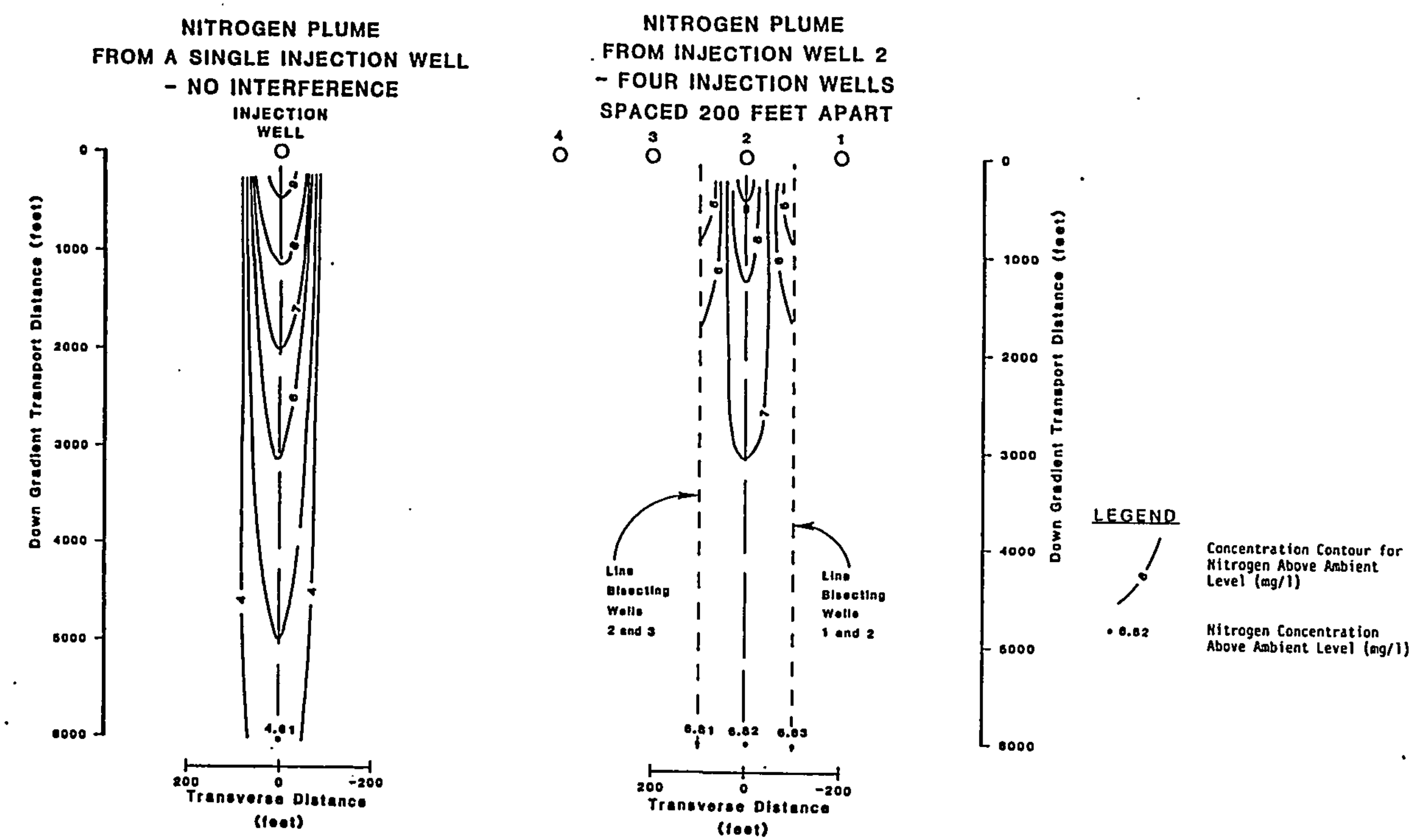

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Steady-State Nitrogen Concentration Contours
Lateral Dispersivity of 1 Foot
Hilo Wastewater Injection Wells
Hilo, Hawaii

PLATE 3

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
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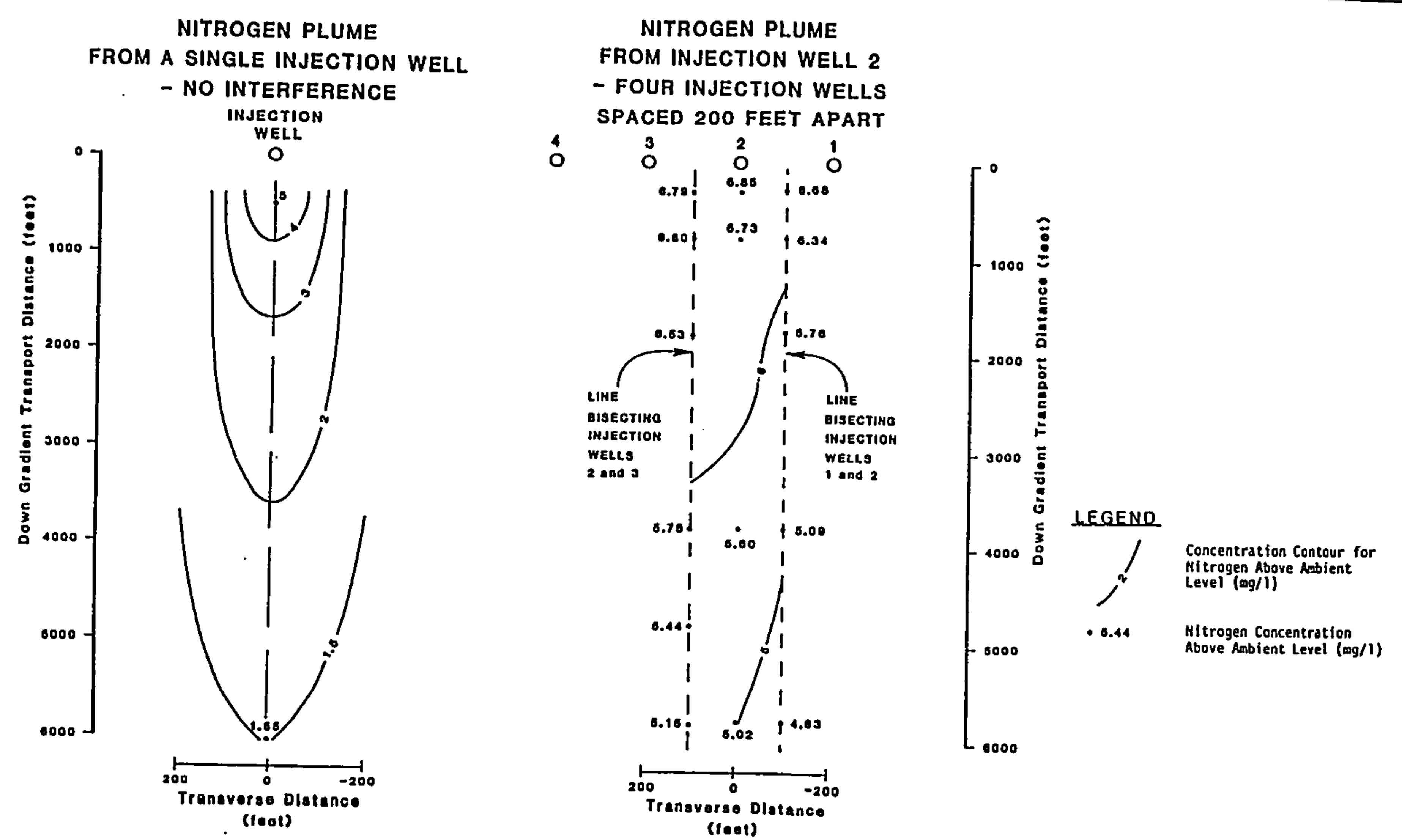

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Steady-State Nitrogen Concentration Contours
Lateral Dispersivity of 10 Feet
Hilo Wastwater Injection Wells
Hilo, Hawaii

PLATE **4**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
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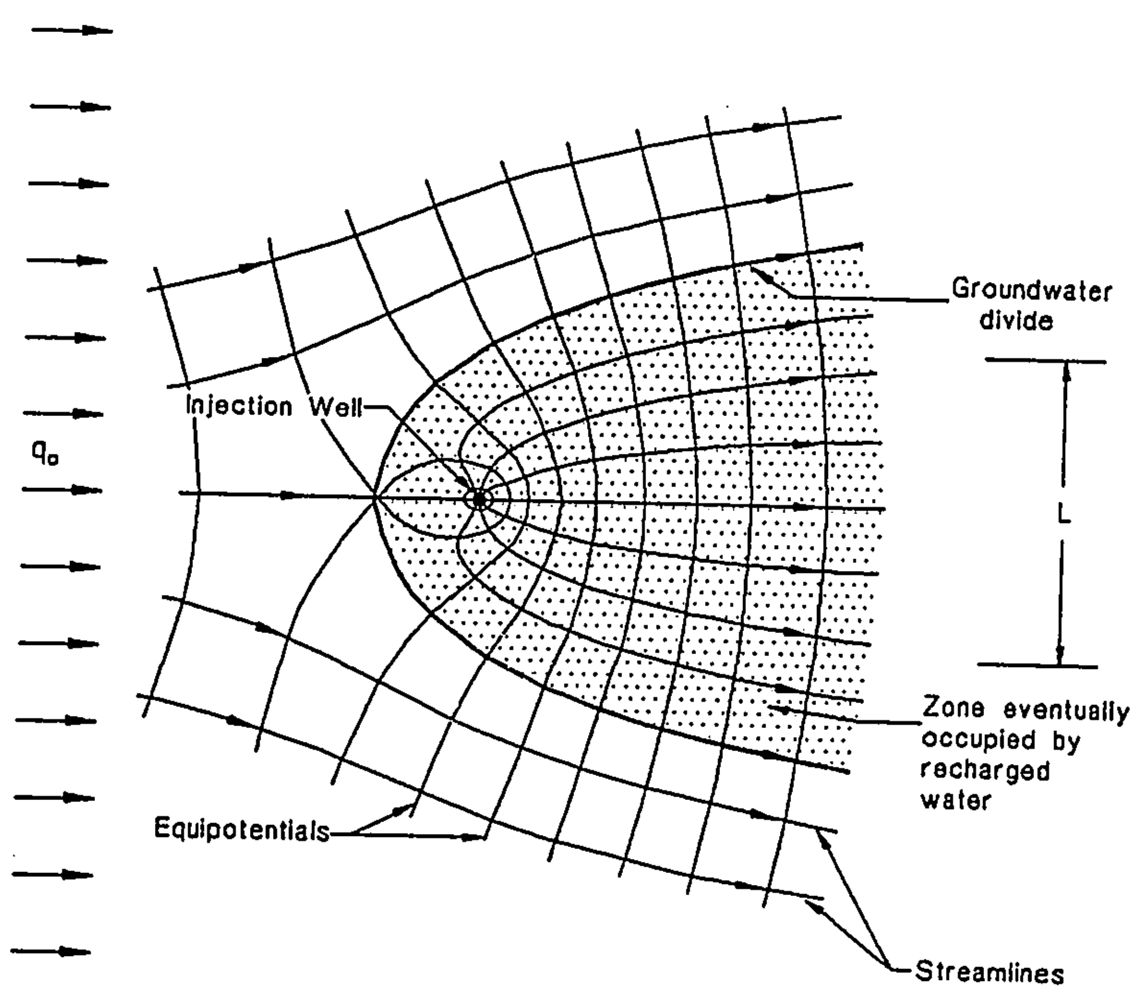

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Flow Field Surrounding Injection Well
Hilo Wastewater Injection Wells
Hilo, Hawaii

PLATE
5

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
gwl	17458,006.06	HKE	8/88		

APPENDIX A

STATE OF HAWAII DEPARTMENT OF HEALTH WATER QUALITY STANDARDS

WATER QUALITY STANDARDS EXCERPTED FROM TITLE 11,
STATE OF HAWAII, DEPARTMENT OF HEALTH CHAPTER 54.
SECTION 11-54-04.

Basic Water Quality Criteria Applicable to All Waters

1. All waters shall be free of substances attributable to domestic, industrial, or other controllable sources of pollutants, including:

   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 combination 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;

   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.

WATER QUALITY STANDARDS EXCERPTED FROM TITLE 11,
STATE OF HAWAII, DEPARTMENT OF HEALTH CHAPTER 54. SECTION 11-54-06.

Specific Criteria for Embayments

Parameter	Geometric Mean Not to Exceed the Given Value	Not to Exceed the Given Value More Than 10% of The Time	Not to Exceed the Given Value
Total Nitrogen (ug N/L)	200.00(a) 150.00(b)	350.00(a) 250.00(b)	500.00(a) 350.00(b)
Ammonia Nitrogen (ug NH_4-N/L)	6.00(a) 3.50(b)	13.00(a) 8.50(b)	20.00(a) 15.00(b)
Nitrate & Nitrate Nitrogen (ug[NO_3+NO_2]-N/L)	8.00(a) 5.00(b)	20.00(a) 14.00(b)	35.00(a) 25.00(b)
Total Phosphorus (ug P/L)	25.00(a) 20.00(b)	50.00(a) 40.00(b)	75.00(a) 60.00(b)
Light Extinction Coefficient (k units)	0.40(a) 0.15(b)	0.80(a) 0.35(b)	1.20(a) 0.60(b)
Chlorophyll a (ug/L)	1.50(a) 0.50(b)	4.50(a) 1.50(b)	8.50(a) 3.00(b)
Turbidity (N.T.U.)	1.50(a) 0.40(b)	3.00(a) 1.00(b)	5.00(a) 1.50(b)

(a) "Wet" criteria shall apply when the average fresh water inflow from the land equals or exceeds one percent of the embayment volume per day.

(b) "Dry" criteria shall apply when the average fresh water inflow from the land is less than one percent of the embayment volume per day.

Applicable to both "wet" and "dry" conditions:

pH Units shall not deviate more than 0.5 units from a value of 8.1.

Dissolved Oxygen - Not less than 75% saturation.

Temperature - Shall not vary more than 1°C from ambient conditions.

Salinity - Shall not vary more than 10% from natural or seasonal changes considering hydrologic input and oceanographic factors.

APPENDIX B

STEADY-STATE BASAL GROUND-WATER FLOW ESTIMATION OF HYDRAULIC CONDUCTIVITY

STEADY STATE BASAL GROUND-WATER FLOW ESTIMATION OF HYDRAULIC CONDUCTIVITY

Ground water occurs as a basal lens of fresh water floating on top of denser salt-water in the coastal region of Hilo. The position of the fresh/salt water interface can be predicted by the Ghyben-Herzberg relationship as:

$$h_s = \frac{\gamma f}{\gamma s - \gamma f} h_f = Ch_f \tag{1}$$

The variables in Equation (1) are defined in Plate 2.

The steady flow of ground-water towards the coast shown in Plate 2 of Q_o is given by:

$$Q_o = K_f \frac{dh_f}{dx} (h_f + h_s) \tag{2}$$

where K_f is equal to the hydraulic conductivity.

Substituting the Ghyben-Herzberg relationship for h_s into Equation (2) yields:

$$Q_o = K_f (h_f + Ch_f) \frac{dh_f}{d_x}$$

or

$$Q_o d_x = K_f (1 + C) h_f dh_f \tag{3}$$

Integrating Equation (3) yields:

$$Q_o (x_2 - x_1) = \frac{K_f}{2} (1 + C)(h_{f_2}{}^2 - h_{f_1}{}^2) \tag{4}$$

The Ghyben-Herzberg flow relationship shown in Equation (4) is applicable in regions where ground-water flow is fairly horizontal. The vertical component of flow becomes significant near the shoreline and, consequently, Equation (4) would not be applicable in this region.

Regional hydraulic conductivity can be estimated for the basal aquifer from Equation (4) using the ground-water elevation data shown in Plate 1. Substituting ground-water elevations of 7 and 4 feet above mean sea level, the distance between these two ground-water elevations of 3,000 feet and a steady flow Q_o of 30 mgd per mile (Mink and Peterson, 1988) into this equation yields an estimated hydraulic conductivity of 3,370 feet per day.

APPENDIX C

GROUND-WATER DIVIDE AT WELL

GROUND-WATER DIVIDE AT WELL

The flow field near an injection well in a uniform ground-water flow regime is shown in Plate 5. The distance between the boundary of the ground-water divide (zone occupied by recharged water) at the well perpendicular to the direction of flow for a confined aquifer is given by:

$$L = \frac{Q_w}{2q_o B} \qquad (1)$$

where q_o = specific discharge up-gradient from the injection well

= (hydraulic conductivity) x (hydraulic gradient)

B = thickness of aquifer

Q_w = injection flow rate

The width of the line source at each injection well will be estimated by L. Substituting the following parameters into Equation (1):

q_o = $K_f i$ = 3370 ft/day x (3/3000) = 3.4 ft/day (see Appendix B for estimation of K_f)

Q_w = 1/4 (5 mgd) = 167,100 ft^3/day

B = 41 (h_f) = 41(4) = 164 ft.

yield a value of L equal to 150 feet. The width of the line source at each injection well will be estimated to be 150 feet.

DISTRIBUTION

EVALUATION OF INJECTION WELLS FOR
DISPOSAL OF SECONDARY WASTEWATER EFFLUENT
AT HILO WASTEWATER TREATMENT PLANT
AUGUST 30, 1988

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